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VOICE & DATA

Connecting the Digital World

CyberMedia

THE ACHILLES HEEL OF MOBILE-FIRST NATION

As a large and fast-growing mobile economy India ranks #1 on the target list of fraudsters. It is also the second-largest victim of mobile ad frauds globally

MONEY LOST

22.6% of global mobile media spend was wasted in 2019 due to mobile ad fraud

PLATFORMS AT RISK

Android apps have a fraud rate of 30%, 2.5 times higher than 12% rate of iOS

SIZE MATTERS

20% of large apps have 30% fraud, compared to 13% among medium-sized apps

25 YEARS [INTERNET IN INDIA]

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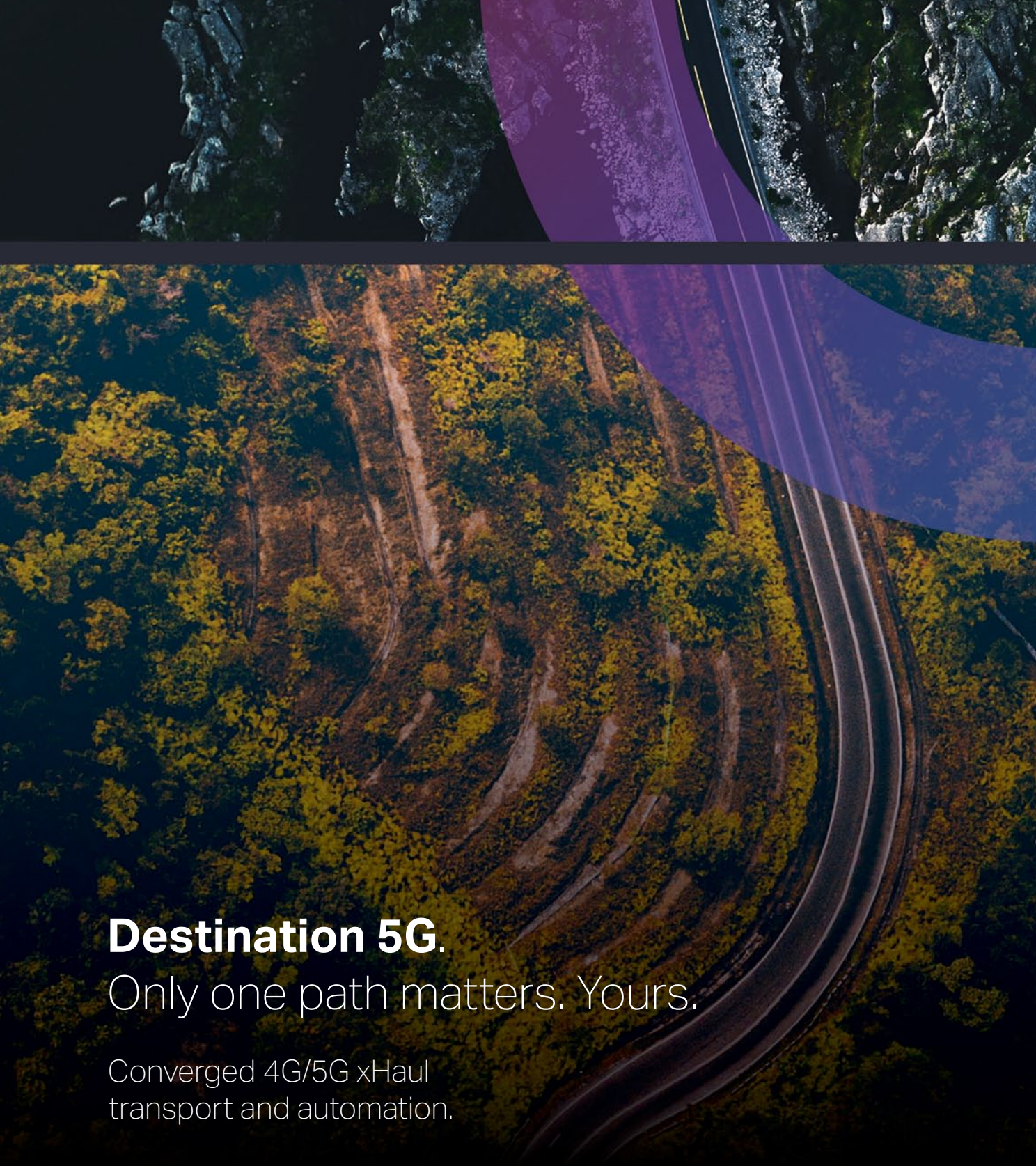
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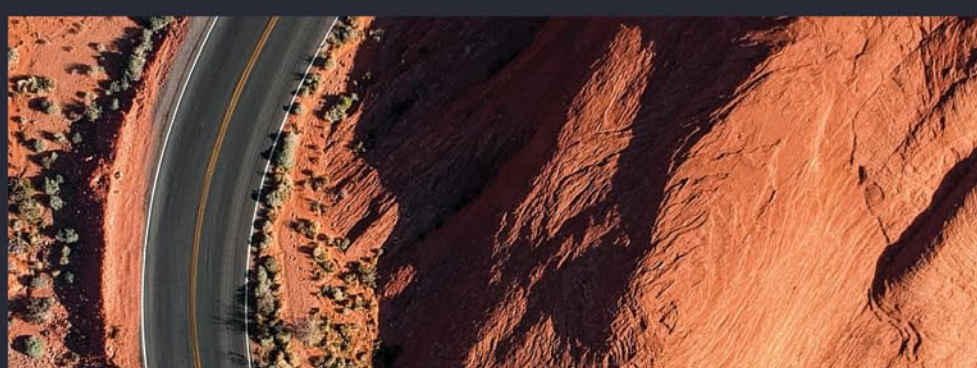

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[OPENING NOTE]

The hybrid warfare threat

A recent collaborative investigation by media and researchers across several countries has revealed that Shenzhen, China-based Zhenhua Data Information Technology Co Limited has been harvesting information and monitoring over 2.4 million "human targets" worldwide. The number could be much higher.

The cache of the files, Overseas Key Information Database (OKIDB), was leaked to a US academician, Vietnam-based Professor Chris Balding who worked at the Peking University till 2018. He sought the help of an Australian cybersecurity company, Canberra-based Internet 2.0, which managed to recover nearly 10% of the OKIDB records, including that of 10,000 Indians.

According to Balding, the database is constructed around numerous existing databases or platforms and harvested into one large database with multiple points of overlap. It includes a big data analytics layer that allows analysts to track key influencers.

While corporate, as well as political parties have for long been tracking influencers and organizations of interest using open-source intelligence gathering and analysis (OSINT) techniques, what makes Zhenhua database different is the company's links with the Chinese Communist Party and Government of China. Notably, its clients include the Chinese military and intelligence agencies.

Reports indicate that the OKIDB focuses on influential individuals and institutions that China deems important. "From politicians and their families to professors and think tanks to scientists and tech leaders to organized crime figures, all are individuals and institutions that the Chinese security, intelligence, and influence operations are known to be interested in," a paper by Balding notes.

"The fundamental purpose appears to be information warfare, something that Shenzhen Zhenhua talks about openly," the paper stated, adding that the data covers a broad array of public and non-public data with classifications and rankings on individuals and institutions designed to assist Chinese analysts.

Analysts and researchers also believe that there is a high possibility that the data is being used to support Chinese intelligence, military, security, and state operations in information warfare and influence the debate and narrative about China.

A report quoting Internet 2.0's chief executive Robert Potter indicates that there is every possibility that Zhenhua has built the capacity to track naval vessels and defence assets, as well as a mechanism to assess the careers of military officers for strategic hybrid warfare.

While India celebrates 25 years of the commercial internet services and is gearing up for a new digital era, it is vital that the country prioritizes data privacy and security to the highest level. It will also be necessary that all national digital assets and networked-infrastructures are adequately mapped for security and a hybrid warfare vulnerability audit be conducted to identify and plug the gaps.

Equally important is the need to regulate all digital platforms, including intermediaries and data infrastructure companies operating from the country, as well as providing services to Indians. Going ahead, the government should also launch a countrywide initiative to create user-level awareness about security best practices in the hyper-connected world.

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THE ACHILLES HEEL OF MOBILE-FIRST NATION

As a large and fast-growing mobile economy India ranks #1 on the target list of fraudsters. It is also the second-largest victim of mobile ad frauds globally

BY SOMA TAH

Mobile ad spend has been a consistent portion of digital ad budgets accounting for about half of the global ad spend today. The reasons behind are pretty clear. Given the omnipresence of mobile devices in our lives today, mobile advertising is definitely one of the most effective channels for reaching out to a particularly large base of potential customers. The fact that it encompasses multiple advertising channels as well also makes it a preferred outreach media. With large number of companies focusing on mobile-first strategy majority of India's ad spend are now shifting towards the mobile channels.

The popularity and money involved in mobile advertising have made it a magnet for the fraudsters. The threat of mobile ad fraud is looming large, draining marketing and advertising budgets at an alarming rate. According to the mobile ad fraud report by Appsflyer, 22.6% of global mobile media spend in 2019 was wasted on mobile ad fraud. The scenario appears even more abysmal, when one considers the collateral damages the frauds can cause on such as decision-making based on polluted data – a sheer waste of time, money, and resources.

India is not alone in facing the challenge. Other fast-growing countries with large population bases are also among the top target regions of these fraudsters. The large base of attack makes up for the lower payouts and is the reason that makes India the second-largest victim of mobile ad frauds globally, after Indonesia.

Exposure varies across platforms, verticals

Mobile ad fraud has emerged as a major concern, especially in the in-app advertising space, siphoning away budgets, reducing campaign effectiveness and making the entire ecosystem less trustworthy.

With USD 2.3 billion exposed to fraud in the first half of 2019 alone, mobile app install fraud is already a multi-billion dollar threat to the app marketing ecosystem. The larger the fish, the higher the chances of it being targeted by fraudsters, the Appsflyer report indicates. Data shows that 20% of large apps have more than 30% fraud, compared to 13% among medium-sized apps and only 8% of small apps.

Fraud rates on different platforms are also not the same. The percentage of Android apps that have a fraud rate of over 30% is 2.5 times higher than iOS that registered 12% such cases (see App install fraud: Global trend by platform). Similarly, the exposure to frauds is also different across verticals. For example, the finance sector is most exposed to fraud due to the high payout it offers and its scale, followed by shopping and business (see App install fraud: Top 10 financially exposed verticals worldwide).

With USD 2.3 billion exposed to fraud in the H1 2019, mobile app install fraud is already a multi-billion dollar threat to the app marketing ecosystem.

Factors behind ad fraud menace in India

Absence of any strict industry regulation or punitive measures has worsened India's ad fraud scenario further. According Mobile Marketing Association (MMA) India Country Head Moneka Khurana, the lack of transparency and absence of standardized regulatory practices are the major reasons for the existence of fraudulent activities in mobile advertising.

"Lack of monitoring sources of traffic and using campaign metrics that can be easily manipulated by fraudsters are some other factors that contribute to ad fraud. The absence of open, real-time data sharing between marketers and ad space sellers makes the advertisement vulnerable to fraudulent activities at various stages of the publishing chain," she said.

"As marketers start venturing into mobile platforms for marketing purposes, they also become susceptible to fraudulent activities due to the loopholes in the ad buying and publishing process," Khurana added.

InMobi Managing Director for Asia Pacific region Vasuta Agarwal further pointed out that the rise of ad fraud can be attributed to several factors: the steady shift of advertising dollars to digital, increasing pressure to drive growth in highly competitive markets especially in the Asia Pacific focused on high Return On Advertising Spend (RoAS), and the fast-paced nature of technological advancement.

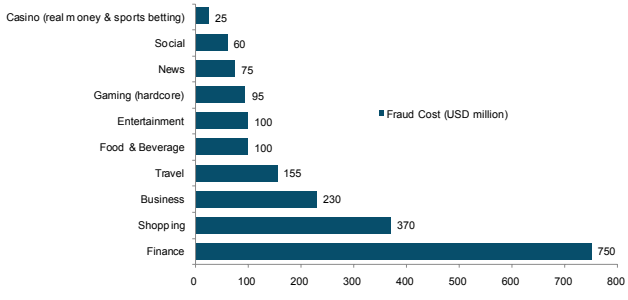
"When it comes to solving these, advertisers need to focus on quality growth and disincentivize fraudsters in the ecosystem. Also, there is no single standard for fraud detection or prevention today and this provides fraudsters with the opportunity to exploit chinks in the third-party measurement armous," Agarwal stated.

mFilterIt Director and Co-founder Amit Relan pins the blame on the confusion related to the relevant IT laws and few gaps. "IT laws are generally confusing and have a few gaps as well and fraudsters simply take advantage of this situation. While mobile advertising has served the purpose of ensuring that developer interests are met properly, it has also become a platform for various types of fraud," he said.

Relan further added that ad fraud situation gets even more confusing as it involves several complicating factors. "Fraudsters use different techniques to block businesses from discovering who they are. Even the methods that can track them can only yield an IP address or location which is useless to make a criminal case," he stated.

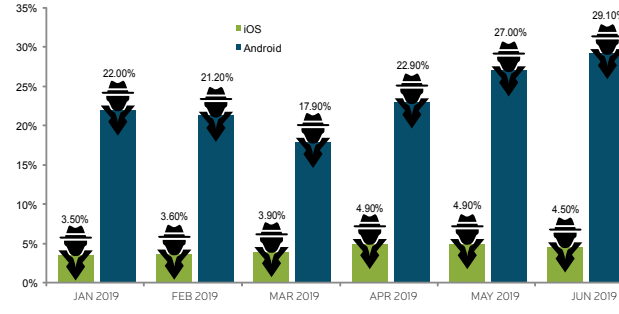
A benchmark report on the state of Mobile Ad Fraud in India by The Mobile Marketing Association (MMA)

App install fraud: Top 10 financially exposed verticals worldwide (H1 2019)



Source: The state of Mobile Fraud 2019, AppsFlyer

App install fraud: Global trend by platform (H1 2019)



Source: The state of Mobile Fraud 2019, AppsFlyer

reveals that Indian marketers' awareness about ad fraud risks is very low with almost a fifth of the marketers are not fully aware how much of their mobile advertising budget is subject to ad fraud (see Ad Frauds: Eating into mobile ad spend).

Interestingly, the majority of respondents indicated that the lack of transparency and a clear system to penalize the perpetrators have caused the rise of mobile ad fraud in the country. The respondents also agreed that perpetrators are benefiting from the fraud and hence are evolving methods.

The MMA report also indicates that over 90% of the companies are using a solution or are planning to do so in the near future (see Fighting ad fraud: Current investment and intent to spend in solutions). According to the report, over half of the respondents pointed out that they were using solutions (mainly external) to help combat ad fraud, while about a third respondents said they were planning to do so in the next 6-18 months; only one in 10 of the companies are not considering a solution.

What hurt advertisers, publishers the most?

Although frauds targeting mobile app marketers and the publishers are evolving faster, the most common forms of frauds are invalid traffic (IVT), where fraudsters mimic genuine traffic to earn money illegitimately. IVT is fake traffic generated by bots, spiders, and crawlers. GIVT (general IVT) is highly transparent about its non-human origin, but SIVT (sophisticated IVT) is designed to appear human-like.

- **Ad stacking:** Fraudsters stack multiple ads on top of each other. However, they make advertisers pay for serving the ads, regardless of where they are placed in the stack and even though the ad was never technically visible.
- **App spoofing:** Fraudster sends in ad requests claiming to be a legitimate publisher and make advertisers pay for the ads that end up appearing on a different app than what the advertiser paid for.
- **Click spamming:** Fraudster orchestrates clicks for users landing on their apps, or mobile pages, and claims credit for random installs the user made. Fraudsters also send fake reports of a large number of clicks in the hopes of misattribution and a potential payout.

Why mobile advertising is so popular?

- **Accessible:** Campaigns get delivered instantly and accessed easily by the users. The chances of seeing an ad on a mobile are higher than traditional advertising methods.
- **Cost efficient:** Designing a campaign costs a small fraction of a TV or radio ad.
- **Geo-targeting:** It's easy to deliver location-based, geo-targeted advertisements.
- **Personalized advertising:** Unique IDs of mobile devices helps to study the habits of the target consumers for customizing campaigns as per users' preferences.
- **Creative and Interactive options:** Strong visual appeal makes a stronger impression on the target audience. People also like to take part in advertisements that come along with contests, games, etc.
- **Higher conversion rates:** Mobile-based ads, clicks, spend and conversions report the highest growth rate when compared to desktops or even tablets.

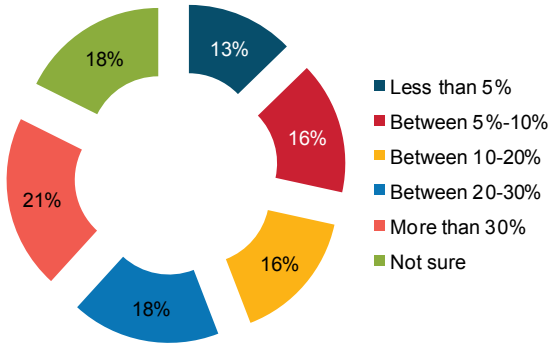
Don't let your guard down

Although there's no denying that anti-fraud tech has always struggled to evolve fast enough to keep pace with fraudsters, hence it is always a good idea to follow some best practices to avoid such attacks. Here are some Dos and Don'ts that can help you avoid the fraud.

- **Buying ad space:** Buying ad space directly from publishers and programmatic buying platforms is one way to reduce susceptibility to ad fraud. When buying digital ad space, ensure that the seller has a transparency clause in their agreement, or works in a transparent manner with marketers, allowing them real-time access to data about traffic, impressions, etc.
- **Do a background check of your publishers/networks:** Checking the background of your publishers is of paramount importance as it helps you understand their target audience. Marketers need to keep an updated list of blacklisted media channels in-house, so that they know where not to publish their ads.
- **Set a reasonable price for your campaigns:** Setting prices for your campaigns too low or too high can be dangerous for advertisers. If you set a too low price for your campaign then you will get low-quality traffic in your campaigns. But, if you set too high a price for your campaign, then also there is no guarantee that you will get high-quality traffic.
- **Check your campaign metrics regularly:** When the publisher's performance report does not match the real traffic on your website or the already established conversion benchmarks, there may be reasons to worry.
- **Upskill your team:** Advertisers need to start bridging the skill gap by training their staff about frauds and how they can curb it. Many a time, marketing teams get incentivized to hit the performance goals-unknowingly allowing ad frauds to continue.
- **Use an independent and unbiased media-neutral ad fraud detection tool:** Using an independent media-neutral Ad Fraud tool will allow advertisers to get the best protection for their ad campaigns immediately and ensure unbiased fraud analysis for advertisers.

Ad Frauds: Eating into mobile ad spend

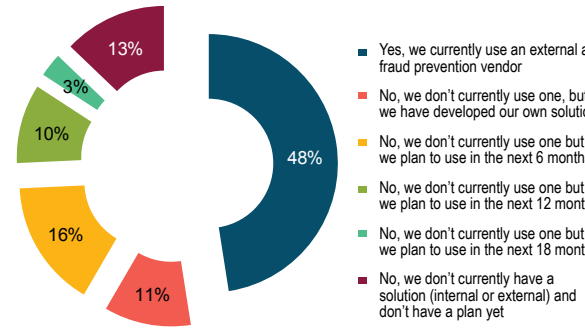
How much of your mobile ad spend is subject to ad frauds?



Source: Mobile Fraud in India 2019, MMA Global

Fighting ad fraud: Current investment and intent to spend in solutions

Are you using a solution or planning to do so in the near future?



Source: Mobile Fraud in India 2019, MMA Global

- **Click injection:** A sophisticated form of click spamming, which uses an app on the user's device that listens to app installation broadcasts. When new apps are installed on the device, it triggers a click before the installation is complete, taking credit for the installs.

- **Retargeting fraud:** Bots imitate the human's intentions and deceive advertisers by visiting a website. They mimic the behavior of humans interested in a specific product. Some threats hurt users and therefore affect legitimate app publishers also.

- **Auto-downloads:** A misleading ad resulting in an automatic download without the user's intent or knowledge, usually downloading a malicious program to the user's device.

- **Auto-redirects:** A user is redirected to a page that resembles a known webpage, but loaded with hidden and visible ads, which are used to download malware to the user's device or steal sensitive user data.

- **Malware:** A bogus ad causes a user to download a harmful program. Those malware can be used to steal sensitive data, hijack phone functions, generate fraudulent traffic, or hold the device ransom.

- **Cryptojacking**: Fraudsters serve up ads containing JavaScript code to mine cryptocurrency that leaves the users' smartphone CPU and battery power drained.

- **Video ad fraud:** Fraudsters are making money by arbitraging the difference between display and video CPMs (cost per thousand impressions). They simply earn more money by passing display inventory off as video.

- **Inappropriate ads:** Most reputable mobile advertising platforms don't allow offensive ads (nudity, bad language, drugs, etc.), but some advertisers intentionally obfuscate these ads to avoid detection. This can have a damaging effect on the user experience.

Tech tools to fight ad frauds

With fraudsters using increasingly advanced methods and tools to orchestrate attacks, it becomes even more difficult for organizations to fight them effectively. It demands constant attention and advanced tech muscles to identify and block potential attempts to fraud on an ongoing basis.

For example, machine learning (ML) can handle large volumes of data from varied sources and identify patterns of irregularity to fix the ad fraud issue. Blockchain also has been touted as a potential technology for the prevention of click fraud in the digital space. However, marketers in India are yet to understand and unlock the true value of these technology applications to prevent digital frauds.

"Marketers have a long way to go before these technologies can be put to positive impact in fraud detection technology," Resulticks Co-Founder and Head of product and strategies Dakshen Ram said, adding that, "While marketers are aware of these technologies to detect and prevent fraud, they are challenged by the complexity of and lack of knowledge and experience in applying them."

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[INTERVIEW]

AD FRAUD

"RIGHT ML ALGORITHMS CAN SNIFF OUT POTENTIAL FRAUD SCHEMES"

VASUTA AGARWAL
Managing Director, Asia Pacific, InMobi

Soma Tah (ST): What are the reasons behind the rising ad fraud cases in India?

Vasuta Agarwal (VA): Ad fraud is a part of a larger global problem in which players across the advertising chain, from the advertiser to tech platforms to the publisher, is trying to solve. The rise of ad fraud can be attributed to several factors – the steady shift of advertising dollars to digital, increasing pressure to drive growth in highly competitive markets especially in the Asia Pacific focused on high return on advertising spend, and the fast-paced nature of technological advancement. When it comes to solving these, advertisers need to focus on quality growth and disincentivize fraudsters in the ecosystem.

Also, there is no single standard for fraud detection or prevention today and this provides fraudsters with the opportunity to exploit chinks in the third-party measurement armors. In the long term, transparency and investment in advanced fraud prevention will be the change-drivers by providing visibility into the entire supply chain and helping advertisers stay ahead of fraudsters.

ST: Are advertisers willing to spend on detection and prevention tools?

VA: In our experience, yes, advertisers are willing to spend. There's a reason why there is a robust market for third-party verification, measurement, and attribution solutions, with each player deep-diving into a nuanced solution on different aspects of ad fraud such as viewability, invalid traffic, audience verification. In fact, most advertisers are unwilling to work with partners if a base level of third-party verification is not set in place. Having said that, it is important that advertisers lead the charge in ensuring that their partners are quick to adopt the latest tech standards released by industry bodies, thus helping holistically fight frauds.

ST: What are the technologies that can help the industry deal with this problem?

VA: We see a lot of potential for artificial intelligence (AI) and machine learning (ML) in fighting fraud. While slightly distant, the right ML algorithms powering fraud detection platforms/tools can sniff out potential fraud schemes before they even arise. AI algorithms can also help spot anomalous behavior before humans can, which ensures that fraud schemes when they do pop up, are shut down more quickly.

ST: Can you suggest some best practices for the advertisers to protect from such ad frauds?

VA: There are several steps that advertisers can take. First and foremost, advertisers should make sure they aim for quality growth and only work with reputable partners that have a strong track record of being trustworthy and transparent. Also, advertisers should invest in the proper measurement, attribution, and tracking, so they can have proper oversight over all their efforts. Advertisers need to invest in advanced ML/AI tools or in partners and platforms that have these capabilities and checks. It is also critical that both advertisers and their partners are raising their voices in the industry to shape the trust and transparency conversation from time to time.

Trust and transparency are a mandate for the entire advertising ecosystem. But, it's important to note that we are making progress. App-ads.txt and sellers.json, two IAB Tech Lab initiatives that InMobi helped spearhead, have gone a long way towards adding greater transparency to the programmatic mobile advertising space; which is where the future of media is.

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"SWITCH FROM CPC TO CPA MODEL TO PUT A CURB ON AD FRAUD"

DAKSHEN RAM
Co-Founder and Head of Product and Strategies, Resulticks

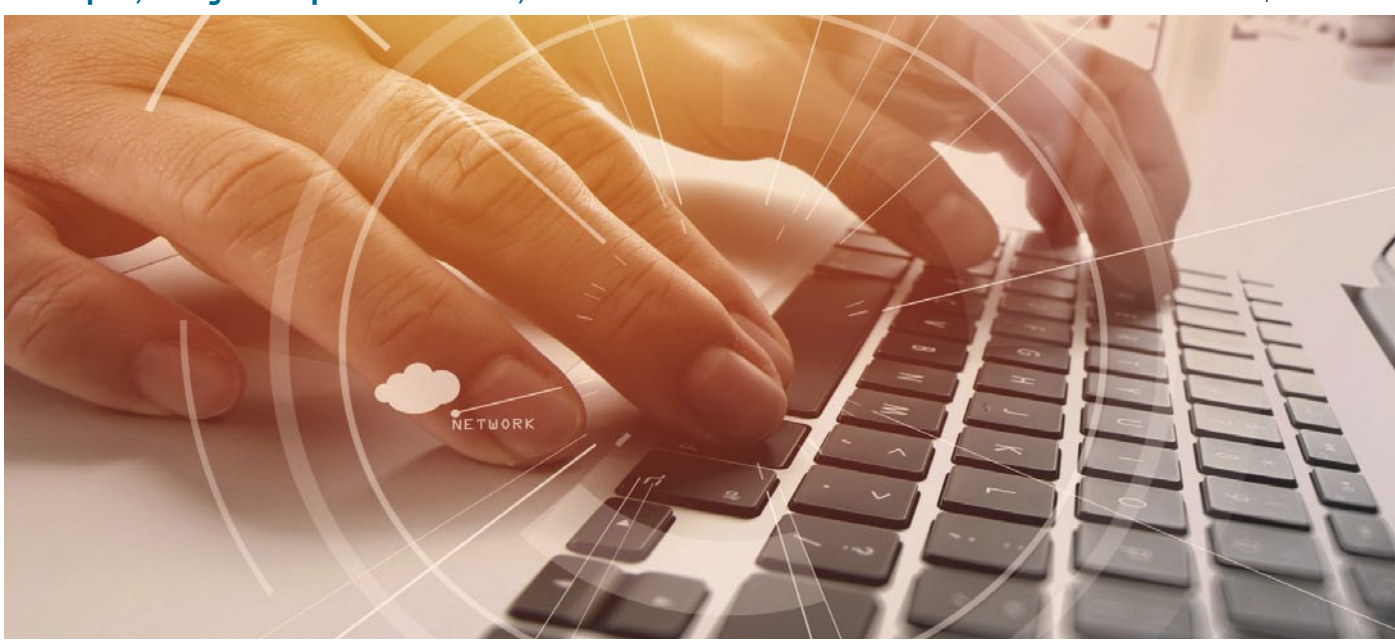
Soma Tah (ST): The number of ad fraud cases in India is on the rise. What are the main reasons?

Dakshen Ram (DR): Advertising fraud has existed ever since online advertising came into being. A recent digital ad fraud market report by techARC notes that app fraud contributes to more than 85% of the total digital ad fraud. This indicates that the web platform is quite vulnerable to fraud. The digital industry, in general, has recognized this as one of the major constraints of the online advertising business. With limited or no regulations to combat digital fraud, marketers are concerned about addressing cybercrime. Inadequate penalties and the absence of strict industry regulations have spiked digital crimes making it difficult to curb ad fraud cases.

ST: While fraudsters are pivoting newer attack techniques, how geared up are advertisers, and are they willing to spend on detection and prevention tools?

DR: With frauds being extensive in the Indian advertising ecosystem, mobile applications are leaning on the riskier side. In the last few years advertising on mobile platforms and videos has surged significantly. The Mobile Marketing Association (MMA) reported that an estimated 20% of mobile ad spends in India are subject to ad fraud.

Considering that advertising fraud is a concern across the global landscape, there is a significant shift in mindset towards spending on prevention tools. Businesses that have put aside a budget for the detection and prevention of ad frauds are better equipped and far ahead when it comes to handling a crisis and mitigating losses. But marketers and advertisers are yet to gauge the impact the associated fraud has on business and customers. Hence,



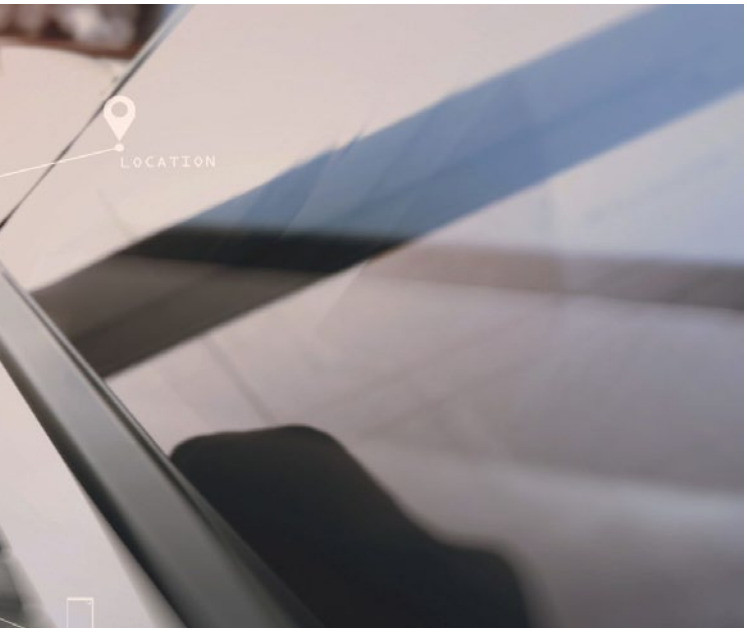
> High volume of hits from IP addresses that can be traced to a data center instead of a household or corporate computer means that a fraudster is at play.

the amount of money that organizations are willing to spend on detection and prevention of digital ad frauds is less than a quarter in any marketing budget.

ST: How effective are technologies like artificial intelligence, machine learning, and blockchain in fighting the ad fraud menace?

DR: Machine learning (ML) can handle large volumes of data from varied sources and identify patterns of irregularity to fix the menace. With the right feed, ML can capture patterns of behavior to detect fraud, and in combination with artificial intelligence (AI) at a more robust volume. Blockchain is another potential technology that can help in the prevention of click fraud in the digital space. However, marketers in India are yet to understand the true value of blockchain applications to prevent digital fraud. With online fraud on the rise, marketers are streamlining budgets to cover ad frauds but seem unaware of the capabilities blockchain offers to prevent such incidents.

While marketers are aware of these technologies to detect and prevent fraud, they are challenged by the complexity of and lack of knowledge and experience in applying them. Bluntly put, marketers have a long way to go before AI, ML and blockchain can be put to a positive impact on fraud detection technology.



ST: It seems the fraudsters are at the cutting edge of the technology and evolving very fast, while the fraud prevention solutions providers are busy playing catch-up. What are some of the best practices that can help advertisers protect themselves?

DR: It is important for advertisers to check their campaign metrics regularly. When the publisher's performance report does not match with the real traffic from the website or the already established conversion benchmarks, there may be reasons to worry. If there is a huge gap between the number of clicks generated and the number of visits or the click-through rate (CTR) is very high but does not translate into visits, it should raise a red flag in the marketer's mind.

The high volume of hits from IP addresses that can be traced to a data center instead of a household or corporate computer also means that a fraudster is at play. Visits from very low domain authority sites or spammy looking sites are another indicator.

To detect these trends and bring in preventive measures, marketers need to check campaign analytics and site analytics very closely on a regular basis to catch any exceptions. Effective fraud detection plans need to have elements of resilience, adaptive, and quality data. All of the above can be detected through analytical, ML, and AI models that can provide quick insight and help the marketing team take action. Techniques like feature extractions are being used extensively. Sometimes, switching from cost-per-click (CPC) to cost-per-acquisition (CPA) advertising model, or cultivating trust with advertisers by having independent audits will yield better results.

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"REGULATIONS MAY VERY WELL HELP COUNTER AD FRAUD"

MONEKA KHURANA
Country Head, Mobile Marketing Association, India

Soma Tah (ST): Mobile advertising sector globally is facing a severe ad fraud challenge. How would you describe the scenario in India?

Moneka Khurana (MK): Lack of transparency and the absence of standardized regulatory practices are the major reasons for the existence of fraudulent activities in mobile advertising. As per MMA's India Ad Fraud Benchmark Report, the rising rate of ad fraud is happening due to multiple middlemen involved in the ad publishing chain. This leads to a lack of data sharing and communication between the marketers and the ad space providers. The absence of open, real-time data sharing between marketers and ad space sellers makes the mobile advertisement sector vulnerable to fraudulent activities at various stages of the publishing chain. Some regularly reported ad frauds are around traffic fraud, ad stacking, cookie stuffing, and misrepresentation fraud.

As marketers start venturing into mobile platforms, they also become susceptible to fraudulent activities due to the loopholes in the ad buying and publishing process. Lack of monitoring sources of traffic and using campaign metrics that can be easily manipulated by fraudsters are some other factors that contribute to ad fraud.

ST: Is there a technology solution for this?

MK: Technology is a double-edged sword. While it has led to the emergence of mobile marketing, it is also the reason that ad fraud exists today. However, the challenge is to anticipate issues and stay ahead by using technology to fight the menace of ad fraud. Going ahead, marketers can use artificial intelligence (AI) and machine learning (ML) tools in marketing campaigns to track original sources of traffic and impressions. This will help identify the sources of ad fraud. Blockchain can then be used to track these sources of fraud and successfully keep them outside the ad publishing chain.

Marketers can utilize ML algorithms to avoid the identified sources of ad fraud for all future ad campaigns, while simultaneously using AI and blockchain to keep identifying new sources of ad fraud. There are third-party organizations that provide tech-driven anti-fraud solutions. Marketers must be diligent while choosing the solution that fits their organization's needs.

ST: While technology will always remain a catch-up game, what are the dos and don'ts that the advertisers can follow?

MK: While technology can help control ad fraud to quite an extent, there are some precautionary measures that advertisers can take to protect themselves. The simple dos and don'ts include buying ad space directly from publishers and programmatic buying platforms. This is one of the ways to reduce susceptibility to ad fraud. When buying digital ad space, ensure that the seller has a transparency clause in their agreement or works in a transparent manner with marketers, allowing them real-time access to data about traffic, impressions, etc.

It is also important to know your channel and marketers need to keep an updated list of blacklisted media channels so that they know where not to publish their ads. Advertisers may also adopt technology-enabled solutions in-house to flag fraudulent activities on a real-time basis and protect their campaigns from exposure to fraudulent activities. For example, marketers can use ML algorithms to avoid the identified sources of ad fraud for all future ad campaigns, while simultaneously using AI and blockchain to keep identifying new sources of ad fraud.

Regulations may very well help counter ad fraud, particularly if they can be designed in a way that ensures that they don't impede the innovation or erode the benefits of digital ads. The challenge is to strike a balance between restraining and restrictive regulations.

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"SMBs WITH LIMITED BUDGET REMAIN HIGHLY VULNERABLE"

AMIT RELAN
Director and Co-founder, mFilterIt

Soma Tah (ST): There is a clear lack of regulations and transparency in the mobile advertising sector. Is this the reason for a steep rise in ad fraud cases in India?

Amit Relan (AR): In today's digital world, trust, verifiability, and transparency barely exist. IT laws are generally confusing and have a few gaps as well. The fraudsters are simply taking advantage of this situation. For instance, a majority of apps on the Play Store today are free for users. The developers of these third-party free apps leverage in-app ads to collect revenues from ad networks. App developers get revenue from advertisers based either on the number of ads displayed or the number of ads clicked by users. While mobile advertising has served the purpose of ensuring that developer interests are met properly, it has also become a platform for various types of fraud. The most common ad fraud is fake installs where publishers cheat the advertisers through employing individuals or bots to drive fake installs to earn a profit. The other ad frauds include fake devices, fake attribution, Bots, click spam, incorrect region among others.

Ad fraud gets even more confusing as it involves several complicating factors. Fraudsters use different techniques to block businesses from discovering who they are. Even the methods that can track them can only yield an IP address or location which is useless to make a criminal case.

But, it's not that companies are not filing suits. Recently, Uber filed a case against five ad tech companies for squandering tens of millions of dollars on fraudulent ads. According to the complaint, the inventory they bought was all fake ads. The companies that Uber engaged with were into fraudulent activities such as click spamming, ad stacking, click spoofing, etc. After the trial, the judgment came in Uber's favor and the companies which were sued were asked to pay compensation.

ST: How aware are the advertisers? Are they willing to spend on detection and prevention tools?

AR: Advertisers lose millions of dollars every year due to ad fraud, which is hard to detect. One has to review the outcomes of one's campaigns to notice it. But businesses have become conscious about their brand safety. Marketers also want to know where their ad dollars are being spent.

To avoid incurring losses, advertisers are deploying third-party platform-agnostic fraud detection solutions for brand and performance marketing. Many large companies are setting aside budgets to curb ad fraud but still many SMBs who work on a limited budget remains highly vulnerable to ad fraud. If these advertisers set aside 10-20% of their budget for detection and prevention tools, they can save money on their ad campaigns and get genuine traffic that can convert into customers.

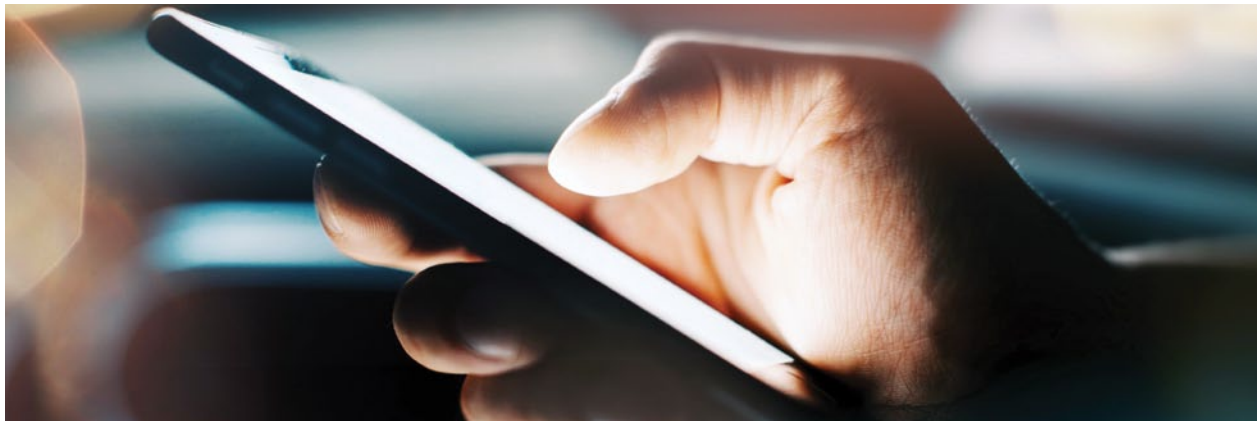
Using an independent ad fraud detection tool will allow advertisers to get the best protection for their campaigns immediately. These tools are media-neutral and not linked with media spends or media tracking- which ensure an independent and unbiased fraud analysis for the advertiser.

ST: How effective are technologies like AI, ML, and blockchain in fighting the ad fraud menace?

AR: The advertising industry is evolving faster than ever and so is ad fraud. Thanks to automation, many advertisers today are buying ads without speaking to any single human being at a media company. Ad frauds have also become quite sophisticated and difficult to detect and hence require better ad fraud detection and prevention techniques.

Although blockchain can trace the ad counts in real-time, we need artificial intelligence (AI) and machine

> The most common ad fraud is fake installs where publishers cheat the advertisers through employing individuals or bots to drive fake installs to earn a profit.



learning (ML) algorithms and deep-learning to fight ad fraud. The capacity of blockchain is limited for real-time transactions, which becomes a challenge in digital advertising given the huge number of real-time transactions that are processed every day. But both AI and ML techniques are extremely effective in detecting fraudulent data patterns such as bot-driven traffic or non-human traffic.

Bots are instructed to visit premium sites, picking up desirable cookies, and then visit fraudulent sites. Since Bot's behavior is automated, they tend to visit the same cluster of premium websites over and over again. AI and ML-based fraud detection solutions can easily detect these patterns since no human would visit the same site in the same order. The solution identifies these patterns and marks them as a fraudulent activity. These technologies ensure optimized results for fraud prevention and detection models.

ST: Tools and techniques of ad fraud are evolving very fast, while the fraud prevention solutions providers are busy playing catch-up. Could you suggest some best practices for the advertisers to protect themselves?

AR: There is no doubt ad fraud is the biggest challenge of advertisers today. Fake ad traffics gets created using malicious mechanisms for delivering ads. This not only affects the advertisers but also affects the ad-networks, agencies as well as the publishers. It is important that advertisers conduct a background check of the publishers/networks and blacklist fraudulent publishers. Checking the background of your publishers is of paramount importance as it helps understand the target audience. Publishers can tell you how their target audience data was collected and in what way it can benefit your campaign. Demanding a zero tolerance to fraud is important to ensure a better quality of campaigns. Any publisher whose behaviour matches fraud patterns must be blocked as soon as possible.

It is also important to set a reasonable price for campaigns. Setting too low or too high prices can be dangerous for advertisers. If you set too low a price for your campaign, you will get low-quality traffic. But, even if you set too high a price there is no guarantee that you will get high-quality traffic. This is especially true for performance campaigns, since the measure of performance may not be the right indicator of fraud. In performance campaigns, high-quality performance may not always indicate clean traffic.

Advertisers also need to start bridging the skill gap by training their staff about frauds and how they can curb it. Many a time, marketing teams get incentivized to hit the performance goals-unknowingly allowing ad frauds to continue. It becomes important for marketing teams to have data sciences experts to look at suspicious patterns and curb the fraud at the earliest. Besides, using an independent media-neutral ad fraud tool will allow advertisers to get the best protection for their ad campaigns immediately and ensure unbiased fraud analysis for advertisers.

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The new enterprise mantra

The complexity of IT infrastructure and the need for an agile network requires that enterprises quickly adapt virtualization first strategy

BY ADITYA KHAITAN

Network virtualization is the process of transforming the physical hardware within the network to virtual networks or machines. Multiple virtual machines are created using software and hosted on a single physical hardware. The virtual machines perform compute, storage, and network function similar to the physical hardware.

Globalization, market trends in Industry 4.0, automation, the growth of artificial intelligence (AI), big data analytics, and internet of things (IoT) as well as the black swan event of 2020 in the COVID-19 pandemic have only accelerated the pace of digital transformation in enterprises. With accelerated digitalization, the growing scale, and complexity of IT infrastructure in enterprises have raised concerns around network agility to meet the demand and resiliency to provide uninterrupted service.

Network and information security is a growing concern across IT, ITeS, manufacturing, banking, and financial services, government and public sector, defense, telecommunication sectors amongst others. Further, businesses are focused on cost reduction as the key strategic imperative for sustainability.

Network virtualization offers a reduction in hardware and power costs by consolidating multiple physical hardware servers and devices into a single host machine. As opposed to managing each physical node in the network, translating into virtual machines enable easy automation of provisioning and configuration processes, trouble-shooting as well as the implementation of security protocols. IT teams can then define security policies and controls for each workload or virtual machine which helps ensure enforcement down to the individual virtual machine.

Unlike in traditional networks, if an intruder gets through the data center perimeter defenses, here the threat is localized to a workload by abstracting network from underlying hardware. This merging of network functionality, hardware, and software resources into software-defined virtual network is known as software-defined networking. This software-defined networking that is simply referred to as network virtualization can be implemented across wide area networks – also known as software-defined wide area networks or SD-WAN – to replace expensive physical hardware with cloud-based provisioning of connectivity and services.

It can also be extended to routers, switches, tunneling gateways for virtual private networks, service assurance, and security functions such as firewalls, virus scanners, intrusion detection systems, as well as specific applications in an enterprise network.

Virtual networks are easily scalable and provide agility to meet business demands. Given these benefits, many of the enterprises have adopted the 'virtualization-first'

> Network virtualization could provide the ability to create service differentiators for both service providers and their enterprise customers.

approach. As part of the approach, enterprises are no longer purchasing new physical hardware, but meeting the new storage, compute, and network requirements through virtualization of workloads. Hardware refresh requirement each year is likely to be minimal, resulting in optimizing capital expenditure as well as improvement in bottom-line through the reduction in maintenance and energy costs. Enterprises are virtualizing their network services giving rise to 'as a service model' for entire networks, services such as security, assurance, or specific applications. Hence, the opportunity is not just one time but continues through the managed services phase of virtualized networks.

Businesses across sectors have expressed interest in investing significantly into virtualization in the near to medium term with a varying scale of initiatives. Many large enterprises globally and in India have already planned network virtualization or implementation of software-defined networking as part of their network architecture in 2020. Even the small to medium enterprises have shown their interest to virtualize and seem to be inclined towards 'as a service' models. Most are likely to look to single service providers as a one-stop-shop for all their technology needs. With virtualization being location agnostic, enterprises have a wide choice of providers to choose from ranging from system integrators, technology vendors, webscale providers as well as communication service providers.

Communication service providers (CSPs) are uniquely placed to provide these services to their enterprise customers integrating communication, connectivity, and networking. Many CSPs have started offering services focused on network virtualization, including security services, video conferencing, content delivery networks, unified communication services, mobility, SD-WAN, private networks for their business (enterprise) customers. However, to realize the full potential of the opportunity CSPs would need to undertake and expedite internal architectural, business processes, and organization transformation.

As part of the architectural transformation, CSPs would need to consider migrating from IP to software-defined networks of their own, collapsing network and IT boundaries to offer virtualized network services to their customers. Service providers are using virtualization to relocate the network functions in the proprietary gear of original equipment manufacturers such as telecom switches, gateways, IP multimedia systems, etc. This telecom led change is known as network function virtualization and specific to the network virtualization effort of CSPs. Implementation of network function virtualization results in infrastructure delivery as a service. Service providers need to realign the organization and operating model from a product-based to service/function/application-oriented model.

As enterprises scale up on the digital maturity ladder, they would require their networks to be agile, resilient, and secure. Deployment of 5G, IoT and M2M use cases could require enterprises to make provision, control, and manage millions of devices. We have seen the emergence of private networks deployed by car manufacturers and various other large engineering players as part of Industry 4.0 securing five nines quality carrier-grade networks. More and more enterprises are likely to seek their own private virtual networks offering massive broadband, ultra-low latency, high resiliency to offer digital services to their own customers, for example, e-governance services for government, digital payments and banks in financial services, connected car eco-system in case of auto, as well as telemedicine and telesurgery in healthcare to name a few.

This trend is only the first wave with opportunity slated to grow multifold in the near future. Network virtualization could provide the ability to create service differentiators for both service providers and their enterprise customers. The opportunity is wide open across a range of telecom and technology sector players; however, the realization is dependent on their own ability and agility to provide the most flexible service and performance-oriented virtual networks.

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End of the router as we know it

The changing nature of internet services and applications are driving manufacturers to develop better and cost-effective router systems

BY HANNES GREDLER

Since its beginning in the 1980s, network routers have evolved significantly. The greatest leap in development was observed when the World Wide Web was introduced. Network providers were suddenly faced with the challenge of having to keep up with the rapid introduction of internet services and the demand for bandwidth-intensive applications. In order to meet the demand, they invested enormous amounts in networks, which they had great difficulty in refinancing. They asked network equipment manufacturers to help them build value-added services, which in the years that followed led to a flood of new features that are now available for almost every router.

Critics argue that by adding new features but not removing obsolete ones, the cost of the routers has risen so much that they are no longer in proportion to the actual benefits. James Hamilton, VP and Distinguished Engineer at Amazon Web Services expressed this observation as follows: "The network is anti-Moore." In this context, here are some functions that have become redundant in the course of the current technical developments.

Hardware-buffer

In their Paper Sizing Router Buffers (2004), researchers at Stanford University describe their observation that buffers with a depth of up to 2000 ms are clearly suitable for services with low bandwidth and data stream diversity. But at speeds of 10 GBit per second and diversity of up to 10 million data streams, the advantages of buffering become extremely doubtful with a typical internet backbone connection.

The benefit is also questioned by the fact that there is no signalling to the Transmission Control Protocol (TCP) layer during "buffering". Most routers, however, still support a buffer depth of over 100 ms for 100 Gbps switching. A simple calculation shows that 1.25 GB DDR4-RAM is required for every 100 GBit/s port in a given router.

Exactly this DDR4 RAM, sometimes the most expensive form of RAM, makes the buffer the biggest cost driver for today's router hardware. Not only is it needed for a function that rarely works with today's internet backbone usage patterns. At the same time, it must be implemented as off-chip memory, which increases the cost of external I/O, power consumption, and cooling.

Hardware-forwarding tables

The second-largest cost factor for a router's data level is the size of its forwarding table. Modern hardware can store approximately two million forwarding entries in its IPv4, IPv6 and MPLS forwarding tables. The design of this forwarding engine is based on two basic ideas.

- One, a single forwarding entry can have a high data consumption. In fact, a single prefix can take up the entire bandwidth of a connection. This is still relevant today as content delivery networks and Web 2.0 companies direct a large part of their Internet traffic to just a few IP prefixes.

- Two, all forwarding entries can carry the full connection bandwidth. This no longer applies today. Traffic per prefix on the internet has increased exponentially, which means that the chip design for data forwarding has to be radically revised. Instead of treating each IP forwarding entry equally, a memory cache hierarchy is much more practical. This is comparable to today's computer designs: a tiered memory hierarchy with

> Traffic per prefix on the internet has increased exponentially, which means that the chip design for data forwarding has to be radically revised.

different levels of memory, each with different speeds, with adequate costs.

Modern IP routers still work at only one storage level, on the assumption that every forwarding entry must be fast. However, if you take a closer look at the analysis of the real backbone traffic data it is no longer the case. In fact, the forwarding tables for contemporary practical use are now 10 times oversized.

The good news is that the hardware can be easily optimized. Customers only need to clearly formulate what is usually required so that the next generation of forwarding hardware can be adapted accordingly. Network software, on the other hand, is a very special kind of problem.

Software features

It is difficult to say which software functions are actually redundant and which are not, since these depend on the individual needs of the telecommunications company. Over time, manufacturers have developed a wide range of features at the request of network operators and inserted them directly into the code. However, this procedure makes it impossible to deactivate certain functions after implementation. This can quickly become a cost factor as network operators have to pay for these features even when they are not being used. At the same time, when a new function is introduced, interference tests must be carried out every time for all existing functions – even for those that are not required.

The background to this is that the software for the router was previously programmed as a monolithic system, whereby new functions were closely linked to the underlying infrastructure. The removal of such functions from the code base can be as complex as their original development. At the same time, the hurdle for a functional expansion increases with each new feature.

In today's highly competitive telecommunications market, however, service providers rely on their systems being agile, easy to maintain, and tailored to their needs and those of their customers. Accordingly, router system manufacturers have to develop a new, more cost-effective approach that enables network operators to flexibly and smoothly manage, update and, if necessary, remove functions.

The solution = Disaggregated Systems + Distributed SDNs + Modular Code

The first step in the right direction is the disaggregation of hardware and software. This allows network operators to choose between different bare metal switches and validated network software for them, and to take advantage of the latest chip generations and thereby strengthen their innovation potential. However, this means that the responsibility for function management lies entirely with the network operators. A distributed software-defined network (SDN) offers the ideal conditions for this. It combines the advantages of an SDN with the advantages of a distributed control level and thus enables smooth management of the software.

To ensure that functions can be added and removed smoothly, the code should be structured in such a way that it can be put together from individual blocks of code. These should be able to be supplemented or taken out again as desired, whereby there should be no interdependencies between the blocks. An "internet-native" approach can help here. Independent micro services are used, which are carried out in containers. If a new function or an update is required, a corresponding container is supplied by the software developer, which updates or adds the respective feature within milliseconds and without interrupting the service. In this way, route processing, updating, and restarting are 20 times faster than with conventional router operating systems. If open interfaces are also available, network operators can even develop and implement their own functions.

Traditional routers and dynamic control systems are challenged by new concepts such as disaggregation and distributed SDNs. These promise significantly faster implementation, automated control, and a shorter time to market. In order for future router designs to meet these challenges, fundamentally new router hardware and software must be developed, and modern software architectures and paradigms introduced.

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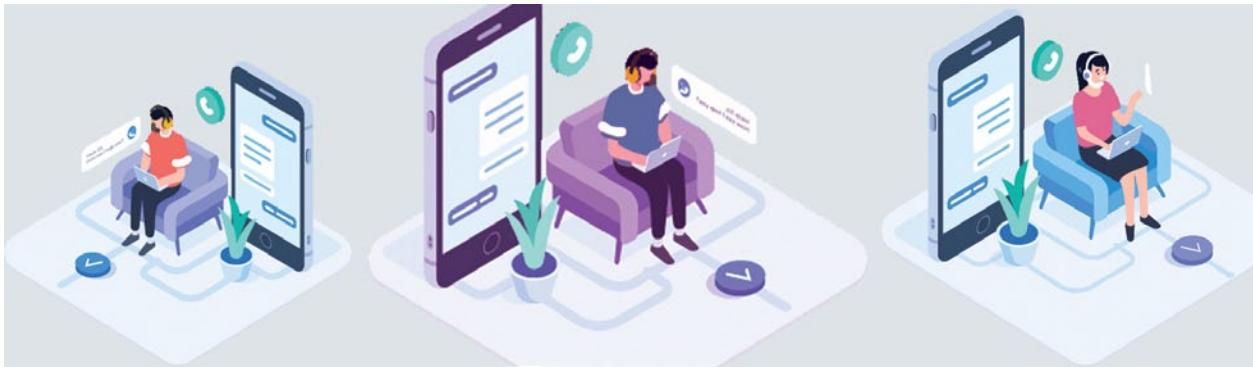
Rise of automated customer service

Telecom sector needs to adopt new approaches including a virtual call center to improve customer interface and increase service satisfaction levels

BY PRAKASH NAGARAJAN



The current COVID-19 pandemic has brought to the front the importance of agile working and business continuity for enterprises. It has also reminded them that technology is imperative for businesses to function. While traditional enterprises faced grave difficulties due to COVID-19, the ones leveraging technology were relatively at ease.

Like many, the telecom industry took severe blows due to the lockdown and disrupted business that put employees and customers at considerable risk. Even now, the industry is working with limited staff causing a considerable impact on the customer support initiatives. In this scenario, technology is becoming an effective facilitator of organizational continuity. The sector is leveraging technology to automate business operations and ensure practical work from home prospects.

However, the telecom companies first need to secure reliable cloud infrastructure before rethinking customer service with automation. According to Transparency Market Research, the international cloud telephony market is projected to reach USD 4176.83 crore by 2026.

Augmenting customer service

Cloud technology is already playing a prominent role in streamlining operations for various industries. However, for the telecom sector, the reliance on cloud can be of even more significant strategic benefit. According to a survey, 66% of global contact centers are not using the cloud; however, they plan to facilitate the shift due to the pandemic.

The market is expected to grow at 17.2% CAGR from 2018 to 2026 and the pandemic is working as a catalyst for the same. Cloud telephony integrates a series of valuable features, grants seamless and secured access to client information, and brings automated chat and sales tools while ensuring better collaboration with CRM and helpdesk. It also offers a host of time-saving, quality assurance, and other business-critical integration tools to ensure better productivity. Furthermore, cloud tools drastically reduce the demand for on-premise hardware assistance and bring flexible operational benefits to a contact center.

E-commerce and digital customer service

The series of lockdowns and large scale, societal changes have altered the way consumers buy and interact. The boil in the e-commerce sector brought a lot of traditional retailers online. With on-premise call centers facing severe continuity issues, digital customer service and automated chatbots were extensively used by banking, finance, telecom, and other industries.

Earlier, in a six-minute customer service call, 75% of the total call time was invested in doing manual work by the agent, and only 25% was deemed meaningful

> The use of AI and machine learning complemented with cloud technology can unravel valuable insights into understanding the customer satisfaction levels.

conversation. With the bulk of the customers embracing self-help and automated versions of customer service, contact centers, too, need to adapt to a smarter way to interact. To achieve the perfect customer service experience, businesses can quickly adopt a new comprehensive method to communicate. This includes creating frequently asked or commonly asked questions (FAQs), the use of interactive voice responses (IVR), and chatbots. This can help provide a detailed step by step assistance on different queries.

CRM and CX

The lion's share of the telecom industry is dominated by Customer Experience (CX), which is the essence of effective sales and generating ROI. Contact centers actively work to build a satisfied customer base, and agents require seamless access to customer data to achieve the same.

With active integration of Customer Relationship Management (CRM), agents can access real-time customer data and better handle the incoming calls. While CRM empowers the agents to gain disputed customer's history, it also helps in ensuring better functionality, reducing call time, and serving customers in an uninterrupted manner.

AI and machine learning

Industry 4.0 solutions are quickly making their way in the telecom sector. The use of AI and machine learning complemented with cloud technology can unravel valuable insights into understanding the customer satisfaction levels. Aspects like call duration, communication gaps, lingual complexities, long waiting time, and more can be readily identified and solved through AI algorithms.

The agent's performance can also be assessed on these parameters through new-age technologies. Furthermore, the future will see AI playing a more useful role in helping trainee agents build soft skills and their ability to tackle difficult situations.

Flexibility, scalability, cost-efficient

In the future, a virtual call center will be a silver bullet for handling all the continuity challenges faced by on-premise contact centers. Going ahead, cloud-powered setups will transform the face of the industry as we know it today.

- **Flexibility:** Other than being inexpensive, cloud-based virtual call centers are highly flexible in their work. Agents are empowered to work from anywhere in the country, which has proven revolutionary in work from home culture.

- **Scalability:** The high scalability factor allows businesses to downsize or scale their operations during different business scenarios. Top emergencies like the current pandemic have proven the higher feasibility of a cloud-based contact center over on-site premises.

- **Cost-effective:** Furthermore, the CAPEX involved in initiating a contact center can be prohibitive, and the return on investment (RoI) might take years to churn substantial results. A virtual call center plummets various investments required in a traditional setup to a single software subscription that is revolutionary for the industry. A sales team can have better targeting by hiring local people without them migrating to an office.

If nothing, the pandemic has taught us that the world is unpredictable, and all businesses can prepare for the worst. The dramatic rise of automated contact centers is the first step towards laying the foundation of an efficient operation. A flexible and highly scalable system might not be a bulletproof prospect, but it will help enterprises recover and bounce back with less hassle.

Adopting new tools and technologies is critical for the support teams to be of higher service and deliver better ROI. Also, the crisis has made businesses realize that keeping flexible tools within reach is more important for business continuity and efficiency than not having them.

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From holding a 'brick' to touching a screen

Mobile phones have become versatile, all-in-one devices that are turning faster and sturdier by the day with features designed to make life a tap away

BY MANU KUMAR JAIN

The growth, innovation, and technological advancements in human communication over the two decades have been phenomenal and mystical. The technology in communication has combined large distances to one small global village by diminishing the geographical boundaries and time difference. From writing telegrams to standing outside queues to using a PCO to landlines at home to cordless and mobile phones, today connecting with our loved ones has become merely a matter of milliseconds. In the last few decades, mobile technology has made a leap so wide that looking back, the journey looks almost magical. What started with 'brick' like phones available only to the military and the uber-rich has now transformed into beautiful slim devices aka 'screens' that are accessible easily.

How it all started?

It's been 25 years since the first wireless phone call was made in India. This was way back in 1995; some of us were just toddlers then. Functions on the phone were limited to just making calls with an exorbitant rate card attached to both incoming and outgoing calls. The turning point for phones going truly mobile was in 1998 when we were introduced to a mobile phone. The fun thing about the year 1998 is that anyone who started using a mobile phone then is still a user today! With the increasing number of mobile SIM registrations and advancements in telecommunications, the call tariff rate started reducing. Note that there is no internet yet at this point, therefore no GPS and if you had your phone stolen or misplaced you could be assured you wouldn't find it again.

Customs duty made up around 60% of the cost of handsets made, with further sales tax and turnover tax added to it, this made mobiles quite an expensive buy. At this time, we had companies like Ericsson, Siemens, Sony, Philips, Nokia, and Motorola as the primary mobile phone maker who sold in the country.

The beginning of innovation

Mobile phones underwent a new innovation during 2001-2002. The market was flooded with phones that had tiny coloured LCD screens with games apart from 'Snake'. During this time the Indian Telecom industry had a massive disruption taking place. It was in 2002 that Reliance Infocomm introduced a nationwide Wireless in-Local Loop network with a tariff that was the most ambitious ever listed by any telecom company in India at that time.

This disruption would cause waves that would further enable consumers from smaller markets to look at mobile phones as a possible purchase. Up until this point, people still relied largely on landlines and phone booths to make calls through government-owned BSNL and MTNL. Owing to Reliance, in 2004 for the first-time ever, the number of mobile phone connections in the country overtook the number of fixed-line connections.

The coming of the world wide web

Soon after the success of Reliance, during the early 2000s broadband internet penetrated the length and

> Mobile phones underwent a change during 2001-2002. The market was flooded with phones that had tiny, coloured LCD screens with games apart from 'Snake'.

breadth of the country. Today we access the internet seamlessly through our handheld phones. But this too has been a journey of massive technological leaps which is on-going even today. In 2005 we saw a massive boom of broadband subscribers – one million strong. Till this time, we had 2G internet. But in 2007-2008 a massive smartphone wave occurred with the introduction and rise of touch screen phones which also drove internet consumption amongst the users in India.

In 2008 India entered the 3G arena with the launch of 3G-enabled mobile and data services by government-owned Mahanagar Telephone Nigam Ltd. The 4G came soon after and its usage and development have persisted till today. We recently had some announcements made, wherein the country would soon foray into 5G.

Saying goodbye to Java-based phones

Does anyone remember the various operating systems our phones had back in 2010? Or the infamous battle of the operating systems? This was the wave where all of us wanted to be part of the Blackberry club. But today we only have Android and iOS that have remained standing as the most preferred operating system globally. This time period was also the end of plain feature phones and the birth of smartphones. OS-based applications started developing at a quick pace. Gone were the texting days and soon we had apps like Facebook messenger, Line, and our beloved WhatsApp that came into the picture.

Ecommerce apps entered smartphones, and so did various banking apps (that have only evolved with the times). There is so much in our phones, that we essentially don't feel the need for other devices today, effectively replacing the need for computers in many households.

Becoming the most coveted market in the world

While accessibility and demand for smartphones kept increasing, by 2014 India only had two smartphone manufacturing units to meet the increasing user demand. It was also at this time that Xiaomi entered India with the Mi 3 through an exclusive partnership with Flipkart. It was perhaps the first smartphone in India at the time that offered top-of-the-line specifications and a premium design in the sub-Rs 15,000 price segment. With increasing demands, production and assembly of smartphones became a cornerstone for Prime Minister Narendra Modi's Make in India initiative.

In 2015 we initiated our own Make in India initiative and within six months set up a plant in Sri City, Andhra Pradesh in partnership with Foxconn; today we have seven plants. With services like that of Reliance Jio available – launching 4G services with free data and voice calls – it further pushed smartphone development and adoption in the country. With internet accessibility made easy, applications developed exponentially. By 2019, smartphone manufacturing units in India increased from two to sixty; it's also in this year that we surpassed the United States and became the largest smartphone market in the world, second only to China.

The smartphones in our hands today are versatile and fast-changing. Software updates take place year-on-year, practically every month we have a new handset launched that is faster, sturdier, and can click better pictures than the one before. Applications only keep getting more and more features that are designed to make life a tap away. Today, we no longer need to stand on the road and hail a cab or call an agent to book our travel tickets or ask a relative or friend about a great place to have a meal.

Mobile gaming has changed too, where once we would get excited over hitting the highest score on 'Snake' to now, where we play online multiplayer games against players globally. Looking back the journey and evolution of smartphones is vast, and today practically everyone owns these beautiful, precise, and fast touch screen phones.

Technology is changing at a fast pace and who knows what the next innovation would be. We have come far in the last 25 years. We can only imagine where the next 25 will take us.

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BRIJENDRA K SYNGAL

THE INTERNET COMES TO INDIA

In 1995 India achieved what only two Asian countries, Japan and Hong Kong, had achieved till then – launch of a full-scale commercial internet service

It was a great honour for me to take over at the helm of VSNL as it placed me at the centre of Indian telecommunication, and telecommunication, more than perhaps anything else, has contributed to humanity's progress over the last two centuries. If man's ability to harness the power of steam flagged off the Industrial Revolution, it was telecommunication that vastly quickened human response to events – from personal to global, connected the world, and powered more efficient trade and industry. Yes, it made warfare too more efficient, but it would also have prevented many wars by making diplomatic exchanges and negotiations much faster and easier.

VSNL itself was the culmination of 150 years of human endeavour and ingenuity.

In May 1837, Englishmen William Fothergill Cooke and Charles Wheatstone patented their electric telegraphy system, and overland telegraphy quickly became popular. In the 1850s, Constantinople (now Istanbul) in Turkey became the nodal point linking Europe with England. In March 1855, when Russian czar Nicholas I passed away in St Petersburg, the news was announced in the House of Lords in London just a few hours later. Only thirty-four years earlier, in 1821, it had taken two months for the news of Napoleon's death on the island of St Helena to reach London.

The East India Company official William O'Shaughnessey pioneered telegraphy in India. In 1851, the first line – 33 miles long – began operations between Calcutta, the capital of the Raj, and Diamond Harbour. O'Shaughnessey managed to enthuse Governor-General Lord Dalhousie so much about the benefits of rapid communication, that he was appointed Director General of Telegraphics, and by 1855, had built a telegraphic grid across India, from Calcutta to Peshawar to Bombay to Madras. In 1870, the 11,000-kilometre telegraph line between Calcutta and London became operational, including two submarine cable segments in the Persian Gulf and the Black Sea. A message from Calcutta to London took six hours and seven minutes to reach, which, at that time, was considered nothing short of a miracle.

But technology moves on. In 1876, Alexander Graham Bell invented the telephone and in 1901, Guglielmo Marconi (who almost definitely built on the pathbreaking work of Jagadish Chandra Bose, whose seminars he had attended in London) managed to transmit a wireless radio signal across the Atlantic Ocean, from Newfoundland to England. In 1923, a group of Bombay businessmen set up the Indian Radio Telegraph Company, and introduced wireless telegraphy to India. On 1 May 1933, radio telephone service was started between Bombay and Poona in India and Great Britain.

During the Second World War, the British Raj invested heavily in communication networks, and also allowed private investment. However, when the war ended, in August 1945, the British government decided to bring all overseas telecommunication services in Britain and its colonies and dominions under government control. On 1 January 1947, the Overseas Communication Service (OCS) was established. It amalgamated all companies, public and private under one entity. OCS would be the precursor of VSNL.

In its thirty-nine-year lifetime, the OCS established telephone links from India to across the world – from China to Egypt to Russia to Saudi Arabia to Australia.

> When we introduced internet services in 1995, even China did not have the net. The Chinese vice-minister visited VSNL in 1996 to learn the tricks of the trade.

International subscriber dialing was introduced for more than a dozen countries. In 1968, the Maharashtra government moved a century-old marble statue of Queen Victoria adjacent to the historical Azad Maidan and Flora Fountain in central Bombay to make space for a headquarters for OCS, which had till then been operating from several offices spread across the city.

The 250-feet-high building with a 150-feet tower on top that was inaugurated in 1970, would become a city landmark, and is today known as the Videsh Sanchar Bhavan.

Incidentally, Videsh Sanchar Bhavan was one of the buildings on the terrorists' original list of targets for the 1993 Bombay bomb blasts, along with other key sites like the Bombay Stock Exchange, the passport office and the Air-India building. But we had received some intelligence a few months before that there could be a terrorist threat to us. So I had given instructions that no car could be parked within 500 metres of the building (all the bombs used in the attack were hidden in vehicles parked near their targets). Even my car would drop me at the gate and drive off.

On 19 March 1986, the OCS, a government department, was converted into a government-owned public sector enterprise Videsh Sanchar Nigam Ltd.

When I joined in June 1991, though VSNL had had several acting CMDs, I was only the second person appointed to the post on a full-time basis with the proper requisite contract.

I spent the first two years in my job at the VSNL concentrating on bridging the digital divide for the knowledge industry through the SEA-ME-WE2 cable, leased lines and earth stations. I also focused on putting my ship in order – raising staff morale, changing attitudes and transforming work culture from that of a stodgy service-apathetic organization to an aggressive customer-driven market force. The results were visible, and our top and bottom lines were reflecting them. Call minutes had risen 57%, and profit after tax had soared by 70% by 1991-92 and 1993-94.

Now the focus turned to human connectivity, to the World Wide Web. It would ultimately lead to my dream concept – the commoditization of connectivity, which could accelerate economic and social development. Pressure was building up from industry, scientific bodies and the public at large. The onus of bringing the internet to India fell on VSNL vis-a-vis a lumbering DoT and its attendant processes. VSNL accepted the challenge.

Till then, only three countries in Asia had introduced commercial net service – Japan, Singapore (limited access, not full commercial access) and Hong Kong (it was a British Dominion then).

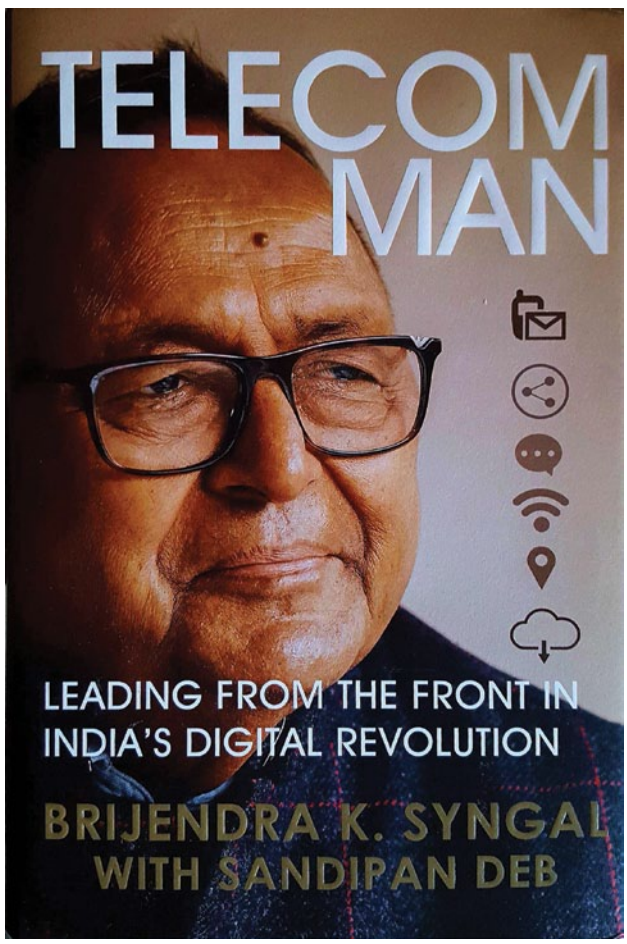
It was a challenge with a timeline which involved self-education based on the available literature with some help from British Telecom and the likes. The pioneering effort was a watershed event in the Indian connectivity story, the results of which are all around us today. In a quarter of a century, it has become a necessity after roti, kapda and makaan. The internet is all-pervasive.

There are more than 550 million Indians connected to the internet today, that is, more than 40% of the population. This number also makes our country the world's second largest online market. Yet, when we at VSNL introduced internet services two and a half decades ago in 1995 even China did not have the net. The Chinese vice-minister visited VSNL in 1996 to learn the tricks of the trade.

There had been a rudimentary version of the internet available in the country since 1986, when the Educational Research Network (Ernet) – a joint undertaking of the Department of Electronics (DoE) and the United Nations Development Program (UNDP) – was launched but Ernet was only meant for the use of the educational and research communities. Also, the software that would truly define the internet and make it accessible to the layman – the web browser – had not yet been invented.

> The pioneering effort was a watershed event in the Indian connectivity story. In 25 years, it has become a necessity after roti, kapda and makaan.

Developed in the American defence laboratories, and initially used only by the US military and research establishment, the US government was now allowing the internet to be used by all. In the Indo-Pacific region, countries like Japan and Australia had already launched the service. Therefore, there was an inquiry from the government as to why we should not venture into internet provision. The government had three options – DoT, Mahanagar Telephone Nigam Limited (MTNL) and VSNL. Eventually the government leaned towards us because we had the international connectivity and relationships with external carriers. At the time of commissioning of the SEA-ME-WE2 cable in 1994, we were approached to start considering providing internet as a service.



We started planning as soon as we got the green light. We also started talking to our correspondents, like British Telecom, MCI and AT&T on how they had gone about it. The building blocks were soon put together. The essential component was the connectivity to an internet service provider outside India. Our choices were very limited we could get to Australia, Japan, Hong Kong, the US and the UK. We zeroed in on 128 kbps lines to these countries. Simultaneously, we started setting up the hardware.

We chose five cities as the first lot for internet connectivity – Delhi, Bombay, Calcutta, Madras and Pune. We left out Bangalore and chose Pune because we had a large set-up there. From the logistics point of view, Pune was easier but from the requirement point of view, Bangalore was certainly more important. We set up the equipment, the servers and connectivity between these five cities so that we had some sort of a fail-safe system. Honestly speaking, according to our intelligence gathering, we thought we had done a reasonably good job. We started the beta testing about forty-five days before the launch date, which we had set as 15 August 1995 – actually the day before, so that the announcement would come on Independence Day.

Finally, the D-Day arrived and we launched the service simultaneously from the five cities. I was in Calcutta, and the media coverage was extensive. In fact, some news reports termed it as a second Independence Day, after 15 August 1947!

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Excerpts published from the book Telecom Man: Leading from the front in India's Digital Revolution, by BK Syngal with Sandipan Deb, with permission of the author and the publisher Westland Publications Private Limited. The content has been partially edited to match V&D guidelines and for brevity.

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VOICE&DATA

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Collector's Edition

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PRAKASH KUMAR

THE TRANSFORMATION CATALYST

With the internet becoming more accessible each year, its role as an agent of change and empowerment has been growing bigger

The internet is the digital highway, which like the railroad and highway connects people, places, and entities. While road took thousands of years to graduate from dirt to tar and cement to help increase the speed of vehicles, the railroad took a hundred years to migrate from coal to diesel to electricity. Internet, on the other hand, has taken just two decades to grow from Kbps to Gbps and more. Unlike road and rail, the throughput of internet has also seen an exponential increase and it requires less space and is less capital intensive.

This has enabled the developing world to move fast and catch up with the rest of the world. In the last 25 years of its existence in India, the internet has changed the way we read, work, play, and entertain.

The high-paced technological advancement has ensured a constant reduction of per-unit cost (Rupees per GB of data) making it possible for the governments to use in a big way for the empowerment of people. Ubiquitous access to fast, two-way communication has transformed the way we interact, learn, meet, get entertained, and live our life.

This information highway has been used in a big way to deliver business-to-consumer (B2C) services, government-to-citizen services (G2C) and it has become a big enabler for improving the lives of the least privileged in sectors like education, health, and women empowerment.

Lockdown and partial unlock brought to focus on how people started using the internet to buy goods and services from the comfort of their homes. This is an example of a B2C service delivery. This empowerment was not one way, i.e, citizen to sellers, but also the other way round. The producers of goods and services are vying with each other to reach the target buyers on their mobile in the most innovative ways.

In the last two decades, we have seen how access to government services has improved. The government first started this by bringing in various service delivery departments and agencies in one place and making the operation time longer, including on weekends, to ensure that people can avail of these services at their own convenience without any need of taking leave to pay a bill or get a certificate. E-seva, Friends, Sukhmani, etc. are few names of such centralized e-service delivery vehicles that have been possible, thanks to the internet. Higher internet speed coupled with better and cheaper computers/tablets/phones and mobile-based applications have made many of these services available 24X7 to the confines of our homes. This was the second level of empowerment.

The next level of internet-driven empowerment has been enabled by the micro-blogging sites – social media. A tweet by a citizen has the potential to make government machinery think and act in a certain way, which was unheard of in the pre-social media age. This is a revolutionary change as the new tool has empowered the citizen in a big way, improving access to authority. Our former minister of external affairs was known to provide immediate relief to people seeking her help on Twitter.

This empowerment is not limited to government space but also to consumer services. In the pre-internet era, individual buyers had little or no way of communicating with anyone higher up the corporate chain of command. Now, in the post-internet era, anyone with Twitter or Facebook account can tag the company on shoddy services and goods. Dominant companies that earlier used to give two hoots to consumers are now bending backwards to remedy an aggrieved and dissatisfied customer.

With the internet becoming accessible to more and more people every year, its role as an agent of change

> The internet has provided a space for marginalized communities to voice their opinions, express their identities, and run businesses and movements.

and empowerment has grown bigger. The internet has provided a space for marginalized communities to voice their opinions, express their identities, and run businesses and movements.

Let us now see how the Internet has empowered women. The increasing number of e-commerce sites trading indigenous arts and crafts, show the potential of using the Internet for income generation. For example, the Self-Employed Women's Association (SEWA) – a membership organization of 250,000 self-employed women, with approximately 35,000 members from scheduled tribes have successfully started trading their arts and crafts on the web.

SEWA is demonstrating that in cases where local communities are being represented through an effective community-based membership organization, and the technology is being owned by the groups themselves, the internet can make an important contribution in improving the livelihoods of local communities.

Delivery of health services remotely was seen as tech mumbo-jumbo till the COVID-19 pandemic set in. During the last four months, remote delivery of primary health services has picked up in a big way. Coupled with affordable data charges and mobile, the poor and disadvantaged living in remote areas are able to access primary health services through teleconsultation. The availability of digital stethoscope, blood pressure instruments, and app on mobile to conduct simple tests has enabled medical professionals to provide the first level of health services to remote locations.

Delivery of education through the internet was largely limited to the higher education sector or training of people in tech areas. Once again, closure of schools due to the COVID-19 outbreak led to the delivery of classroom instructions through the internet. However, it has its own challenges in terms of managing a class of 40 to 50 students, especially of primary or middle schools. The other challenge has been the delivery of content on small screen devices such as mobile phones where reading becomes very difficult. Nevertheless, digital classrooms ensured that the lockdown period, which would have otherwise passed without any activity, could at least be utilized for education.

While discussing the topic of empowerment through the internet, one also needs to see how certain constraints may lead to this tool working in the opposite direction. Under the right conditions, the internet along with digital technologies can contribute to achieving the targets set out in the Sustainable Development Goals (SDG) by fostering economic growth, improving governance, and delivering better outcomes in education and health.

However, technology is a double-edged sword that can also amplify social, economic, and political inequalities. The poor citizens, especially women and marginalized communities will be the worst affected if the access gets limited or expensive. This is being seen in many developing economies, leading to further widening the gulf. The government and civil society not only need to enable equitable access, they also need to help such groups in acquiring skills to use digital tools. If not done, this will further entrench the wage gaps and these groups will get further marginalized as more employment opportunities and jobs move online.

The road ahead should be to ensure taking the information highway to every village. Today, over four lakh of the total 6.5 lakh villages are yet to get high-speed internet through fibre. Besides, there is a need to ensure that the poorer sections of society get adequate training opportunity to develop the required skills to use digital tools.

Making available content in the local language is another area which needs to be given due attention. Last, but not least, encouraging local companies to come up with applications and solutions suiting needs of our people rather than allowing ever-increasing colonization by large companies from other countries who have a virtual monopoly in many areas.

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TV RAMACHANDRAN

TALE OF GROWTH AND EMPOWERMENT

The internet has established itself as the underlying infrastructure for India's incredible transformation and growth. However, we need to achieve more

"Connectivity is the key to the transformation of one billion people into members of knowledge society," stated the late visionary scientist and former President of India, Dr. APJ Abdul Kalam, as he had prophetically envisaged this true meaning of connectivity, way back in December 2006.

Today, the very word connectivity has evolved to include both voice and data connectivity. Through a wonderful coincidence, this happens to be the silver anniversary of both mobile telephony and public internet services in India. This convergence over the recent past few years with the advent of 4G (LTE) mobile technology has resulted in almost 98% of the people accessing the internet via their mobile phones or smartphones today.

Dr. Kalam would have indeed been happy to observe the tremendous proliferation of internet connections today in India – approximately 718 million, of which over 660 million are broadband connections.

Though internet made its entry in India in the form of a government project called Ernet (Education and Research Network) in 1986, it was only on 15 August 1995 that public internet services were formally launched by Videsh Sanchar Nigam Limited (VSNL), a Government of India PSU. The government showed great foresight by recognizing the need for encouraging the spread of the new technology in the country and opened the sector for provisioning of internet services through a string of industry-friendly and ease-of-doing-business measures.

The first Internet Service Provider (ISP) guidelines were announced in November 1998, and then subsequently revised in 2002. Ultimately on 1 November 2003, a token license fee of one Rupee per annum was levied for a national license. A liberal licensing regime with no entry fee, zero license fee, and permitting an unlimited number of players, was put in place. The National Telecom Policy (NTP 99) envisaged opening up of internet telephony, whereupon the government decided to permit ISPs to offer internet services from 1 April 2002.

The usefulness of the service was soon recognized and led to immense popularity and increased internet penetration across the country. The business of cyber-cafes boomed across the nation, serving multitudes for academic, professional, or personal purposes. It has indeed been a long journey for the spread of the internet in India from a single government entity to privatization and liberalization of the sector, which saw the induction of over a thousand ISPs catering to different geographies.

The launch of public internet in India was the harbinger of today's broadband services, which has been fundamental to the socio-economic growth of the country and is the prime engine of its digital transformation. The mobile internet has become a key enabler and empowered millions, while bringing about exceptional transformation in India on several fronts, including the national economy and socio-economic development. Irrespective of whether its agriculture, rural connectivity, banking, payments, education, healthcare, and medicine, the internet has touched and transformed every aspect of our lives. The recent COVID-19 crisis has further reiterated the important role of the internet not only for the ordinary citizens of the country but for the industry and the government as well.

The Digital India programme is envisioned to make government services available to citizens electronically through robust online infrastructure and better internet

> The popularity of mobile internet, proliferation of fixed-line broadband and the uptake of Wi-Fi services led to an exponential growth of the broadband ecosystem.

connectivity. Under the umbrella of Digital India, the government has introduced various internet-based services for the masses like MyGov, GeM, and UMANG, to name a few.

The popularity of mobile internet, the proliferation of fixed-line broadband, and the uptake of Wi-Fi services have led to exponential growth of the broadband ecosystem, and made the internet a basic requirement across all social and geographical sections of the people. The introduction of digital services such as e-commerce, digital payments, e-banking, e-health, e-education, and e-agriculture have formidably improved the entire landscape of the nation, addressing social as well as economic barriers and helping reduce the digital divide between the urban and rural populace.

In rural areas, the greatest advantage of the internet is its ability to bridge the inadequate physical and institutional infrastructure, specifically in the areas of transport and information infrastructure, emergency services, and social interactions. Under the Bharat Net programme, the government has been able to successfully connect around 1.50 lakh panchayats across the nation with high-speed broadband connectivity through optic fibre, and is determined to provide the same to all 2.5 lakh gram panchayats in the country. Moreover, in his recent speech on this Independence Day, Prime Minister Narendra Modi announced that India's 6,00,000 villages will be connected with the optical fibre network in the next 1,000 days.

Recent findings by an IAMAI and Nielsen report indicated that for the first time in India's history, rural internet connectivity and usage has exceeded that of the urban demographic, an encouraging trend indeed. According to the report, rural India had 227 million active internet users, 10% more than urban India's approximately 205 million (Nov 2019) – marking an increase of 30 million users since March 2019, chiefly owing to affordable data services and devices.

This signifies a historic shift in trend towards equal and inclusive growth for the nation's populace, bridging the rural-urban digital divide. Moreover, around 71 million children in the age group of 5-11 years are reported to access the internet using devices of family members, making India the second-largest internet user market in the world with 504 million active internet users who are five years old or above. The report also marked an encouraging increase in female internet users at 21%, as compared to 9% for males, as 26 million new female users went online during the March-November 2019 period, thus addressing the gender gap/balance issue to some extent as well.

In conclusion, I'd like to state that in spite of the rapid strides taken so far we cannot be complacent about being number two globally in both mobile telephony and internet usage. We have undoubtedly come a long way to 718 million internet connections, but this represents only about 50% penetration and we have an equally long and arduous haul ahead, and at the end of it is the rewarding New Frontier of a "Knowledge Society", as President Dr. Abdul Kalam termed it. Our 4G speeds are about a quarter of the global norms and more than 50% of the population do not have access to broadband. Addressing this would give a big boost to our GDP growth rate and also vastly improve the quality of life of our citizens. The advent and the introduction of new and advanced technologies like 5G, AI, IoT, and Big Data are expected to drive this pursuit for improvement and excellence further in the future.

As the internet has established itself as the underlying infrastructure for India's incredible Digital Transformation, and with the broadband ecosystem expanding exponentially, we aspire to facilitate efficient and economical broadband services to all citizens across the country through a judicious and practical mix of mobile, Wi-Fi, Satcom, cable, and other new and innovative technologies. At BIF, we pledge complete commitment to this goal, so that the benefits of the internet-led digital revolution and the resulting increase in the number of gainful digital services can reach each and every citizen in an all-inclusive manner.

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SUBHO RAY

GETTING INTERNET FOR ALL

The internet in India has evolved through many crests and troughs. Can the digital ecosystem take it to the next "inclusive" level?

My friend Subhendu Parth just reminded me that the internet in India, as we know it, was started at the Lakshmi Nagar Exchange in Delhi. Those of us who are familiar with Delhi would know that in 1995 it was a not a very prosperous locality abutting the up-coming middle-class colonies of Patparganj and Mayur Vihar Phase 1 and Phase 2. The irony of it was not lost on me. Internet, which was for a very long time thought to be a "toy" for the rich kids in India, started in the relatively poor Lakshmi Nagar Exchange.

My story about the internet in India reaching the masses is in four broad phases: 2000-2007; 2008-2013; 2014-2019; and 2020 and beyond. However, let us start at the very beginning. The total number of internet users in India was 14 lakh in 1998, which grew to 28 lakh [ITU] in 1999. However, even this ridiculously low number did not prevent many entrepreneurs from riding the internet wave.

This was the age of much optimism and many dreams mainly supported by the developments in the US, and some of the marquee internet companies that we know today were founded during this period [Zoho, 1996]. Most of the internet entrepreneurs who are household names today left their well-paying jobs in India and the US and took a plunge into entrepreneurship during this period. If my dates are right, the biggest event of this period was certainly the selling of IndiaOne to Satyam for an eye-popping 115 million dollars in 1999.

Phase 1: 2000-2007

If 1999 was the year of Y2K opportunity for the software industry, 2000 was the year of the biggest challenge, the dotcom bust, for the infant Indian internet industry. Valuations plummeted for many companies, investors withdrew, and it was predicted that consumer internet business is never going to be able to stand on its feet.

Our first phase starts dramatically this year. Data shows India had 55 lakh internet users this year. In spite of the crisis, business internet users had almost doubled from the previous year: users had faith in the medium as did the founders, only the investors had withdrawn. This was also the year when the government foresaw the general potential of IT and the internet and passed the Information Technology Act 2000 to provide some guidance and some protection for the emerging technology services and consumer internet business. This proved to be an early encouragement to many businesses.

From the business point of view, this was the period of heroic survival and growth of some of the most famous consumer internet companies in India such as InfoEdge [Naukri.com], JustDial.com, IndianMart.com, Bharatmatrimony.com, shaadi.com, Rediff.com, Indiatimes.com among others. Use cases and business cases were limited to media, classifieds, and listings. Google made its bashful appearance in India in 2004 with five employees, Jobsahead.com was sold to Monster.com and Facebook became available in India in 2006. Towards the end of this period two very ambitious companies put their hats in the ring: FlipKart and Myntra (founded in 2007). In 2007, India's internet users reached 4.2 crore covering nearly 3.5% of the population.

Phase 2: 2008-2013

The next phase of the internet becoming a mass media began with another crisis – the global financial crisis, which began as a subprime crisis and had a domino

> Internet, which was for a very long time thought to be a "toy" for the rich kids in India, started in the relatively poor Lakshmi Nagar Exchange.

effect on all sectors including digital. This was also the period when the internet in India actually took off. According to Mary Meeker's report of 2011, India added 69 million new users between 2008 and 2011, exactly the period when the impact of the global financial crisis was the deepest!

Four powerful developments account for this. First, in 2008, by now quite outdated, the IT Act was amended to include a clear "safe harbour" provision for "intermediaries. This in turn allowed many Indian companies to offer new services to internet users. The second development was the introduction of 3G in December 2008 by the state-owned BSNL. This in turn ushered in the period of smartphones, solving the biggest problem of lack of "user end device". The lack of PC penetration was one of the major impediments to the growth of the internet.

The third factor was that for the first-time government actually got into rural internet access "business" by announcing the formation of Common Service Centres in rural India in July 2009. On 1 January 2011, the Ministry of Communications and Information Technology published a white paper titled "Saaransh: A Compendium of Mission Mode Projects under NEGP" signalling the government's arrival into providing digital governance at the doorsteps of the citizens.

The fourth and final factor was the passing of the Payments and Settlement Act in 2008 which promoted digital payments and allowed RBI to make rules under the act to regulate the industry. For the Indian tech startups, this was the period of experimentation and diversification. Startups offering exciting new services such as PayTM, Razorpay, Policybazar.com, Zomato, Ola, Nyaka and Toppr among many others were founded during this period. At the end of 2013 over 19.3 crore Indians or 21% of the population was using the internet.

Phase 3: 2014-2019

The last period thankfully did not start with a crisis. It started with an event that genuinely led to the internet becoming a mass movement. The run-up to the general elections of 2014 brought one of the world's greatest democratic exercises very close to the internet. Some people wrongly give credit only to social media overlooking the fact that an entire gamut of digital instruments from email, SMS, virtual projection, phone calls were extensively used in the campaign. It was a lucky day for the internet as the party that had put the highest stakes on digital won the day. It was as if the internet had gained the faith of the last non-believer, the political class.

On 7 February 2014, the soon to be Prime Minister of India shared for the first time his dream of Digital India at the India Digital Summit organized by IAMAI. On 1 July 2015, the Prime Minister launched the Digital India initiative. The top four pillars of the initiative were: broadband highways; universal access to mobile connectivity; public internet access programme; e-governance; and e-Kranti.

On 15 August 2014, the Prime Minister announced the JAM project of connecting bank accounts with mobile phones through Aadhar. Two visionary initiatives geared to take the internet to the masses and integrate it with governance and delivery of government services. In a way, this was the period when the internet in India had its biggest and best use cases – governance and delivery of public services. This was also a clear signal to the digital startup ecosystem and investors to go for the big game.

The number of private equity and venture deals went up from 253 to 610 between 2014 and 2019. The most important development during this period from the connectivity standpoint was the commercial launch of Jio 4G services on 5 September 2015. In May 2018 Walmart announced its intention of buying 77% controlling stake in FlipKart. e-Governance, e-connectivity, and e-business were happening at a scale and speed that amazed even many of the participants in the process.

> Between 2015 and 2019 the number of internet users grew from 30.2 crore to 63.6 crore; a whopping increase of 33 crore in four years.

According to reports, at the end of 2019 India had 40,000 active startups, 33,000 registered with DPIIT, 31 Unicorns with a valuation of nearly 115 billion dollars [let that sink in] and 58 Soonicorns [soon to be Unicorns] which had collectively raised 9.4 billion dollars. Between 2015 and 2019 the number of internet users grew from 30.2 crore to 63.6 crore; a whopping increase of 33 crore in four years. Of course, the flip side of a bigger internet market, larger investments in digital business, and a deeper involvement of the government led to a fierce reaction from incumbents; rough competition among digital companies; a shift from providing access to control data; and multiple agencies making rules regulations for internet businesses.

The pandemic and beyond

In 2020 as I write this, we are in the middle of a crisis in the form of the global pandemic. India also faces a national security threat from a belligerent neighbour. The immediate opportunities for digital as the only option and lesser competition to Indian startups are not lost on anyone. In fact, at first glance, this is the mother of all opportunities for the entire digital ecosystem in India. But we need to take a long second look at the following basic challenges to the ecosystem.

- According to various estimates, India has between 700-800 million people who do not have internet connectivity. These fellow citizens either cannot afford to or have not seen any benefits of the medium.
- Although number three in the world, our startup ecosystem and its funding is broken primarily due to the overhang of laws made for traditional sectors and for lack of RoI to big investors.
- Government's activism for regulations means the high possibility of making laws for new business models that are still emerging. This is likely to nip these businesses in the bud.
- Large scale sudden disruptions are likely to lead to social unrest since there is not much trust that digital can deliver. In September 2020, however, the entire country seems to repose its hope on digital.

I hope the digital ecosystem is able to live up to it.

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AMAN SINGH

BIJLI, PANI, INTERNET

Despite steep growth in the number of internet users, India still has 670 million unconnected people. "Internet for All" should be the next big target

Yesterday's news was consumed over a cup of tea in the morning, maps were still printed on paper, long-distance calls were made only to convey news of a wedding or a death in the family and cameras were what you took with you on a vacation. YOLO and FOMO were not yet words. If, you went to sleep around the time of the millennium bug and like Rip Van Winkle, have just woken up after twenty years, you are unlikely to recognize India.

Almost nothing has been left untouched by the internet. The way we learn, interact with people, buy rail tickets, decide our driving route, order food, watch movies, pay bills, shop, and even how we troll and insult people – everything has been transmogrified. The internet has transformed governance – empowering people with information. It has given wings to micro-entrepreneurs and start-ups with access to markets and financial services. It has also created scores of internet billionaires. And social media, the internet on steroids, has consumed almost everyone who is online.

Like with any other powerful tool, the internet too has its underbelly – it has given us deepfakes, cybercrime, and the dark web. It has caused the death of children obsessing over online games. It may have made the world a little more insular. It has most certainly led to mental health and self-esteem issues from the endless barrage of others' happiness being chronicled on social media. Some have to resort to social media de-addiction and digital detox.

All things considered, the internet has been a godsend. And from the days of the long waiting periods for the status symbol called a phone which went dead every time it so much as drizzled, to being abreast of the world in telecom technology, we haven't done badly. Depending on whose numbers you have greater faith in among Statista, AIMAI, and TRAI, there are between 500 and 700 million broadband subscribers in India.

The general agreement is that roughly one in two people in India have access to the internet. According to TRAI, by March 2020, over 670 million people had access to the internet – a phenomenal growth rate particularly over the last four years; over 40% annually compounded. At 11 GB per month, we are each consuming thrice as much data as the average American! Half of our internet users are now in rural India. 54% of India's internet users are in the 20 to 39 age group. And there are more than 210 million women internet users in India.

That India now has the second-largest number of internet users in the world may be worth celebrating, but it only underscores the irony of having the highest number of the unconnected – 670 million people in India have no access. In a familiar India versus Bharat story, while three in four urban Indians have access to the internet, only one in three has access to it in our villages. Only one in three women has access. And the poor and the old have little or no access. The odds are heavily stacked against the poor, middle-aged, rural woman. Access is hugely skewed.

This is where a futuristic and timely programme of the previous Chhattisgarh Government deserves a mention. Realizing this obvious disadvantage that rural women in general faced, it decided to embark on a path of correction. As it studied data around access, affordability, and ownership, it was clear that another major cause of inequity in access was attributable to the low population

> In a familiar India versus Bharat story, while three in four urban Indians have access to the internet, only one in three villagers have access to it.

density of India's tribal hinterland. Bastar was unlikely to have access to a mobile network because the population density of the area is 64 (for perspective, India's is 382, UP's is 690 and West Bengal's is 1,028).

Since the telecom service providers (TSP) measure profitability per tower, it was never going to be viable to bring the deep innards of central India into the mobile network. In what is an example of evidence-based policy design, Chhattisgarh came up with a brilliant intervention. It distributed 30 lakh entry-level 4G smartphones, along with a SIM each to the female heads of rural households. In return, it got the TSP to extend the network to unserved and underserved areas of the state at their own expense. In one bold stroke, they addressed the issues of access to the network, quality of service, and empowerment of women. The plight of the average rural Chhattisgarhi would have been much worse during the severe COVID-induced lockdown, had it not been for Sanchar Kranti Yojana.

Access to the internet is as fundamental to life today as access to electricity and water. Irrespective of the political dimensions, any step towards access facilitated by the government cannot be dole. Without state intervention, mobile and internet saturation in Chhattisgarh may have taken an estimated 30 years. By injecting a 10% increase in mobile broadband penetration, the government altered the internet penetration growth trajectory.

During the COVID nightmare, stranded migrant workers saw money appearing in their ravaged Jan Dhan Accounts, forms to travel home got filled online and DBT for various schemes are all miracles of the internet.

Access to the internet as a driver of economic growth is an established fact. As per a December 2018 paper by Rajat Kathuria et al at the Indian Council for Research on International Economic Relations (ICRIER), a 10% increase in internet subscribers results in a 3.1% growth of a state's GDP. This impact of a 10% increase in penetration was estimated at 1.1% in 2010 and 2.4% in 2016.

There is a scramble for taking internet broadband to the hard-to-reach corners of the pale blue dot. SpaceX, OneWeb, Iridium, LeoSat, and O3b are just some of the companies that plan to offer internet everywhere via satellites. There are also several non-satellite technologies that are attempting to occupy this space. Companies like Google, Facebook, and Airbus have interests in high-altitude balloons and solar-powered drones as a means of providing internet access to the last three billion. They could ensure availability, but affordability is another thing altogether. The state will continue to have a role in this fundamental service.

It took a pandemic for the digital divide to stare us in the face. We could no longer bury our heads in our 4G smartphones, watch the latest forwarded WhatsApp video and pretend that the most confounding questions of our times were whether IPL would happen this year and how the stock market would perform in the COVID aftermath. We cannot even begin to imagine what life would have been like if COVID had reared its ugly head even ten years ago instead of now – it would have been devastating.

'WFH' was not an understood abbreviation. It was what only some nerdy software developers could sometimes have the luxury of doing. But for many communities in remote areas of our country, particularly in central India and in the north-east, it was a painful experience to be telegraphically off the map while also being physically cut off during the lockdowns. It was akin to being deprived of a fundamental right.

Now, we still do not know when the children in our schools and colleges will go back to class. But we do know that the technology of today can alleviate the pain provided the digital divide is bridged. The Ministry of HRD had recently projected to the 15th Finance Commission that it would allocate Rs 60,000 crore over the next five years for buying four crore digital devices for higher education students. That is a step in the right direction but will fetch greater results if combined with a concerted

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strategy to bring the unserved nooks and crannies into the digital mainstream.

It is no coincidence that these network dark spots have a high degree of overlap with the Fifth and Sixth Schedule areas, also a case of resource curse since these are our most mineral-rich lands. The low population density of these parts has not helped these tribal communities either. Digital parity can do more to empower our most vulnerable than anything else. Ironically, digital inequity will not just leave them further behind but possibly permanently marginalized. COVID-19 is an opportunity to leapfrog masquerading as a challenge.

The Universal Service Obligation Fund (USOF) was set up in 2002 with the objective of providing 'non-discriminatory access to quality ICT services at affordable prices to people in rural and remote areas'. More urgent and vigorous implementation of its objectives and speedy utilization of the funds available to it will ensure that the communities in remote, hilly, and forested areas get on to the grid soon. Funded by USOF, BSNL erected 146 2G cell towers over three years in Chhattisgarh. Sanchar Kranti Yojana managed to get over 950 4G sites in rural Chhattisgarh in just under a year.

BharatNet's objective is to take broadband to every Gram Panchayat. This is a little like the village electrification definition used in India earlier. To correct this, the Government's Saubhagya scheme was launched in 2017, with the objective of ensuring last mile connectivity and electricity connections to not only all remaining unelectrified villages but to every household for achieving universal household electrification under which 2.6 crore households were covered in just two years. Now this Government is implementing Jal Jeevan Mission in a similar mission mode, providing water connections along with a tap inside the house to every household so they can live with dignity.

The next target needs to be universalization of the internet by launching a mission 'Internet for All'. Sanchar Kranti Yojana was just one strategy. The approaches that work for different states may vary widely, but every government needs to examine how they can bring our poorer half into the digital mainstream. Faraday, Edison, and Tesla could have scarcely imagined that electricity would change the world the way it did.

We can no longer ignore those for whom data on tap is still a distant dream. It will have to be bijli, pani, and internet. Government spending on any strategy to fund internet infrastructure will serve the added purpose of spurring demand by driving private investment during these COVID times. It would be a shame to waste such a crisis.

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AMITABH SINGHAL

WORLD WIDE WEB MAGIC

Internet is one of the very few General Purpose Technologies in the history of mankind, with the capability to alter societies and their economic and social structures

The internet is 25 years old in India. Well, yes and no! Yes, because the first commercial internet access service became available from 15 August 1995, to the general public by VSNL, a government overseas communication monopoly company those days. No, because, the internet, as it existed then, was being used by a select few in a handful of scientific and educational institution networks and technical community folks from a few years prior to 1995. To that extent internet in India is older by a few years more than 25 years.

A few folks like us, at the then newly formed Email and Internet Service Providers Association, whose initial 5-6 member companies had begun to provide India's first licensed email services and were setting up the initial private data networks approached the Chairman of Telecom Commission sometime in 1994-95, to formally allow us to offer internet services by leveraging our growing email networks.

That request to offer internet services was rejected on the grounds of uncertain security issues and likely societal implications. Meanwhile, VSNL launched its internet services in 1995. And then it took another three years of hectic advocacy and lobbying before private companies were permitted in November 1998 to start providing internet access services.

> Between 1995 and 1998, before privatization, the number of internet users was under 200,000. This was insignificant enough to matter socially and economically.

In the meantime, there was an abortive attempt by DoT to announce some form of an ISP Licenses earlier in January 1998 – I did my bit in stopping that and intervened by re-writing a new ISP license with more acceptable terms. I mention this because people must know that the policy concessions we obtained and other interventions we made, resulted in some critical internet infrastructure investments and reforms, which matter greatly in calculating sectoral contributions to the GDP growth of any country.

These reforms that we pushed (telcos then used to oppose them) also set the foundations for the continuous growth of the internet in the country.

The trajectory of internet: 1995 onwards

Between 1995 and 1998, before privatization, the number of internet users was under 200,000. This was insignificant enough to matter socially and economically.

Almost immediately after opening up of the sector in November 1998, hundreds of new ISPs entered the scene, fuelling fierce competition and offering attractive, unheard of before service plans, including free access. This led to the birth of a completely new service industry.

Internet demand spiraled and user numbers grew pretty quickly. By the end of 2000, there were 3.6 million users. The number swelled to 6.7 million by 2005 and tripled to 18.9 million by the end of 2010 (see: India's rising internet trajectory).

There were two major developments that followed. By early 2000, high-speed internet (< 256kbps) became the norm and broadband was almost on the horizon, and by mid-2000, feature phones came with improved data capabilities and started to become affordable (remember the 2004 Monsoon Hungama, which put mobiles in the hands of even economically poor people).

We reached a critical inflection point, between mid to the later parts of the first decade of 2000. Internet, broadband, and mobile integrated, and uptake surged. The Indian communications growth story started to mature, leaving impactful marks on the social fabric and economic output of the country. This high impact story continues to grow.

Driving country's economic growth

In the last couple of decades or so, the internet's ubiquitous role in digitalizing almost every aspect of our lives, activities, and business is amply obvious. Using any model or technique, all research and studies have conclusively established the co-relation between the increase in internet usage and its contribution to the economic outputs of any country.

In simple terms, it's the Network Effect at play, described as, phenomenon where the value of a good or service increase in a certain proportion relative to the number of users. And the internet is a classic example. As the internet grows, infrastructures get laid, more content, information and services get enabled, and additional jobs are created.

An ITU study indicated that once the critical mass level is reached, telecommunication and broadband investment has a larger impact on economic growth per dollar of investment than other types of infrastructure investment because telecommunication infrastructure exhibits network effects.

A Telenor-BCG 2009 study report conducted in three countries (not India), essentially captured both supply and demand-side dimensions of internet usage. The study theorized: "Internet service is a capital good that enables increased production across the economy".

The demand side impact was found in productivity improvement and new business activity. The report suggests that a 10 percentage point increase in internet penetration is correlated with a 1% increase in the annual rate of new business formation. Similarly, the report highlights that the supply side impact was on infrastructure investment, employment generation, tax revenues, besides other direct/indirect benefits.

> By 2015-16, there was a 17% increase in internet traffic which contributed to an increase of Rs 7 lakh crore, nearly USD 110 billion, or 5.6% of India's GDP.

The demand side impact captures the benefits of businesses using the internet, while the supply-side impact measures the GDP contribution of the activities that are undertaken to produce or consume internet services.

The report, The Economic Contribution of Broadband, Digitization and ICT Regulations, published by ITU in 2018 tested and established that an increase of 1% in fixed broadband penetration yields an increase in 0.08% in GDP, while an increase of 1% in mobile broadband penetration yields an increase in 0.15% in GDP.

It also indicated that the economic impact of digitization on GDP growth and productivity is higher than the one found for fixed broadband and similar to mobile broadband; digitization being the whole digital eco-system, taking into account broadband networks, devices ecosystem, software and applications development, and effects from their use on government services, e-commerce, social networks, and online information channels.

The report indicated that an increase of 1% in the digital ecosystem development index results in a 0.13% growth in GDP per capita. It also highlighted that ICT Regulations impacts the overall economic output (I am not getting into the granular nuances of saturation and scale effects, country status and other numerous variables and numbers, etc).

The numbers tell it all

Multiple published studies and reports indicate that up till 2008, the internet created 5% of GDP in India, whereas in 2009 alone, its contribution was 3.2%. It then grew to 5.6% and 8% respectively in 2015-16 and 2017-18 and could potentially be as high as 16% in 2020 (remains to be seen).

While a McKinsey report in 2011 points out that during 2004-2009 the internet added 5% to India's GDP was, the BCG-IAMAI report indicates that in 2013, the internet contributed 2.7% of India's GDP. Similarly, an ICRIER and BIF report highlighted that by 2015-16 an increase of 17% internet traffic contributed to an increase of Rs 7 lakh crore, nearly USD 110 billion, or 5.6% of India's GDP.

According to McKinsey Global Institute, in 2017–18 the internet accounted for 8% of nominal GDP, or about USD 200 billion, according to estimates of MGI released in early 2019. The report mentioned that most of this value – nearly USD 170 billion – came from the core sectors that already provide digital products and services at scale, including IT and business process management (USD 115 billion), digital communication services, including telecommunications (USD 45 billion), and

INDIA'S RISING INTERNET TRAJECTORY

End of Year	Internet Subs base (millions)	Nominal GDP (USD billion)	GDP Per capita
2000	3.610 (approx)	468.39	443
2003	4.138	607.7	547
2004	5.45	709.15	628
2005	6.703	820.38	715
2010	18.69 + Mobile Data Subs*	1675.62	1358
2015	331.66**	2103.59	1606
2016	391.5	2294.8	1733
2017	445.96	2652.75	1982
2018	604.21	2713.17	2006
2019	718.74	2875.14	2104

**TRAI reported Internet/Broadband & 337 million+ Mobile Data Subscribers*

*** Till the end Dec 2012, TRAI reported the Internet/ Broadband subscribers at 25+ million and subsequently from 2013 March-end, the base of total internet subscribers jumped to 164.8 million with the change in reporting methodology.*

Note: 99% of the internet is accessed over mobile phones of which 58% is via mobile broadband

> In the 25 years we have made rapid strides in diffusing the GPT that has contributed vastly to the country's economic growth and has helped achieve the SDG objectives.

electronics manufacturing, including mobile handsets (USD 10 billion). The remaining value comes from early scaling of newly digitizing sectors and applications like e-commerce and direct benefit transfers.

Going forward, ICRIER-BIF suggests that by 2020, this contribution is expected to grow to 16% or Rs 36 lakh crore, half of which will be driven by apps. The study predicts that the internet economy could contribute up to USD 537.4 billion to India's GDP in 2020, of which a minimum of UD 270.9 billion would come from the fast-growing mobile application sector.

According to IAMAI-BCG estimate, by 2020 the internet's contribution would grow to over 4% of India's GDP – up from the 2.7% in 2013. MGI, on the other hand, predicts that core digital sector already constitute a large and growing portion of India's economy and could alone contribute between USD 355 to 435 billion to the country's GDP in 2025.

A data-driven economy in the making

The impact of internet as a General Purpose Technology (GPT) is definitively reflected across all business segments such as manufacturing and services, including financial services, agriculture, logistics, education, healthcare, government services, retail, energy, aviation, online media, and entertainment.

Firstly, India is the second-largest telecommunications market in the world with 1.2 billion connections. While 98% of the 21-million internet subscribers are mobile internet users, 2% have fixed-line connection. Mobile broadband, with nearly 720 million internet users already, is set to grow to one billion in the near term. Hence, India is undoubtedly becoming a mobile broadband heavy territory that is extremely data-rich.

Secondly, in terms of digitization, defined as a holistic digital eco-system, which drive economic activities and output higher than broadband or on par with mobile

The internet has proven to bring the maximum benefits in less developed territories, helping address priority social issues amongst marginalized communities and rural areas.

Education: Providing enhanced accessibility and improved quality of teaching tools and methods, across age and gender.

Healthcare: Through telemedicine to improve the healthcare of people, as well as that of cattle and livestock.

Inclusive Development: Providing access to information and rights, skills-based training, disaster management applications, and updates on the latest agricultural practices.

India seems to be in sync with the ITU/ Katz modelling, checking the boxes fairly well during the period 2001-18.

10% mobile penetration increased economic output by 1.9 %.

10% increase in internet subscribers increased states GDP by 3.2 %.

Between 2013 and 2018, a 10% increase in internet traffic added 3.1% to GDP per capita compared to mobile traffic that added only 1.6% to GDP.

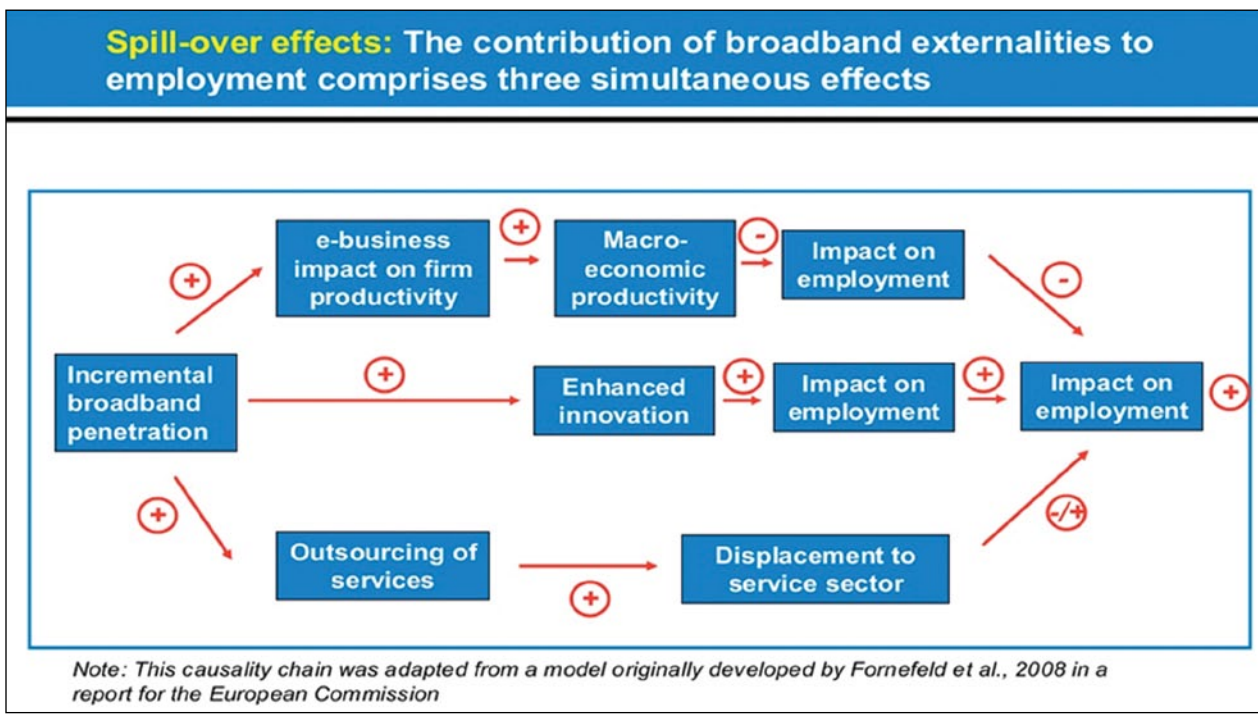
Overall investment in telecom infrastructure during 2010-2018 added 3.3% to India's GDP.

Source: ICRIER Report, 2018

> The internet is a classic example of Network Effect at play. As the internet grows, infrastructures get laid, more content, information and services get enabled, and additional jobs are created.

broadband, some numbers as under are significantly impressive.

- There are 550 million smartphones, set to grow to 820 million by 2022, and around 350 million are feature phones and are increasingly affordable to more people.
- Indians averaged the highest data use, compared to anywhere else globally, consuming 10.4 Gb of data per subscriber monthly. Expected to become 18 Gb.
- India is the fastest growing applications market at 19 billion downloads in 2019.
- A good number of these applications are in different Indian languages.
- High usage is driven by the lowest data rates at approx. 13 US cents per Gb/month.
- Over 270 manufacturing units are targeting to produce 1 billion mobile units by 2025.
- Web hosting and domain services have been growing at 4.6% per annum as well.
- E-commerce market is forecasted to touch USD 64 billion in 2020, while the domestic IT-BPM market is expected to cross USD 44 billion in the year.
- Over 1.23 billion Aadhar cards issued to citizens till now.
- Under various e-Governance services, over 8,919 crore e-transactions were recorded since its inception till December 2018 (as per MeiTY).
- Digital payments eco-system has touched billions of dollars in transaction per month.



Courtesy: Extracted from a PPT by Prof. Raul L. Katz; 2014.

All of the above go to show how India has been digitizing rapidly, with the use of smartphones and connected devices growing exponentially, rising use of apps, and digital services, booming e-commerce, Digital India initiatives for e-governance, and social networks.

Thirdly, ICT Regulations developed over the years have played a positive role in impacting the economic output as well over the last 25 years as well.

The first National Telecom Policy came in 1994, then in 1999, and 2012. Similarly, the government brought in the Broadband Policy in 2004, National Digital Communications Policy (NDCP) in 2018, National Broadband Mission in 2019, Cyber Security Policy, and Policy on National Electronics, to name a few.

In between, there has been a slew of regulatory directions and programs/schemes such as Digital India with its nine pillars and Government e-Marketplace to stimulate different dimensions of sectoral competition, investments, and growth. In fact, the government envisages spending of USD 100 billion in telecom infrastructure under the NDCP 2018, which according to ICRIER, has the potential to add USD 1.21 trillion output to the economy.

Fourthly, ITU's Katz model refers to the "Spill Over Effects", which broadly states that a 10% increase in digitization results in a reduction of unemployment by almost 82 basis points (0.82%), as also increase of monthly income levels, and contributes to poverty reduction via improved skills and productivity. The Mckinsey Global Institute in its 2019 report stated that the core digital sectors will contribute up to USD 435 billion to the economy and help add 65 million new jobs.

Societal Impact: Benefits needs to seep deeper

In 25 years, India has nearly 720 million Internet users. That's only about 55% of the population with access. Urban/Rural Divide has for long been a matter of concern. The latest data (from TRAI) indicates that over 37% of internet subscribers are from rural areas, compared to about 62% of urban population who have internet access, whereas, in terms of mobile subscribers, the ratio is far better at 44% rural to 56% urban.

Basically, the gap is still high for the internet but narrowing for mobile penetration. A big cause for worry is that nearly 63% of the rural population still remains unconnected. While universally, the rural population almost always lags behind, compared to urban connectivity it's been a challenge for policymakers and practitioners. Despite several intervention mechanisms such as Universal Service Obligations, Common Service Center, BharatNet, rural Wi-Fi and such initiatives, connectivity and services have been taking their own languid pace to effectively penetrate the rural population deeply.

Government and the Regulators with their policies and frameworks, plans for public spending on rural communications infrastructure, and the public and private sector ISPs/Telco's investments in expanding the networks, services and digitization receives due attention as we have seen above.

In the 25 years, since the internet first came to Indian people, we have made rapid strides in diffusing, what is now a General Purpose Technology that has proven its mettle in vastly contributing to the growth of India's economy, as also helping to achieve the Sustainable Development Goals.

Going further, the humongous amounts of data, that we are consuming and generating has spurred the development of relatively newer technologies like the internet of things and artificial intelligence. They are already making a mark and expected to further enhance our human and economic capacities. By 2025, India is aiming to take a 5-6% share of the USD 1 trillion IoT revenues, as also expecting AI to add USD 400-500 billion to our GDP.

So far, so good.

However, despite high numbers on most parameters, we still have about 45% of the population virtually unconnected (63% of the rural population lacks it and about 38% of the urban population lacks. It poses both a challenge and of course a vast opportunity in waiting.

Some obstacles and barriers that need consideration include, negligible fixed-line, end-user affordability with respect to purchasing power, Common Service Centers and BharatNet's delayed targets, quality of service and bandwidth speed issues, 5G delays, high tax/levy regime.

Lastly, what concerns me is the reduced competition with only four big operators serving a population of nearly 1.3 billion people could be an issue.

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RISE OF THE DATA NETWORKS

While the internet had a critical role in accelerating India's economic growth, the penetration of mobile internet is now driving its own life-altering revolution

The internet is the digital highway, which like the railroad and highway connects people, places, and entities. While road took thousands of years to graduate from dirt to tar and cement to help increase the speed of vehicles, the railroad took a hundred years to migrate from coal to diesel to electricity. Internet, on the other hand, has taken just two decades to grow from Kbps to Gbps and more. Unlike road and rail, the throughput of internet has also seen an exponential increase and it requires less space and is less capital intensive.

This has enabled the developing world to move fast and catch up with the rest of the world. In the last 25 years of its existence in India, the internet has changed the way we read, work, play, and entertain.

The high-paced technological advancement has ensured a constant reduction of per-unit cost (Rupees per GB of data) making it possible for the governments to use in a big way for the empowerment of people. Ubiquitous access to fast, two-way communication has transformed the way we interact, learn, meet, get entertained, and live our life.

This information highway has been used in a big way to deliver business-to-consumer (B2C) services, government-to-citizen services (G2C) and it has become a big enabler for improving the lives of the least privileged in sectors like education, health, and women empowerment.

Lockdown and partial unlock brought to focus on how people started using the internet to buy goods and services from the comfort of their homes. This is an example of a B2C service delivery. This empowerment was not one way, i.e, citizen to sellers, but also the other way round. The producers of goods and services are vying with each other to reach the target buyers on their mobile in the most innovative ways.

In the last two decades, we have seen how access to government services has improved. The government first started this by bringing in various service delivery departments and agencies in one place and making the operation time longer, including on weekends, to ensure that people can avail of these services at their own convenience without any need of taking leave to pay a bill or get a certificate. E-seva, Friends, Sukhmani, etc. are few names of such centralized e-service delivery vehicles that have been possible, thanks to the internet. Higher internet speed coupled with better and cheaper computers/tablets/phones and mobile-based applications have made many of these services available 24X7 to the confines of our homes. This was the second level of empowerment.

The next level of internet-driven empowerment has been enabled by the micro-blogging sites – social media. A tweet by a citizen has the potential to make government machinery think and act in a certain way, which was unheard of in the pre-social media age. This is a revolutionary change as the new tool has empowered the citizen in a big way, improving access to authority. Our former minister of external affairs was known to provide immediate relief to people seeking her help on Twitter.

This empowerment is not limited to government space but also to consumer services. In the pre-internet era, individual buyers had little or no way of communicating with anyone higher up the corporate chain of command. Now, in the post-internet era, anyone with Twitter or Facebook account can tag the company on shoddy services and goods. Dominant companies that earlier used to give two hoots to consumers are now bending backwards to remedy an aggrieved and dissatisfied customer.

With the internet becoming accessible to more and more people every year, its role as an agent of change

> Nobody, not even the earliest pioneers of the internet could have envisioned just how drastically it would transform the shape of human existence.

and empowerment has grown bigger. The internet has provided a space for marginalized communities to voice their opinions, express their identities, and run businesses and movements.

Let us now see how the Internet has empowered women. The increasing number of e-commerce sites trading indigenous arts and crafts, show the potential of using the Internet for income generation. For example, the Self-Employed Women's Association (SEWA) – a membership organization of 250,000 self-employed women, with approximately 35,000 members from scheduled tribes have successfully started trading their arts and crafts on the web.

SEWA is demonstrating that in cases where local communities are being represented through an effective community-based membership organization, and the technology is being owned by the groups themselves, the internet can make an important contribution in improving the livelihoods of local communities.

Delivery of health services remotely was seen as tech mumbo-jumbo till the COVID-19 pandemic set in. During the last four months, remote delivery of primary health services has picked up in a big way. Coupled with affordable data charges and mobile, the poor and disadvantaged living in remote areas are able to access primary health services through teleconsultation. The availability of digital stethoscope, blood pressure instruments, and app on mobile to conduct simple tests has enabled medical professionals to provide the first level of health services to remote locations.

Delivery of education through the internet was largely limited to the higher education sector or training of people in tech areas. Once again, closure of schools due to the COVID-19 outbreak led to the delivery of classroom instructions through the internet. However, it has its own challenges in terms of managing a class of 40 to 50 students, especially of primary or middle schools. The other challenge has been the delivery of content on small screen devices such as mobile phones where reading becomes very difficult. Nevertheless, digital classrooms ensured that the lockdown period, which would have otherwise passed without any activity, could at least be utilized for education.

While discussing the topic of empowerment through the internet, one also needs to see how certain constraints may lead to this tool working in the opposite direction. Under the right conditions, the internet along with digital technologies can contribute to achieving the targets set out in the Sustainable Development Goals (SDG) by fostering economic growth, improving governance, and delivering better outcomes in education and health.

However, technology is a double-edged sword that can also amplify social, economic, and political inequalities. The poor citizens, especially women and marginalized communities will be the worst affected if the access gets limited or expensive. This is being seen in many developing economies, leading to further widening the gulf. The government and civil society not only need to enable equitable access, they also need to help such groups in acquiring skills to use digital tools. If not done, this will further entrench the wage gaps and these groups will get further marginalized as more employment opportunities and jobs move online.

The road ahead should be to ensure taking the information highway to every village. Today, over four lakh of the total 6.5 lakh villages are yet to get high-speed internet through fibre. Besides, there is a need to ensure that the poorer sections of society get adequate training opportunity to develop the required skills to use digital tools.

Making available content in the local language is another area which needs to be given due attention. Last, but not least, encouraging local companies to come up with applications and solutions suiting needs of our people rather than allowing ever-increasing colonization by large companies from other countries who have a virtual monopoly in many areas.

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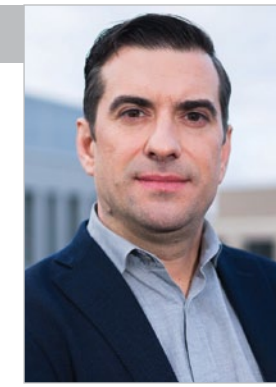

THE PAST, PRESENT, AND FUTURE

The internet is already changing people's lives. Twenty-five years from now it will be considered a basic human need that must be provided to all

Since its inception, the internet has revolutionized the history of communication across the globe. Far from the early days of screeching modems and extremely long wait times, the internet has become ubiquitous, wireless, easy to use, and accessible while you're on the move. It is a tool that delivers the information and the content we want almost instantaneously. It has enhanced society's capability for learning and sharing knowledge.

The enormous number of 4.57 billion people – which makes up for 59% of the global population – use the internet today. It has connected the world and transformed it into a global community, while also driving breakdown of social and economic boundaries. India, in particular, has overtaken Japan, Russia, and the US and is the second-largest growing internet economy in the world after China.

At the beginning of internet technology, there was the landline telephone. Screeches, squeaks, and white noise told the early internet user that they were getting connected. The early public internet was built on telephone networks that were slow and expensive. The foundations of the internet in India were laid down in 1986, through the Education and Research Network (Ernet) Project.

Launched by the union government with funding from the UN Development Programme, Ernet was initially responsible for aiding research and development activities across eight institutions. A decade later, on 14 August 1995, commercial internet services were rolled out by the state-owned Videsh Sanchar Nigam Ltd (the official launch was on 15 August 1995).

Carriers or network operators globally laid the internet backbone on land and even began investing in the more expensive, but more efficient fibre-optic cable technology, which could transport signals considerably further, meaning that data could be transported over long distances more reliably. Much later on, the broadband-enabled telephone companies to offer phone calls and internet access, and the internet became silent.

Besides building the internet backbone on land, over the last several decades', consortiums have joined to lay cable undersea – connecting regions, nations, continents, and over time, everything in between – and thus creating the global infrastructure for modern communications. From this point in the connectivity value chain, internet service providers needed to interconnect their networks to exchange data.

The very first Internet Exchanges, bringing together in each case a handful of networks, were founded in the US in the early nineties, followed by several in Europe, including DE-CIX in Frankfurt, in the mid-nineties. It quickly became clear that Internet Exchanges were a crucial junction for improving performance and user experience for the networks, as the interconnection through a hub reduces latency and therefore significantly speeds up reaction and load times. This concept and its importance are still relevant today, where Internet Exchanges remain vital for providing end-users with seamless high-speed connectivity.

> At the beginning of internet technology, there was the landline telephone. Screeches, squeaks, and white noise told the early internet user that they were getting connected.

In the early days, the standard connection at our Internet Exchanges in Frankfurt was a 10 Mbit/s line via Ethernet. This has now increased ten-thousand fold to 100 Gbit/s in Frankfurt and most of our locations around the world. Today, it's even possible to connect via a massive 400 Gbit/s port.

As the digital economy began to take shape, the need to speed up the delivery of web pages and other content led to the formation of a new type of network in the late nineties – the content delivery network – in order to bring content as close to the internet user as possible.

The next major evolutionary step in the development of the networks that forms the internet was the beginning of mobile internet. The smartphone led to an enormous uptake in internet services while on the move, which in turn led to increased demand for the mobile companies and their terrestrial networks, as also the CDNs that providing the content, the ISPs and carriers tasked with transporting the data, and of course the Internet Exchanges.

As users became increasingly mobile, using small devices with limited storage capacity, the next evolutionary step in the history of networks became necessary: the beginning of the cloud era. With each of these evolutionary steps, the goal of networks was always to minimize latency and optimize the user experience. To achieve this, the networks needed to start building not only higher capacity networks, but also in greater geographical density, and thus began the broadband rollout to bring high-speed internet directly into the building in cities and industrial parks, as well as taking fibre to untapped regional and rural locations.

In many areas of the world, this is an ongoing project involving investment from ISPs and carriers, but also from governments – to offer their companies and citizens access to services which demand high speed, low latency, and reliability.

And now the internet is changing how we communicate, how we do business, and what our expectations are which in turn places new demands on digital infrastructure to take the next steps in the evolution of digital services. Schools are integrating the internet into the learning process because it has an important role in enabling access to information and as a means of communication. In addition to governments, medical services, and financial institutions, even the simplest elements of public life, like entertainment, work, and communication are largely dependent on the internet.

The next disruptive wave on the horizon will be based on 5G, IoT, and AI/ML technologies, which themselves are driven by the internet. Due to the ongoing transformation in digital enterprises, the shift of data and computing processes to the cloud, streaming in increasing resolutions, and new fields of technology such as 5G, artificial intelligence or the internet of things, data traffic is currently increasing at an astonishing rate.

No one can imagine a future without the internet. It is the foundation for all upcoming digitalization processes and is likely to become increasingly globalized with humanity itself getting completely integrated into the World Wide Web.

Twenty-five years from now, the internet itself and technologies based on the internet will be commonplace, and at the same time the DNA of our lives. By then, access to it will be considered a human right and a natural basic need that must be universally provided to every person.

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DR. KESHAB PANDA

TRYST WITH DIGITAL EMPOWERMENT

India is in the middle of a digital transformation that is altering not just our lives, but also businesses and industries in many significant ways

According to a Statista report, internet users in India had reached nearly 700 million as of July 2020. This indicates the massive market for internet services in the country. There has been a steady rise in accessibility compared to just five years ago when the internet penetration rate was about 27%.

It is fascinating to see how the internet has grown in the last twenty-five years – no one could have predicted that it will shape our lives and herald a dramatic change in a relatively short span of time. It has enabled the flow of information: entertainment, financial, and academic. The Internet has been able to bring people closer together via various interpersonal platforms like email, messaging, social networking, and video calling. And with this paradigm shift, a major part of our life has shifted online.

Humble beginnings and the evolution

The Internet in India was introduced in 1986 but was available only to the research community and military. It was made available commercially a quarter of a century ago, via the government-owned Videsh Sanchar Nigam Limited (VSNL) that introduced Indians to the borderless world of the web.

The phenomenal growth of the country in the connected world has been powered by a vibrant young population, an increasingly open economy, a host of government initiatives, consumer spending, and far-reaching vision of entrepreneurs. Such has been the growth that India has sped ahead of nations like the US, the UK, Japan, and South Korea, which got the internet much before. The country now has the second-largest online market, ranked only after China.

Technology of the future

We are in the middle of a transformation that is altering not just our lives, but businesses and industries in very significant ways. From this perspective, here are some key technological developments pivoting on the internet and are set to change the course of the future.

> Internet has brought people closer through messaging and social networking platforms. With this paradigm shift, a major part of our life has shifted online.

- **Internet of Things (IoT):** With the internet becoming mainstream we are also experiencing an IoT boost. Everyday items can now be connected to the web. The seamless interaction shared between a person's phone, earbuds, and smartwatch will expand further in our lives, surrounding us with an environment of data.

- **AR/VR:** Industries like sports, logistics, healthcare, education, manufacturing, and entertainment has changed with Augmented and Virtual Reality (AR/VR) adoption. Many things that may be inaccessible right now are likely to become interactive tomorrow.

- **Gaming:** This is one industry that will become more interactive and the industry will get a whole new immersive experience with the involvement of AR/VR. Multi-player gaming can soon become as popular as outdoor sports.

- **5G and mobile data:** Last but not least we are in the final stages of developing and adopting 5G networks. This leap from 4G will enable India to take a big jump in how it uses the internet. Before 4G became mainstream tasks like video calls and real-time gaming was limited to the home broadband connection. 5G will further implement the web in our daily lives as we adapt to a 24×7 connected approach.

Digital India

In a country where most of the population lives in Tier-III cities and rural areas, most people are isolated and cannot benefit from the country's economic progress. There's a growing need for people in rural India to be part of contemporary Digital India. But the challenge has been a low technology literacy among the rural population and infrastructure.

The need for digital literacy in a country as diverse as India is critical. The Government of India's Digital India initiative aims to make at least one person in every family digitally literate to reap the benefits of advancement in technology. Indeed, technology and connectivity can make a huge difference to the socio-economic levels of a community, and eventually to the country. Hence, there is a need that every individual in the country must be equipped with the necessary skills to use the technology with responsibility.

But this ambitious program to impart digital literacy to India's teeming millions is not without challenges. The digital divide and last-mile connectivity issues in remote areas remain a key challenge. Poor connectivity and lack of Wi-Fi hotspots are also issues which need to be addressed at the earliest. A collaborative effort between the government and the private sector can ensure the availability and accessibility of digital tools to citizens in remote areas.

The journey ahead

It has become clear that over the years the significance of internet usage has grown exponentially. According to a report, the number of internet users is projected to grow to over 974 million by 2025. This estimated increase in urban and rural usage in the next few years indicates a dynamic growth in access to the internet.

Today, no organization can imagine growth and success without digitizing a large part of their business, and India will surely add its own technological flavour and make the internet an engine for a more sustainable socio-economic growth.

But this explosive growth in digital connectivity comes with its own set of risks. Primary among them is the risk posed by cybercriminals. With the proliferation of digital, there has unfortunately been a rise in instances of cybercrime and especially cyber-hacking.

Organizations need to put in place proactive and foolproof measures to guard against malicious hackers. Personal cybersecurity is equally important and individuals accessing the internet must protect their personal information. The journey ahead will be exciting and open new opportunities, but one must also proceed with care.

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MANISH VYAS

FOOD FOR DIGITAL SOULS

Much like electricity that ushered in the industrial revolution, internet has accelerated the knowledge revolution and is transforming India

It was not quite long ago, that the internet revolution started in India. From being accessible to a select few to now being a ubiquitous utility, the penetration of the internet in India is a perfect example of Moore's law at play. It has made the world a smaller place, reduced information asymmetry, and has created livelihoods for millions of people.

It is almost impossible to imagine, the world recovering from a pandemic if it weren't for the internet. The internet has a crucial role to play in striking a balance between global health and safety on one hand and economic activity on the other. The COVID-19 pandemic has led to unprecedented disruptions, not seen or heard of in over a century. Yet many people can work from the safety of their homes and children can study at home, thanks to the internet.

In today's day and age, the internet is the food for our digital souls.

Driving socio-economic, business growth

The Internet has played a pivotal role in the rollout of Aadhar, a key pillar in enabling Digital India. Aadhar has provided a secure identity to 1.3 billion Indians, which in turn helped them open bank accounts, get new mobile connections or gas connections, and offered millions of marginalized citizen access to a plethora of government services. Further, e-governance has brought about much-needed transparency in the lives of citizens. Today, an Indian citizen can get his or her passport in a matter of days as against the long historical wait times. The internet forms the backbone of these services.

The government's Universal Payments Interface (UPI) has helped create the whole ecosystem of digital payments. Riding on internet-enabled platforms, it is now common to see kirana stores accepting payments on platforms such as PhonePe, Paytm, or Google Pay. Farmers are now able to access information on better farming techniques and prices rather than solely relying on middlemen. Millions of people are now booking railway, airline, and bus tickets online avoiding the need to spend time in long queues. Insurance policies are sold and bought online, enabling customers to compare and choose better, with minimum paperwork.

Household items are now becoming smarter – thanks to the use of data and the internet. Music and news are available on-demand via smart speakers like Alexa and Google Home which are powered by the internet. Today, our television sets have evolved to become smart, with all the content of our choice available via applications – all due to the power of the internet.

In the last 25 years, India has moved up from just 10,000 internet users in 1995 to more than 687 million broadband subscribers by March 2020. The startup revolution in India and the world have been fuelled by the advent and proliferation of the internet. The IT Industry, which has propelled the economic growth of our country, thrives as the sector which can deliver world-class products and solutions built in India to the world, thanks to the internet. The whole technology outsourcing business grew because of the internet and is now a significant contributor to the country's Gross Domestic Product (GDP) and job generation. There are numerous examples all around us that illustrate the pivotal role internet has played in transforming our lives. In the days ahead, the importance of the internet as a social and economic enabler will only grow multi-fold.

> Riding on internet-enabled platforms, it is now common to see *kirana* stores accepting payments on platforms such as PhonePe, Paytm, or Google Pay.

The connected revolution of "everything"

Indeed, the internet has been a game-changer for the world. Much like electricity, which ushered in the industrial revolution, the internet has accelerated the knowledge revolution and is now the backbone for digital transformation of banks, manufacturing industries, health care delivery, automation and more.

This brings us to the question of what next? What else does the internet have to offer to lead the next wave of technological disruption?

I believe the answer to this is 5G. What I am excited about is not the high-speed 5G promises to operate on but low latency levels that would come with the technology. With 5G, enterprises around us will be able to offer a host of applications. Connected cars, smart cities, remote diagnosis, and surgery are few applications that will become a reality once 5G becomes as ubiquitous as 4G is today. 5G will accelerate the development of smart cities, lead to improvements in city infrastructure, and enable better and faster responses to emergencies. The next wave of the internet will be a connected revolution of everything.

While we celebrate 25 years of internet in India, we must realize that there are still millions of fellow Indian citizens, who are bereft of the internet. The industry and the government must work together to ensure that no citizen is deprived of access to it.

To reiterate, the future is brimming with opportunities, and the journey of the internet has just begun.

The author Manish Vyas is President, Communications, Media and Entertainment Business, and the CEO, Network Services at Tech Mahindra

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RAKESH GOYAL

UNLOCKING ENTERPRISE GROWTH OPPORTUNITIES

Planning, perseverance, and participation of different stakeholders made the internet one of the most critical pillars of India's growth story

More than two decades ago, VSNL brought the commercial Internet to India. On 15 August 1995, the service rolled out formally, and within six months of the launch, the company had added 10,000 Internet users. However, the unprecedented demand brought to fore the gaps in connectivity and network infrastructure that lead to the poor internet experience.

Faced with a myriad of challenges, the first batch of users across India made their journey to experience the worldwide web with the help of dial-up modems.

Since then, India has made rapid progress towards expanding internet penetration and improving the quality of service. India today boasts of over 500 million active internet users contributing to a sprawling ecosystem. The planning, perseverance, and participation of different stakeholders, including the government authorities and the private sector, has made the internet one of the most critical pillars of India's growth story.

India's journey towards digital transformation started in early 2000 with the growth of mobile networks, broadband, and the emergence of cloud technologies. With enterprises focused on improvement in IP networks, the country made the transition from traditional 2G networks to advanced 3G and 4G riding on top of the smartphone boom.

Access to the internet became a primary enabler of the digital economy, giving birth to new business models across industries. From call centers, business process outsourcing companies, multinational companies with various points of presence to smaller Indian businesses witnessed a continued surge in demand for consulting and customized network solutions to control network traffic flow with managed network services, including remote access, VPN, security, and firewall services. Besides, new customer segments such as government and infrastructure added to the demand for managed services.

Need for automated network orchestration

The growing penetration of computing devices used across businesses, universities, and research institutions generated the need for interconnections between computer systems. From sharing storage and printers initially, businesses recognized the need for developing a local area network (LAN). The number of computers (or clients) in LAN were limited and could operate only in a local area, not bigger than an office building within reach of an Ethernet cable or Wi-Fi signal.

In the early years, multi-protocol labeling services (MPLS) was the default choice for network control and augmentation. But with time, the network landscape has continued to evolve, presenting newer challenges for businesses across domains.

Recognizing the need, businesses across education, healthcare, banking, and government institutions incorporated WAN networking solutions to disseminate data and information to key stakeholders worldwide. WAN allowed businesses to use shared resources effectively and carry out internal operations like sales, R&D, accounting, and marketing through authorized networks regardless of location. Soon SD-WAN solutions became increasingly popular as organizations explored innovative solutions for fast, scalable, and flexible connectivity to and between different network environments.

> Access to internet became the primary enabler of digital economy, giving birth to new business models across industries.

SD-WAN allowed for dynamic path selection across a range of connectivity options – MPLS, 4G/5G, or Broadband – providing organizations with a consolidated bandwidth to access business-critical applications from the cloud, without compromising on the network security.

With the evolution and the emergence of new technology themes, including big data, cloud, artificial intelligence (AI), and internet of things (IoT), many enterprises rushed to innovate and integrate these technologies into their operations, products, and offerings. But, legacy infrastructure and network limitations restricted the progress. Nonetheless, over the past years, the cloud has become a mainstay in IT departments, with more and more businesses using cloud technology in some form or another.

Witnessing this significant growth in cloud and rich-media applications deployed at branches, distributed enterprises realized the need for next-generation WAN architectures to deliver high performance, reliability, application availability, and secure access to the networks.

Overall, the growth of the internet has transformed India's digital foundation to a secure, connected, digital experience. Indian enterprises have radically changed the way they function with the growing influence of technology and digital innovation. AI, machine learning (ML), IoT, and robotic process automation (RPA) are creating the very foundation that will trigger the boom across the major sectors such as education, infrastructure, electricity, aviation, medicine, information technology. Additionally, there's been a growing interest from every industry about experiencing the true potential of these new-age technologies.

Sailing through an unpredictable future

The pandemic has galvanized the value of the internet. Businesses lagging far behind in terms of technology are now looking for urgent measures to climb up the bandwagon and digitize their operations to survive the crisis. Remote work routines have created elevated stress regarding privacy breaches, fraud, and crucial data loss to insecure sources.

Post the COVID-19 era, industries are expected to see more cloud adoption for applications hosting, supporting, and managing the availability of critical applications. On the technology front, managing such high demand will require a solution that can help enterprise maintain the quality of experience of business-centric applications without compromising on security. It may also require a solution that can combine routers, network security features, and firewalls into a single point network solution and improve the overall performance and reliability of the network, while significantly lowering the operational cost.

Enterprises will also need to optimize existing network connections between distributed sites over the internet to achieve enterprise-class network performance, stability, and security for critical applications across the organization.

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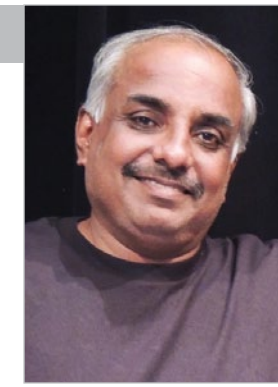
RAJESH KUMAR S



FOR A DIGITALLY CONNECTED FUTURE

Working together with the government, the industry can build momentum for 100% internet adoption and socio-economic development

The internet has truly been our savior during this pandemic by being our only connection to the outside world. Be it for keeping tabs on our aging parents, connecting with our friends, or viewing the happenings around the world through social media, there is no denying that the internet had a major role in cushioning the impact of the pandemic on our social lives.

In the absence of internet and online entertainment choices, our lives would have certainly been unbearable during these months of staying confined to our homes. With the year 2020 marking 25 years of internet in India, it suffices to say that this technology has become an integral part of our lives. Considering this pandemic, the internet has been pivotal in keeping businesses running, enabling access to online classes for students, and rolling out of telehealth services to the masses.

With over 650 million users today, the internet in India has seen enormous growth over the past decade supplemented by a high penetration rate across the country. The rise of online businesses and the opportunity to shop for daily necessities online underscores the power of "anywhere-anytime" internet connectivity. From e-commerce, online banking services, and ride/taxi-hiring services to e-healthcare, virtual medical consultations, and telehealth services, the internet considerably bolstered the socio-economic development of India.

Thanks to advances in internet technology, content delivery has undergone a radical yet innovative transformation as the rate of content consumption has spiked with the introduction of the likes of Netflix and Amazon Prime. The impact of the internet – particularly in the way of mobile revolution – has drastically changed the social lives of people. This evolution has revealed the increasing mobile internet penetration in urban settlements, but more so in rural areas.

Internet connectivity in remote locations across India through 3G and LTE has become more prevalent. However, a key factor to consider as part of this digital transformation is also the increase in security threats, driven by state-sponsored attacks and individual hackers. The losses caused by these cyber threats amount to trillions across the country, companies, and at the individual level. To mitigate these attacks, data privacy acts and cyber laws are actively put in place by the government.

While the lockdown-induced remote working may soon become mainstream, organizations across India are looking to reimagining their office spaces. The internet is at the forefront of this shift, with mobile devices offering a digital avenue to resume businesses or professions. A recent report by the Internet & Mobile Association of India (IAMAI) shows a 13% increase in internet data usage due to remote working models, live streaming, and social media activities during the lockdown period.

The internet has provided us with an efficient way to communicate across the globe through a variety of collaboration applications, social networking platforms, and video conferencing tools for work, education, or leisure. More importantly, the rural population of the country now has access to services like telehealth, online banking, virtual classrooms, and even online government services.

> The rise of online businesses and the opportunity to shop for daily necessities online underscores the power of "anywhere-anytime" internet connectivity.

It is incredible to see the rapid pace of change unfolding over the last few years with the excitement of people in rural areas using smartphones, the latest apps, and services, to improve their lives. The internet can be used as a knowledge hub that connects various universities, colleges, and research centres in India, and creates a platform for training, e-classes, and discussions on a range of topics. This has undoubtedly changed the way people look at the Internet.

Until a few years ago, the internet was accessible only to the urban and semi-urban sections of society spanning sectors that were easy to digitize such as information technology, entertainment, and media. This pandemic has brought to the fore how vastly insufficient this is for our nation's future.

Think about it this way: given the current circumstances, how easily can a migrant labourer use the internet to fish for jobs? How effective the internet can be to teach a young girl in rural India how to write? These are the type of questions we need to address to ensure sustainable socio-economic development of the country.

To achieve this, we must fast track our journey towards developing and establishing a countrywide high-quality, and universally accessible internet infrastructure. This will not only boost our economic productivity but also unleash the full potential of every sector.

In line with this notion, the Government of India has undertaken the BharatNet project to provide uninterrupted internet connectivity and e-services to 2.5 lakh Gram Panchayats through optic fibre cables. This initiative will open new avenues for online services, including the 5G rollout across numerous sectors. The introduction of 5G backed by a robust countrywide internet infrastructure will be essential in accelerating Industry 4.0 initiatives, and kick-starting smart city projects.

Prime Minister Narendra Modi's vision of a Digital India backed by low-cost smartphones, affordable data plans, and a world-class telecom infrastructure has paved the way for India's digital future. Our goal is to satiate the growing consumer appetite for personalized digital content and services. Working together with the government, we can build momentum for internet adoption and socio-economic development.

A digitally connected future is closer than we think.

The author Rajesh Kumar S is Head of Systems Engineering, Enterprise and Government at Juniper Networks India

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SHIVAJI CHATTERJEE

MEETING ASPIRATIONS OF A BILLION INDIANS

India has achieved a lot in the last 25 years. To ensure internet for all, the country now needs to focus on satellite technologies like HTS and LEO

India is the second-largest telecommunications market with a growing spread of connectivity, opening up new ways for people to connect, engage, learn, shop, and entertain; completely transforming the lives of our citizens. With an always-connected life experience and devices all around us, the internet is today entrenched deeply into our lives. But, looking back at the early days of the internet, it was a luxury to even afford a dial-up connection.

More than two decades ago, India witnessed the first spark of this new revolutionary technology and ecosystem – the internet. Although a luxury for most, the anticipation and excitement around the new technology was such that VSNL, responsible for rolling out the commercial internet in India, got 10,000 subscribers within the first six months.

Chronicles from the journey

On 14 August 1995, VSNL introduced public internet access with dial-up connections in six cities, with continued efforts towards expanding the service across India. During the initial phase, only government agencies were authorized to be an Internet Service Provider (ISP), limiting the spread of services beyond the limited urban communities. Besides, the service experience was largely unreliable, with slow, inconsistent connections and excessive pricing. But, with growing interest around the internet, the policymakers also pressed on the efforts towards improving and expanding it.

In 1995, several value-added services, including e-mail and the operation of private networks were permitted. One of the most significant developments in the evolution of the internet in India was the formulation of a new Internet Service Provider policy, which permitted the licensing of companies other than VSNL to provide the services. In March 1998, the number of subscribers touched the 100,000 mark and witnessed further boost, eventually crossing 1,50,000-mark in the next few months. The subsequent involvement and participation from the private sector helped the nation make significant progress in expanding infrastructure and internet services and making it more affordable.

Among the early movers, top Indian news outlets made headway towards creating a digital presence and setting up their websites. At the same time, Indian entrepreneurs worked towards shaping some of the finest digital ventures, including Naukri.com and Rediff.com creating a dot.com boom. As India entered the new millennium (2000), the internet also progressed to become an increasingly important part of day-to-day life for a growing segment of society. But, the growth was not proportional to the possibilities that existed since many middle-class Indians still owned personal computers that were not connected to the internet.

Even as the world progressed to high-speed connections, the internet speed in India was significantly lower compared to global benchmarks. Nevertheless, the opportunities and scale of the Indian market attracted major digital companies to invest and create resources targeted at local users. Tech behemoths like Microsoft, Yahoo, and Google looked to explore India's possibilities with country-focused websites. Google also opened its first office in India in 2004.

India, however, witnessed the most significant (and positive) disruption in the internet ecosystem around 2010 with the growing adoption of advanced mobile and wireless technologies. The government's decision

> India witnessed the most significant disruption in the internet ecosystem around 2010 with the growing adoption of advanced mobile and wireless technologies.

to allocate spectrum for 3G and its quick, subsequent offering of 4G services vastly contributed to this dynamic surge. Affordable mobile devices and hyper-competition led to lower mobile data prices that encouraged users to experience and acknowledge the power of the internet.

Fast forward to the present – India has the second-highest number of internet users and possibly the lowest mobile data prices in the world at Rs 7 per GB, according to Nokia's annual Mobile Broadband India Traffic Index (MBiT) report.

Taking the next big leap

The growing exposure to the world outside today reflects India's young population's choice and ambitions. From chat groups to social networking sites, matrimonial to classifieds, education, and e-commerce, collaboration and digital payments, the internet has provided pathways to the new models of engagement, and in the process transformed the country's culture. In the past two and half decades, the internet has completely transformed the world around and has contributed vastly to India's economic growth.

From creating significant opportunities for Indian startups to fuelling multinational companies' growth, the internet has completely overhauled the business landscape. Besides, the surge in internet penetration across India has also encouraged entrepreneurs to launch and address the users' needs in every possible vertical, from education to health, video, and e-commerce. It has also provided users with a choice for content today – be it text, audio, or video, and the platforms to connect and voice their opinion.

In the next few years, India will deploy 5G networks to improve network speed and enable more applications, especially in urban areas. The wireless broadband service will only get that much stronger with 5G. Even with such progress, the stark reality is that a large section of the country's population still does not have reliable, broadband internet access. Whilst there is a strong impetus on driving connectivity through the rollout of optical fibre across villages, it is not an easy project to accomplish given the length and breadth of the country and the fact that the program has reached about only 20% of our villages in eight years since inception.

Satellite technology through its new advancements of High-Throughput Satellites (HTS) and Low Earth Orbit (LEO) will provide the requisite 100% reliable coverage that Digital India needs to truly empower every citizen, irrespective of where they are.

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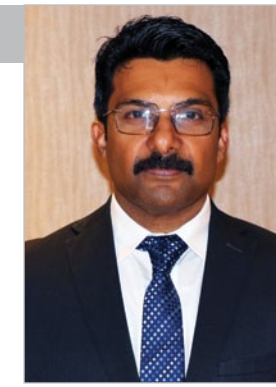

SECURING THE CONNECTED SOCIETY

Cyber attacks and threat actors are a major speed bumps to the internet-driven economy. Secure data is the only way forward to the digital future

Two and a half decades since India took its first step towards the digital world by making the first commercial internet available to the public via VSNL, the country has come a long way. India today, has the world's second-largest online market. According to a report, India stands at #1 globally with 1.2 billion people enrolling in the world's largest unique digital-identity programme, 13.2 billion application downloads, 1.17 billion wireless phone subscribers, 0.9 billion internet users, 354 million smartphone users, and 294 million users engaging in social media.

This staggering data shows the power of the internet that has been driving the country's transformation since 15 August 1995, boosting the socio-economic conditions and putting the country on the global map.

There was a time when street lights, let alone computers had not reached villages in India. We have seen photographs on the web where the world's first hard disk drive was the size of a storage unit and today 1 TB external hard drive is as small as a smartphone. That's the level of advancement that the world and India have achieved. In fact, there is no need for storage units in organizations anymore as cloud services reduce the requirement of storage.

Advancement in the internet has not just helped the IT, telecom or manufacturing industries, its impact has been felt across sectors including governance, health care, education, as well as astrophysics, to name a few.

Internet and society

The United Nations projects that by 2050 there will be 9.6 billion people on the planet, and more than 66% of them will live in urban areas. This will result in huge pressure on metropolitan cities, including that on city infrastructure and resources. The only solution to this problem is the use of technology to make cities smarter. No wonder then, governments across the world are looking forward to building smart cities that sustain not just technology, but also green energy.

To make this possible, there is a need to explore smart options of energy distribution, streamline trash collection, decrease traffic congestion, and even improve air quality with help from sensors and the internet of things (IoT).

Deploying a range of applications to their maximum effect could also potentially reduce fatalities – homicide, road traffic, and fires – by 8-10%. In a high-crime city with a population of five million, this could mean saving up to 300 lives each year. Incidents of assault, robbery, burglary, and auto theft could be lowered by 30-40%.

While smart cities have started to gain popularity, the pandemic is driving virtual connectivity to its peak. In fact, the COVID-19 is driving the majority of the companies to take up remote working solutions, enabling employees to work at their comfort. Virtual education is gaining momentum where children are continuing their education despite educational institutions not being open. Online shopping, online transactions, and e-commerce activities have gained more traction since lockdown and all of this has been possible due to the internet.

Online petitions, social media platforms being used for reformation, and AI being used for the purpose of transparent taxation in India shows how much we as a country have come ahead in terms of technology.

> Today, systems don't mean desktops or laptops, it includes smartwatches to social media accounts and everything that is interconnected and makes one vulnerable.

Cloud transformations, digitization, and IoT are some of the cutting-edge technologies that showcase the transformation and the way the world is headed. However, a key concern is to ensure that the hyper-connected society remains safe and secure from the threat actors worldwide.

Cyber threats and threat actors have been proved to be a major speed bump in the success of digitalization. Zero trust, SSL VPNs, and remote access security solutions are a few of the solutions that organizations need to use to prevent threat actors from accessing sensitive data from their systems. Today, systems don't mean just standalone desktops or laptops, it includes smartwatches to social media accounts and everything that is interconnected and makes one vulnerable. Secure data is the only way for our secure future.

India has come a long way since that independence day in 1995 when the internet was launched in the country, but it still has milestones to achieve before it can become a global technology leader.

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ABHISHEK LATTHE

SHAPING THE DIGITAL FUTURE

While 5G will be driving the 4th Industrial Revolution, it will also play a vital role in transforming India

Twenty-five years ago, in 1995, if your home in India had internet connectivity, you would have been singled out as elite who not only had the financial entails but also the knowhow to make the most of the World Wide Web. Today, close to half a million Indians use the internet in some form or the other.

Very frankly, the impact of the internet on people, economies and countries is something that continues to astonish me. From how you connect, communicate, live, and shop to work and socialize – there isn't anything that the internet has not changed. In fact internet has been transformational in the way it has touched lives.

Today, India is one of the largest and fastest-growing internet economies in the world, second only to China, in terms of the number of internet connections and volume of apps downloaded. While 2020 marks the 25th anniversary of the internet in India, it is geared up to create substantial economic value and redefine connectivity among urban and rural populations, school-going children, and women in the coming year. According to a report, it is estimated that by 2023, there would be over 650 million internet users in the country.

Impacting lives and livelihood

Internet connectivity can certainly inspire communities and impact every single home in towns and villages across the nation, gradually bringing next-generation digital services such as e-governance, fintech, telemedicine, and e-education. It is prudent to say that the vision of smart villages, modern agricultural interventions, cost-effective healthcare systems, and quality education will rapidly become a reality with internet connectivity.

Given this background, the Internet is no longer just a means to stay in touch with your loved ones, but a tool for enhancing development and ensuring social impact. Having endured a paradigm shift over the decades Digital India programme has been looking to engender new growth opportunities, boost industrial productivity, and transform the socio-economic fabric of the country itself.

Internet penetration in India

With increasing internet penetration and exponential data uptake, the government in India and the telecom sector are focused on driving digitalization and accelerating technology adoption across the country. Mobile telecom networks played an important role in increasing internet access; 3G internet service in India was launched in 2008, followed by the 4G services in 2012.

According to a report, between 2013 and 2019, there was a 68% increase in the number of wireless internet users, up from 220 million to 696 million, compared to an 18% increase in the number of wired internet users (from 18 to 22 million). The share of mobile internet users in total internet users grew from 92% to nearly 97% in this period. Like the telecom industry, the internet too has progressed from what it was 25 years ago. It will not be long before India adds its flavour and leverages the internet as an engine for socio-economic growth.

As India prepares to use smart technologies to transform cities into smart cities and take the big leap to become a superpower, 5G is expected to be a key driver for the 4th Industrial Revolution and will play a vital role in shaping our digital future. It is also being looked at as a game-changer for the enterprise.

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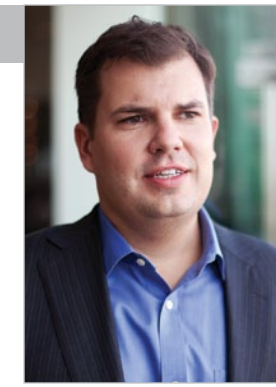

MANAGING INTERNET ERA THREATS

A digitally-connected organization requires business-aligned CISOs to manage and reduce cyber risk

Over the past 25 years, the internet has drawn India closer to the rest of the world by giving people and organizations the ability to connect and share information. For businesses, the internet has unlocked a deluge of data to drive success. This has paved the way for modern, global digital transformation.

Organizations of all sizes in India have embraced digital technologies as a means of competitive differentiation. This transformation is increasingly occurring for providers of critical infrastructure through operational technology as well. They are creating new business models and customer ecosystems, delivering new products and services, and operating more efficiently in the digital economy. Various government-led initiatives such as Digital India and the Smart Cities Mission are a testament that India is well into its digital transformation journey.

Along with the new opportunities that come from digital transformation, there are significant new vulnerabilities and cybersecurity challenges that organizations need to manage. The convergence of traditional IT networks with the internet of things (IoT), operational technology (OT), mobile, and cloud platforms creates an expanded attack surface. Enterprise security teams are now challenged to defend this vast threat landscape.

A recent study by Forrester Consulting reveals that 97% of organizations in India suffered a business-impacting cyber attack in the past 12 months. This figure is a grim reminder that digital progress is outpacing the speed of security. Cybercriminals are always trying to test the strength of corporate cyber defences and OT is becoming an increasing target as it may be a blind spot for security teams who tend to focus on traditional IT devices.

A joint alert in May 2020 from the US National Security Agency (NSA) and the US Cybersecurity and Infrastructure Security Agency (CISA) recommended that all US critical infrastructure facilities take immediate action to secure their OT assets. The advice comes in light

> For businesses, the internet has unlocked a deluge of data to drive success. This has paved the way for modern, global digital transformation.

of the greater use of internet-accessible OT assets to help enable organizations to operate remotely, a phenomenon accelerated by the COVID-19 pandemic. This alert should be an early alert to all countries, including India, to strengthen critical infrastructure security because internet-accessible OT devices are significantly exposed to attackers.

Securing OT and critical infrastructure may seem like a no brainer. However, the Forrester study also revealed that only four out of 10 security leaders in India are able to answer the question, "How secure, or at risk are we?" These findings suggest that CISOs are ill-equipped to provide a clear picture of their organization's cybersecurity posture in a way business leaders understand. This prevents meaningful dialogue between security and business leaders.

Closing the gap between business, security leaders

Security leaders can't align with and support business needs by working in a vacuum. Strong security requires strategic alignment between business and cybersecurity leaders that is lacking in many organizations. The Forrester study shows that only four out of 10 business executives rarely – if ever – consult with security leaders when developing their organizations' business strategies. The report also indicated the lack of effective communication occurs on both the security and business leadership sides of the table.

Business and security leaders should be in lockstep when it comes to ensuring the security of their digital and physical assets. However, this can be challenging if both are disconnected and not speaking the same language. Cybersecurity leaders can begin remedying this problem by ensuring their initiatives are reframed as business priorities. This can be done by communicating business value and ensuring that objectives align with business needs.

It's also important for security organizations to work with business stakeholders to align cost, performance, and risk reduction objectives with the business. One of the key ways that security leaders can bridge this gap is through metrics that speak to business risk. Eighty-five percent of business-aligned security leaders have stated they have metrics to track cybersecurity value while only 25% of their less aligned and reactive peers are able to show business value.

Another way to show business value is through internal and external benchmarking. Just as any company leader will evaluate financial performance versus their competitors, security leaders can become more aligned to business-aligned if they can clearly articulate expectations and demonstrate improvements compared to industry peers.

Business leaders also need to provide their security experts with the right combination of technology, data, processes, and people to succeed. One of the most important ways to achieve this is by giving the CISO visibility of the entire company's operations. This often requires elevating the CISO role within the company, to ensure that security is baked into every business decision from the start. With complete visibility, security experts can take a holistic view of the company's most critical assets, and make risk-based decisions to prioritize security efforts.

Keeping up with cybersecurity needs

The threat landscape has changed significantly from 25 years ago. In today's digital era, every organization, no matter how large or small, must be able to answer a few foundational questions about their security posture.

Where are we exposed? Where should we prioritize based on risk? Are we reducing exposure over time? And, how do we compare to our peers? By connecting the language and metrics of security and business leaders, and by empowering cyber leaders with complete visibility over assets, organizations can take an important first step to close this gap.

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ARUN BALASUBRAMANIAN

FUELLING THE FUTURE OF WORK

Business-wide digital transformation today matters as much as the pivotal decision to embrace the internet adoption 25 years ago

When the first commercial offices were wired with ethernet in the mid-'90s, not many would have guessed that India was on course to become the world's second-largest internet-using population just two decades later.

Over the past 25 years, the internet has transformed every aspect of life in India. Fast internet has become an essential household utility, transforming our homes and workplaces, and giving impetus to the Digital India agenda.

The power of the internet has dismantled geographical barriers, connecting India to the world and opening doors for flourishing talent and business innovation. Global data can be accessed in one click. Business services delivered with one swipe. Career opportunities are no longer restricted by location. Perhaps the biggest and most recent change is the arrival of a truly 'digital workplace' – unquestionably accelerated by this year's pandemic.

The future of work is here and any many ways, it's virtual. The internet has provided the gateway to a new way of working and digital transformation is the top business imperative across every sector.

While remote working was new to most of us at the beginning of 2020, over two decades of investment in internet infrastructure has enabled Indian enterprises to shift gears in a matter of weeks when the pandemic confined us to our homes. Businesses maintained continuity and employers quickly recognized the importance of digital workflows to strengthen employee and customer connection while working from anywhere.

What we're seeing is that companies empowered by digital workflows are better equipped to respond to rapidly evolving employee and customer needs. They're able to build programs in a matter of days, instead of months, and deliver a great experience when it matters most.

The future of work is dictated by the decisions we're making right now. Business-wide digital transformation today will matter as much as that pivotal decision to embrace internet adoption 25 years ago. In 2020, the call to action is how we make work, work better for people.

Enabling digital transformation model

Digital workflows are the core of any digital transformation model. Solving routine, manual processes so that people get time to focus on the innovative work they signed up to do, can drive exponential increases in employee engagement, fierce customer loyalty, better scale, and, of course, higher profitability.

An important component of any transformation is how you apply machine intelligence. Just like the internet, advanced technologies will deliver unparalleled benefits to both people and businesses when the end-to-end process is top of mind, and technology is used in the service of people. Advanced technologies, when integrated into core platforms and applications, accelerate the effectiveness of digital workflows.

There's a good reason why 'pivot' has become a global catchphrase. Intelligent workflows provide powerful real-time data that enable smarter, faster decision-making to improve experiences. When businesses become truly digital, they can adapt at pace and deliver better customer and employee products and services.

As India embraces the 4th Industrial Revolution, the internet of things (IoT) is helping enterprises unlock

> In the next five years we will see much higher connectivity and automation, as organizations continue to integrate IoT into critical enterprise functions.

higher productivity by automating basic but time-consuming tasks across critical functions, ushering in the next wave of innovation.

Take, for example, India's telecommunications sector. Most enterprises have about four to five core platforms that employees need to manage; for the telcos, that number is often much higher. This back-end complexity demands increasingly intuitive and flexible combinations of technology infrastructure, to simplify processes and deliver what their employees and customers want, when and where they want it.

Intelligent workflows can connect the entire telecom operation – from the network to the customer – with one platform. Telcos are able to aggregate data across silos, providing a single view for their employees and customers.

Likewise, ITSM operations underpinned by AI help build enterprise agility. If an employee's computer has an overheated CPU, a sensor can detect this issue and an automated workflow will notify the respective IT function to replace the system. The immediate result: valuable time spent on menial administrative tasks can be redirected to problem-solving and decision-making. And yes, it also adds to bottom-line savings. In the long term, it also helps significantly enhance the core capabilities and skillsets of the IT teams.

Today, IT and HR teams are using chatbots to enable self-service for common tasks like password reset and knowledge-base searches, saving thousands of hours to be reinvested into business-critical efforts.

Digital transformation was a C-suite priority before the pandemic because employees and customers were increasingly demanding workplace experiences that match the ease and simplicity of their favourite consumer apps. COVID-19 has only fuelled this focus. Companies, recruiting during work-from-home restrictions can guide their new hires through the onboarding process with purpose-built mobile apps. At the same time, they can give employees the greatest service experience they deserve.

Given how far we've come since 1995, forecasting the impact of the internet over the next 25 years is a tough ask. In the next five years alone, we will see much higher connectivity and automation, as Indian organizations continue to integrate the IoT into critical enterprise functions.

Digital transformation will underpin India's economic recovery. With added access to and investment in network infrastructure, as well as giving employees a consumer-like work experience with digital workflows, people and the economy will benefit from better ways of working in the new normal.

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GAURANG SINHA

SAFER, SMOOTHER, FASTER

As India enters a more connected virtual world, with over half a billion internet users, it needs to focus on privacy and data security in a big way

It's hard to imagine a world without the internet, but it wasn't born too long ago. A great revolution took place in 1995 when the internet sun started to rise in India, and today, the country has over half a billion internet users.

During the ongoing pandemic, a large percentage of the country's population has adopted the new digital mode of communication. While students are studying online through virtual classes, consumers are buying essential and non-essential goods via e-commerce platforms, payments are being made digitally and much more.

It is estimated that the number of connected devices in 2020 would hit 50 billion, over six times the global population. The number includes devices, machines, and sensors that exist today, not to mention the countless digital tools that are built each day.

Journey of the internet

Over the year, internet-based platforms turned out to be a driving force, empowering people to raise voices and express themselves, while enabling people to connect virtually, and creating multiple jobs. Prime Minister Narendra Modi's speech on India's 74th Independence

> With the internet becoming more widespread, reliable, and faster, we are not far away from a big IoT boost. All everyday items used by us will soon be connected to the web.

Day highlighted that more than six lakh villages across the country would be connected through high-speed internet, using optical fibre within a period of 1,000 days. This is a welcome step that will connect the unconnected and give them equal opportunity.

Currently, India is undergoing the most significant phase of its digital revolution with a large percentage of the country's population adopting digital avenues and getting comfortable with the concept of remote working. As the year 2020 marks 25 years of the internet in India, and while most of us are aware of how the internet has been shaping the lives of Indians over the past two decades, here is how the next 25 years of Indian internet will probably look like.

5G and faster speeds

India is on the threshold of developing indigenous 5G networks. This plunge will allow the country to take a leap in upgrading the technologies and benefiting multiple sectors, thereby boosting the economy. Prior to 4G, live-streaming, real-time multiplayer gaming, and video conferences were extremely limited to the home broadband connection.

The 5G network is expected to improve speed and connectivity, which in turn will further augment digital possibilities. According to experts, the concept of being offline may even become redundant as people adapt to a 24×7 connected approach.

The internet of things (IoT)

With the internet becoming more widespread, reliable, and faster, we are not far away from a big IoT boost. Everyday items used by us will soon be all connected to the web. The interaction, shared today by your smartphone, earphones, and smartwatch will expand heavily in the future. Clothes, backpacks, and even shoes and accessories will soon become smarter, forming a bubble of information around you.

We are already living in the times when connecting devices and smart homes have become a reality and we have already seen a rise in the smart home automation industry. The internet has the ability to control all these devices through a central device like your phone or a wearable band thereby making lives easier.

AI and the internet

The future will see an amalgamation of technologies with the ability and reach of the internet becoming larger than ever before. While we have seen "smart" IoT-connected versions of most appliances, we can expect to see 'smart-home' becoming one unified entity that will know when to open the curtains, change the colour of lights, open the doors, and do the laundry, among other things. AI-controlled decision-making will become normal for most people eventually.

Having said that, it is important that we recognize that privacy and data security is a big concern, particularly with security breaches increasing by the day. It is one of the most neglected areas of technology innovation. There have been several reports on applications storing user data without their consent and using it to generate revenue through targeted advertising.

Cyberattacks too have been on the rise, making users vulnerable to virtual attacks if adequate security measures are not taken by organizations to prevent such occurrences. As we know, data is the new oil, and both brands as well as hackers are trying to gain access to user information that they can benefit from. It was not too long ago that the personal data of 2.9-crore Indian job seekers were leaked on the dark web.

Everything said and done, the internet continues to be a boon, regardless of its obstacles. As India enters its 26th year of the digital age, let us hope for a safer, smoother, faster, and even-more connected virtual world.

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GIRISH UTAGI

REIMAGINING FINANCIAL SERVICES

From web-based stock exchanges to online management of personal finances, the internet has played a major role in making financial services more accessible

Back in 1995, a single user could expect to pay Rupees 5,000 for a 9.6 kbps dial-up connection, capped at 250 hours of usage a month. Today, with 687.62 million subscribers, India has the second-highest number of internet users at less than Rupees 10 per GB – the lowest tariff in the world. So what has made India such a huge market that cannot be ignored by any global company?

A number of factors are in play: a huge consumer base that is wedded to smartphones to access information; a corporate world ready to invest in information technology supporting core business; and government policies paving the way for digital service offerings in the form of a unified payment gateway, land records digitization, the linking of income sources through PAN, Aadhar card, GST, and trade facilitation through a single-window interface, among others.

The ringless, screen-based trading introduced by NSE required brokers to invest in the communications infrastructure that allowed the terminals to connect to the core NSE trading systems. This first step towards connecting brokers scattered around the nation with the NSE platform happened around the same time that the internet came to India in 1996. A web-based trading system was subsequently introduced in 2008 making broker connectivity much easier.

In early 2002, internet trading was introduced allowing small investors to trade while also bypassing brokers. The internet has over the years significantly lowered the cost of distribution and servicing of financial products by opening up access, eliminating geographic barriers and dispensing with the need for middlemen when investors are seeking information on where and when to invest.

The convergence of financial services across industry sectors such as insurance, banking, wealth management, personal finance and credit rating has led to aggregated service offerings via digital channels, where user approval to share data with the aggregator is sought to enrich and improve transaction experience. Personal

> Internet has significantly lowered the cost of distribution and servicing of financial products by opening up access and dispensing with the need for middlemen.

finance applications, trading applications, payment and wallet apps, and e-commerce apps will continue to fight for space on the mobile home page of the consumer.

The demonetization drive by the Government of India in November 2016 served as a catalyst for digitalization within the Indian banking and associated financial services industry, including NBFC, microfinance lending, and neo banks. This would not have been possible without the penetration of internet infrastructure in most parts of the country.

There may be some gaps, but those are expected to be filled via the BharatNet project – part of the wider Digital India program – which is looking to connect all parts of the country by August 2021 via a web of fibre optic networks.

Growth in the financial services industry rides on the information that is now within easy reach of customers, allowing for faster buying and investment decisions, aided in turn by banking transactions that can be instantly completed. The startups and the tech unicorns that have emerged in recent years would not have found their place in the market has it not been for the profound impact the internet has had on the lives of the general public. A particular beneficiary has been the e-commerce technology platform companies that have seen unprecedented growth as the internet has come to touch every individual.

There are some downsides, of course, not least that small segment of 'bad actors' choose to wreak havoc across the internet user community through hacking and distributed denial-of-service (DDoS) attacks. This has been used to facilitate money laundering, thus bringing cryptocurrency under the regulatory purview and the prohibition of virtual currency transactions.

Privacy has become a major consideration for all institutions, both inside and outside of financial services, given the potential for individual users' personal details and habits to be laid bare by the trail of digital bread crumbs left behind by any transaction or data exchange. The internet security companies have sought to address such abuse and misuse through enhanced security protocols and products that track every bit within a movement of data, but criminals themselves continue to innovate to find ways to circumvent such measures.

On a more positive note, during the COVID-19 crisis, the internet has allowed individual states to share and communicate data about infection levels while a nodal government agency has tracked the pandemic at a national level. With social distancing being pushed hard by the authorities, the internet has provided cheap and accessible infrastructure required for remote working. This has ensured that banks and other financial institutions are able to continue servicing their customers. Likewise, in the wider world, it has allowed education to move online and essential commodities to be ordered and delivered using e-commerce apps.

Disruption looks set to continue in the shape of technological advances such as 5G that would feed the appetite for data and ever-faster download speeds, and are expected to drive the adoption of new business models and services. It will also lead to convergence of innovative technologies – such as the internet of things, augmented and virtual reality, AI, and machine learning – with traditional technology platforms as the society moves closer to being online all the time.

With the internet playing a key role in reducing the direct costs of servicing and easing of some regulations, complex financial products in retail and commercial banking and investment management can become more accessible and affordable. Certain business to business services like room sharing in the hospitality industry or agency intermediaries in the insurance sector can be expected to make way for business to consumer services which take advantage of an individual's persistent online status to identify and market products to them in a far more targeted and personalized fashion.

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R ARUN PRASATH

CATALYZING SOCIO-ECONOMIC GROWTH

Internet-driven platforms have opened up the global market to the remotest corner of India, creating unheard of opportunities and providing a level-playing field

Indians have always been fast adopters of technology; they are always looking to do things in a better way, or solve problems more efficiently. For those who remember the initial years of the internet in India, it used to be accessed by a dial-up modem with a series of small screeches and tones that indicated that you were logged on. And the internet service, known as the Gateway Internet Access Service (GIAS), provided a speed of 9.6 kbit/s speed in the early days.

Since then there has been no looking back. India has excelled at using the framework and capabilities that the internet brought to the table. As a typical use case, one can think of a large company that needed constant paper-based communication to and from centralized offices to branch network offices distributed across the country.

Prior to the internet this had to be accomplished through tedious faxes, sent page by page. One had to check up with the recipient office, whether the phone line had been switched to the fax line, then someone had to confirm that all the pages were clear and without errors or smudges. These were really cumbersome ways of accomplishing small business tasks.

With the advent of email, one could easily send myriad business communications efficiently and most importantly – immediately, without fear of loss or compromise. International communication became feasible as one could facilitate business in a much smoother manner.

Online access to information and exposure to global business practices, success stories, and future thinking transformed the way people think, behave, and work. It bolstered trade as companies could now showcase their products and services via websites and listing directories to an international audience while accessing theirs at the same time. This initial phase laid the foundation for the burst that was to come later.

As the years progressed, the internet provided more opportunities for the Indian workforce. Simple things like being able to transfer files and programs over the internet allowed companies in India to quickly cater to the needs of customers across the world. The earlier cumbersome physical transfer methods no longer stood as a hindrance while executing work.

It also allowed Indian professionals to be up to date in terms of knowledge and skill set. From bulletin boards to usenets and knowledge groups – all helped students, professionals, and entrepreneurs across India to get on an even-playing field with that of the world. The internet also helped professionals in India to get on board the open-source movement, which is a force to reckon with now. This led to the emergence of a burgeoning middle class empowered with knowledge, and thus, leading to greater wealth creation. This in turn contributed significantly to the growth of the economy.

Cut to the recent times and we are seeing a quiet revolution that allows a person sitting in a small tier-2 town competing with the best across the world. The growth of e-commerce platforms has given a face to small- and mid-level merchants and they now have the opportunity to sell their wares across the country and the world, at large.

So, a farmer growing a patch of organic vegetables, an artisan creating artworks, or a little girl making designer earrings, no longer needs the usual restrictive supply-

> The growth of e-commerce platforms has given a face to small- and mid-level merchants and they can now sell their wares across the country and the world.

chain mechanisms. A virtuoso e-commerce platform allows them to reach an audience that they would have never before been able to access. Once again, such an ecosystem drives the economy ahead and contributes to wholesome development across all strata.

In the recent past, moving of applications online and to the cloud has also revolutionized the development and access to the software. What this means is that a company can have its headquarters in one city, a development centre in another, and distributed sales and marketing teams across the country and the world. This has brought many talented youngsters and professionals together, despite not being physically present in the same space.

Social media has contributed to another spurt. Media and advertising are gravitating to the online world and many creative, marketing, and analytics professionals are able to work and reach out to target audiences from different regions. The creators, farmers, manufacturers, artisans, and everyone with a product or service offering, have now access to an apt platform to monetize their offerings. Once again this has led to job creation and an economic chain that have a positive socio-economic impact leading to development and growth.

Online education and gaming are other new areas of the online world that is booming. This was made possible only through the availability of the internet. The COVID crisis would have been far worse and would have damaged society dramatically if it were not for the internet. With education moving online and work from home being powered by the internet, we have managed to maintain a semblance of sanity and continuity in our work and social lives.

This has once again allowed people from all over the country to stay connected to social and professional systems, leading to a new normal that will lay the foundation for a brighter future.

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SUNDAR RAMASWAMY

REBOOTING INDIAN ECONOMY

India needs to frame policies that safeguard the unfettered yet secured growth of the internet, the backbone for all the new technologies

The internet is 25 years old today. Its advent coincided with the 1991 reorientation of the Indian economy towards a more capitalistic free-market model. With the two events running parallel, there is sufficient empirical evidence to correlate rebooting of the Indian economy with the steady increase in internet usage and the attendant economic benefits.

The internet-connected and continues to connect people and businesses, foster innovation, and unleash entrepreneurship spirit. At no time its economic upside has been more apparent than the COVID-19 crisis, which in one swoop also reinforced another stark reality: the internet may be an engine of economic growth, but the access to the engine is still controlled by the traditional power structures of our society.

While access to the internet may have created a new generation of haves and have-nots, challenges are also being posed from within by the very stakeholders who benefit from it the most – internet service providers that threaten net neutrality, governments that are keen to

> Widening footprint of AI and automation solutions are the future drivers of the internet-led business, but they bring with it concomitant social challenges.

conduct surveillance programmes, and individuals who endanger the security of internet users.

The widening footprints of artificial intelligence (AI) and automation solutions are the future drivers of the internet-led business, but they bring with it concomitant challenges at a social level.

Citizen empowerment and socio-economic growth

While Twitter and Facebook will vouch for the power of the internet to give a voice that can empower the individuals, the benefits of internet usage are slowly percolating to various social areas like education, health care, and rural development. The internet's contribution to citizens has been its ability to bridge poor physical and institutional infrastructure, especially in the access to government-driven public utilities.

Leveraging the internet, the government has powered the Digital India initiatives. It has provided financial inclusion for all citizens through the Jandhan-Aadhaar-Mobile initiative, reduced leakages in benefits through the Direct Benefit Transfer scheme and enabled safe and instantaneous financial transactions through the Unified Payments Interface.

For many organizations, their Digital Transformation journey has just begun. New technologies in the areas of AI, big data, internet-of-things (IoT) combined with 5G mobile technology have the potential to transform every sector that touches a citizen's life. The economic effects that these technologies would bring include job creation, primarily driven by e-commerce; the Gig economy currently generates more than 50% employment.

The job market will also be impacted by new services and industries on the back of applying new technologies to disrupt the old way of doing business (mobile app revenue ~$200 million in 2019), business innovation leveraging the power of technologies in driving efficiency across the business (IoT sensors and AI powering productivity enhancements) and smart workforce aided by automation and AI technologies like chatbots that provide customer service support.

Managing the automation disruption

Automation is key to a successful implementation of Digital Transformation at the organization level. By automating manual, effort-intensive, repetitive and standardized tasks, organizations are delivering world-class customer service, breaking down internal organization silos, improving security and compliance, becoming more agile while continuing to drive down costs. AI and other new technologies will lead to deeper, faster, broader, and yet more disruptive automation.

While automation is expected to boost economic growth, create new high-skilled jobs, and improve living standards, it may also present serious challenges for workers and communities. This will include existing job displacements, disruptions to local economies, changing skill requirements, and rising inequality if the fundamental issue of access is not addressed at the earliest.

Businesses would need to invest in education, training, and enhanced social safety net, along with a social contract for workers that provide workplace benefits and protections. At the same time, individuals in the workplace will need to get used to engaging with 'bots' as a part of their everyday activities and develop new skills that will be the demand for the new automation age.

But for all of this to come together, the government needs to frame policies that safeguard the unfettered yet secured growth of the internet – as it continues to be the backbone of all new technologies..

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VIPUL SINGH

THE GREAT LEVELLER

The internet has created a level-playing field in business, politics, and society. The lawmakers need to redefine the cyber laws to meet the needs of the future

The leap from the Educational Research Network (Ernet) to the commercial internet opened up fascinating possibilities and all of us must be glad today. The infrastructure enhancement has taken the internet to the remote parts of India, giving the means for everyone to voice their opinions, take up remote working jobs, showcase their talent and connect with loved ones instantly. The internet has leveled the playfield in business, politics, and society.

The emergence of e-commerce, service-on-demand, social networking, internet of things, bring-your-own-device (BYOD), online gaming, health services, entertainment, and many more sectors has accelerated the need to enhance the infrastructure. For instance, a recent report predicts that the BYOD market will touch USD 637 billion by 2022. One can imagine the savings in terms of infrastructure, travelling, workplace maintenance and other recurring costs this would create.

Needless to mention, the rapid growth of cloud, artificial intelligence, robotics, 5G, blockchain and other technologies that would sustain only if the internet continues to exist. If we can leverage these technologies well, it will transform healthcare, transportation, logistics, banking, and other industries for better.

Today, the internet connects 4.6 billion people around the globe; making the socio-economic boundaries inconsequential, and everyone has been benefitting. For instance, the internet has been a life-saver for industries and individuals alike during COVID-19. Despite the slowdown, the digital economy is estimated to reach USD 1 trillion by 2025.

Internet-powered remote working, collaborating with teams, payroll processing, virtual onboarding, and more solutions helped Human Capital Management companies ensure that their clients can pay their employees on time, while providing their own employees a job assurance.

There are stories from the e-commerce, too. Over 20,000 seasonal jobs opened with just one e-commerce giant during the COVID situation because of the high demand. The software technology, the medical profession, and marketing industries also witnessed a surge in job postings mainly to keep the internet-based banking, social networking, streaming and other such sectors running.

The USD 191 billion IT and Business Process Management sector has more positive stories related to the impact of the internet. India is the leading sourcing destination across the world with over 55% share of the USD 250 billion global services sourcing business. This is huge because IT and BPM employs over four billion people and is expected to grow at a CAGR of 10% during 2020-2025.

These numbers speak volumes about the positive impact that the internet has made in India, and it has brought people around the world closer, and the world to India.

Although the internet has its share of consequences, like being the turf for economic war, asymmetry of online platforms, and cyber fraud, the impact of these can be measured out with diligence and stringent laws. The General Data Protection Regulation is one such example and Indian lawmakers are already redefining the cyber laws to meet the needs of the future.

The world is changing at a rapid pace, and the internet is bringing India to the core.

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Source: IDC PC Device Tracker data, 2019Q4, AMD has gained the most share among PC processor vendors for x86 processors for consumer and commercial desktops and notebooks from Q2 2017 through Q4 2019. (RNP-1)