International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 08 | Aug - 2021 ISSN: 2582-3930

Research on telecommunication's role in COVID-19 impacted society

Kasturi Vikas Acharya

Abstract- The outbreak of the Covid -19 Pandemic around March 2020 has by far affected almost all the countries in the world and has caused widespread concerns and economic hardships across all communities around the globe. While the world is struggling through challenging times, the development of two major fields viz healthcare sector and information and communication technology are grappling the researchers worldwide. Thus, based on the severity and surge in the information and communication technology, it is the chosen topic between the two for this independent study. The concept of Telecommunication, even though not new remains an understudied one, and hence to bridge the gap between its transcendence and study the following research is crucial. Telecommunication being a diverse and vast field, the literature review for the study here focuses on the introduction and history of telecommunication, policies related to the industry, Covid-19 impacts, and the future of the industry based on the impacts. The study concludes with understanding the above-mentioned fields and analyzing the future steps for the development of the sector.

Introduction

The ever-growing demand for ICT[1]since the advent of the 21st century has brought with it new complexities especially in the urban planning field *(41st ISoCaRP, Congress 2005*). The professionals whose spectrum was confined to the stereotypical industrial city and model concepts now have to incorporate the ICT industry requirements which in itself is not governed by any stringent laws making planners' roles more convoluted. Communication between any living objects is a process in which there is a transfer of information from a source to a destination. Telecommunication is an advanced medium of communication wherein the exchange of information happens over a significant distance by electronic means referring to all types of voice, data, and video transmission. Telecommunication is an umbrella term for different information- transmitting technologies and communication infrastructure like mobile phones, wired phones, radios, television broadcasting, etc. Telecommunication has two types of network systems, one is the terrestrial or as commonly known wired network (cable, wires, coax, etc.) and the other being x terrestrial or wireless medium (e.g.: - radio waves.
Telecommunication also facilitates the delivery of large-scale information in the shortest amount of time with a reduced number of errors creating a new form of a network between spaces, leading to a complex yet close-knit world.

History of telecommunication - The word telecommunication is a combination of two words wherein the prefix tele is a Greek word that means 'distant' and Communication is derived from the Latin word communicate, which means "to share" thus stating telecommunication as

[1] ICT- Information and communication technology

tools that allow sharing of information over varying distances. Following are the important event and evolutions in the field of telecommunication: -

1876 - Alexander Graham Bell invented the first-ever telephone model (Fig 1) which required an interpreter or telegrapher on both ends. These first telephones were intercom systems, where two phones were connected directly (SearchNetworking, September 2020)

1877- Switchboard (fig 2) was invented, this allowed connection of any two phone lines which enabled communication between them. (SearchNetworking, September 2020).

1891- The invention of the dial telephone (fig 3) helped eliminate the requirement of an operator which made the calls via the telephone much quicker and easier. *(SearchNetworking, September 2020).*

1896- First Radio was invented by Marconi which transmitted long-distance wireless signals over a distance of 2 kilometers.

1927- Television: Phillip T. Farnsworth demonstrated the first working television set. He had been working on a method to transmit images by encoding radio waves with an image and then project them back onto the screen making the first television prototype*. (Mitel, 2021)*

1947- The most revolutionary invention, the transistor (fig 4) (a device that regulates current or voltage flow and acts as a switch or gate for electronic signals) was developed which played an important role in the creation of modern electronics such as computers and calculators.

1948- In places where phone wires did not exist, micro-waves (fig 5) were used to transmit phone signals.

1960- the phones began transitioning from mechanical switching[2] to electronic switching [3]which allowed in developing the features like, voice messaging, speed dialing, and caller ID.

1964- IBM introduces the system/360 (Fig6) that led to computer compatibility allowing machines across the product line to work with each other. (Timetoast timelines)

1969- Arpanet was the first real network to run on packet switching technology used on the computers at Stanford and UCLA connected for the first time, what would one day become the Internet. (Timetoast timelines)

1971- Email was invented by Ray Tomlinson, who also decided to use the "@" symbol to separate the username from the computer name. (Timetoast timelines).

1975- The IBM 5100, the first commercially available portable computer (Fig5), appeared in September 1975 and was based on the SCAMP (processor) prototype. (Timetoast timelines).

1984 – Domain name system/servers (DNS) was created to allow Internet users to type in an easy-to-remember domain name and then converted it to the IP address automatically. (Timetoast

[2] Mechanical switch – is a switch in which the client must depress a button or other surface to cause a movement in the device thus activating the switch.

[3] Electronic switch - As opposed to mechanical switches which require the user to contact the switch for activation, an electronic switch does not require activation pressure.

timelines). Also, during the same year, Cellular and Personal communication service (pcs) was used in the phone. **PCS** provided the user with an all-in-one wireless phone, paging, messaging, and data service.

1989- The first proposal for World wide web was written by Tim Berners Lee which was originally coined as Mesh and later termed the world wide web.

1995- First, SSL (Secure Sockets Layer) encryption was developed by Netscape, making it safer to conduct financial transactions (like credit card payments) online *(Timetoast timelines).*

1996-2001 – Companies like Hotmail, Google, SetiHome, Wikipedia launched web-based services over these 5-6 years which has now revolutionized the way society functions *(Timetoast timelines).*

2005- first 2.5 g wireless network was developed and also YouTube was launched, making a free platform for the masses to share or host online video *(Timetoast timelines).*

2006- Australia and Taiwan launched a 3g service which superseded the 2.5g network.

2007- Mobile internet access feature launched with the innovation of iPhone in the market *(Timetoast timelines).*

2012- Smartphone usage grew extensively in the market.

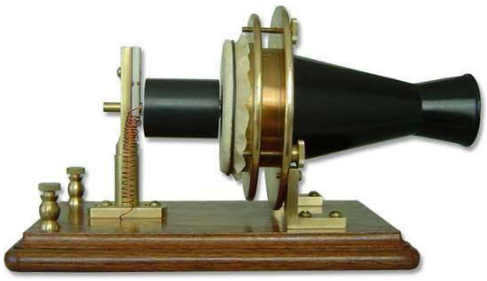


Fig 1- First telephone invented by Graham Bell. Fig 2- switchboard telephone system Fig 3-First Dial Telephone



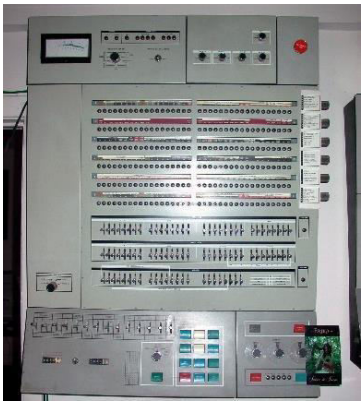
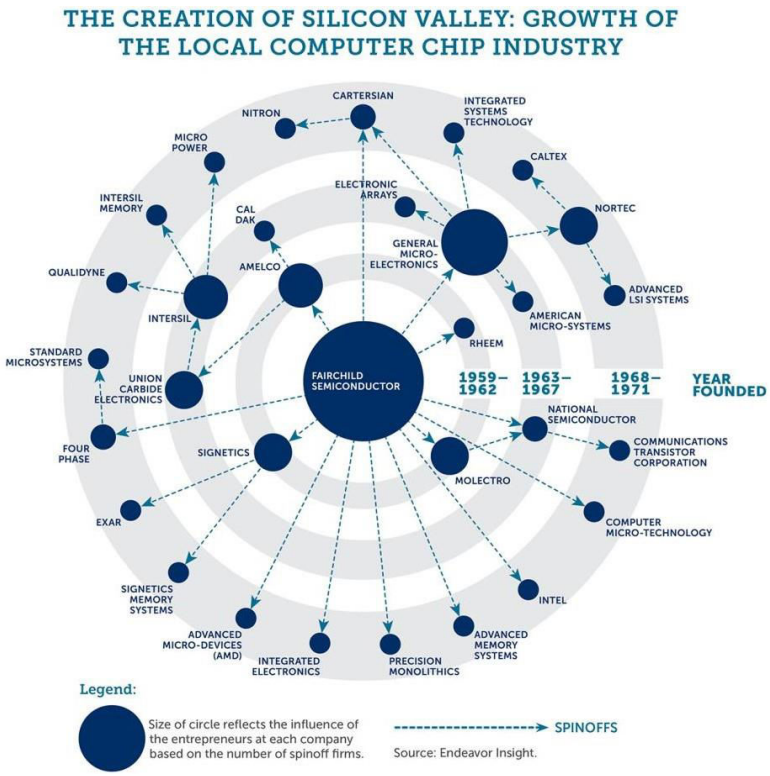


Fig 4- first Transistor Fig 5- First laptop created by IBM (1975) Fig 6: -IBM system/360.

The impact of Telecommunication on Silicon Valley

The renowned Telecommunication and Tech-hub of the world, Silicon Valley was not always like what it is today and experienced its fair share of hiccups.

Telecommunication, a child of the second industrial revolution had a lasting impact on the industry of technology which lasted up until the First world war. This era surged with technological innovations especially in telecommunication sectors focusing on areas of encoding and transmitting signals, and ultimately voice. During this time, the now known Silicon Valley area in the San Francisco bay region was going through a transformational phase. Starting in the early 1930's Santa Clara County, California, known as the Valley of Heart's Delight, was a tranquil expanse of apricot, plum, and cherry orchard and also home of the Stanford University. *(NetValley, January 2013).* The university professor Frederick Terman who liked the tranquility was still concerned about the lack of opportunities for Stanford Engineering graduates on the West coast and thus encouraged few of his students to start companies near the university. By 1950's with the Stanford university's permits and Professor Termans suggestion a part of Stanford university land was leased out to a limited high technology companies, beneficial to Stanford *(NetValley, January 2013*). In 1951 Varian Associates signed a lease, and in 1953 the company moved into the first building in the park. *(NetValley, January 2013).* Another major event which had a ripple effect in explosive boom of startups in the region was due to the establishment of Shockley Semiconductor in 1956. The company which was founded by Nobel laureate and co- inventor of the transistor William Shockley saw a fallout of 8 of its valuable employees just a year after its inception *(NetValley, January 2013*). These employees hereon formed their own company called as Fairchild Semiconductor after receiving a USD 1.5 million investment from the New York company Fairchild Camera and Instrument. After several years of Fair children's establishment, a nuclear fission (fig 7) happened with its formidable leaders leaving the company to form their own. This particular phenomenon was only possible in the Bay area due to the California state law of1872 that defended the employee's freedom of movement, the right to leave his or her employer at any moment, even to immediately go to work in direct competition with their former employer or to create a competing firm on their own *(Net Valley, January 2013*) which otherwise was not possible due to the state compliances. Thus, this unveiling of events created a divergent image of the Bay area changing its demographics in over a span of a century from farmland conducive development to an ICT sector oriented one create a new spatial plan altogether.



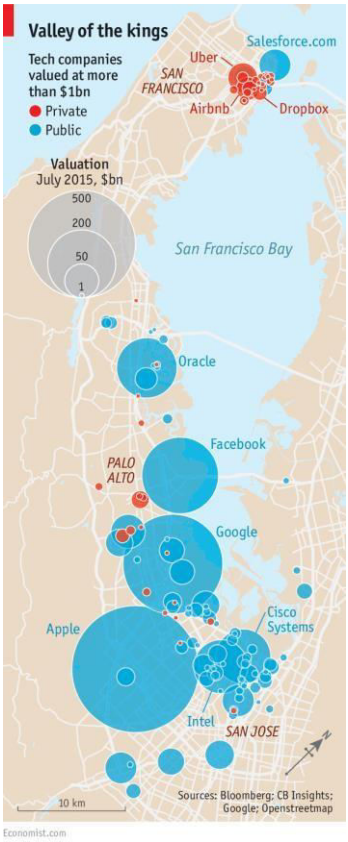


Fig 7: - the Nuclear fission effect of Fairchildren

Fig 8:-Revenue values of Silicon Valley Tech Companies.

Source: - Netvalley, January 2013. http://www.netvalley.com/silicon_valley_history.html

In the 1970's journalist, Don Hoefler documented a 3- part report on this area's semiconductor industry and titled it Silicon Valley U.S.A and it thus continued to have been stuck with the area till date. Post the Semiconductor industry boom by the late 1980s there was a new industry that aroused here in Silicon Valley about every 10 years. Of the top 15 companies [in the region], 12 of those companies were formed in the past 15 years, which generate $600 billion of revenues and employ about three-quarters of the people in Silicon Valley, and they were all entrepreneurial companies before 15 years *(NetValley, January 2013*).

In the 1990s the ecosystem of telecom services all over the globe was disrupted by the revolution caused due to the creation of the internet. The telephone industry was set on a collision course with the high-tech industry. By the turn of the century in the 2000s, the two industries, telecommunication, and the internet merged to provide a rapid pace of internet services to the communication sector and also creating newer means of Telecommunication like E-mails, Instant messengers, etc. It became the global high-tech innovation center, and the telecom industry eventually took a backfoot. In 2007 due to Apple's industry-standard business models' explosive

the effect, the telecommunication innovations, and developments were reinstated in Silicon Valley.

Facebook was established by Mark Zuckerberg in 2004 Facebook has 150 million users in January 2009 and grows by about one million users a day becoming the fastest product ever to reach that many users in five years. By 2014 the Silicon Valley had become home to two dominant smartphone operating systems, portal and search empires, powerful social networking companies; leading hardware, VoIP, and IP networking companies making it a globe tech as well as telecom hub and continues to do so till the present day.

Thus, the role of Silicon Valley is on the watch of many researchers especially due to the surge in the usage of Telecommunication mediums worldwide because of the COVID-19 Pandemic.

Fig 9: -Development in Silicon Valley post 1997 along with venture capital analysis

Impact of Covid-19 on Transportation and its substitution by telecommunication-

During the early stage of the pandemic population movement and transportation infrastructure that increase inter-and intra- urban connectivity, were considered as key factors contributing to the spread of infectious diseases, (Ayyoob Sharifi, December 2020). Different studies over the past few months also confirmed the effect of mobility patterns and how their restriction correlated with the containment of the spread of the disease. A substantial amount of association was found between the frequency of air flights and high-speed rail services and the number of

infected people in the destination cities. It was argued that these travel modes not only increase the risk of infection of travelers but also play a significant role in the increase of the number of confirmed cases in the destination cities (Ayyoob Sharifi, December 2020). The reviewed literature also shows that the pandemic will have a long-lasting impact on the mobility patterns while promoting a virtual medium of communication creating a positive impact on the telecom industry during trying time. A shift from Transit modes to a private vehicle or active mode of transportation is also observed in many countries owing to the rise of Covid-19 and this trend seems to lasting effects in the new normal in case of lack of safer travel regulations being implied. Thus, the impact of travel restriction implemented due to pandemics (as seen above) where curbed to a larger extent (especially in cities) due to the presence of strong ICT infrastructure. These facilities played an important role in saving the economies from crumbling due to the outbreak and aiding along with other front-line workers to keep the society up and running. Also, as per literature reviewed on this shift, it is analyzed that this trend of virtual economic environment will continue in the new normal especially in the IT industry. The following chart shows the major impacts on transportation in covid-19 and future implications/ recommendations for post-covid-19 planning

Fig: - 10 shows the major impacts and implications in the transportation planning

Source: -(Ayyoob Sharifi, December 2020).

Theme		Major issues revealed by the pandemic	Major recommendations/implications for post-COVID planning
Transportation and urban design	Transportation	- Increased transport connectivity is a risk factor that may contribute to the diffusion of infection diseases - Public transportation may increase the risk of transmission during pandemics - The pandemic may increase negative attitudes towards public transportation	- Smart mobility restrictions, based on the transmission risk of different transportation modes, is essential for containing the spread of the virus - More attention to minimizing potential public health risks of public transportation is needed - Modal shift to cycling and walking offers a unique opportunity to further promote active transportation

.

Information and communication technology investments and policies

The role of the government and regulated monopolies in controlling the shape of the new telecommunication systems and ICT sector have been limited during the early stage of industries development, leaving urban planners and policymakers to determine strategies for a field on which they had relatively less control. The ICT sector boom, especially due to the internet and web-based field developments probed the government to intervene in this sector and include tangible rules and regulations regarding the same. The growth of the ICT sector even instigated its data publishing under United States Census Bureau which first released a survey in 2005. Starting from 2003 wherein U.S. businesses with employees invested $229.3 billion on information and communication technology (ICT) equipment, including computer software (*United States Census Bureau, 2005*), the sector has only seen an upward trend in investments from hereon. The latest survey conducted in 2013 demonstrated that there is a growth of over $100 billion investment in this sector since 2003. In the 2013 survey, nonfarm businesses with employees spent a total of $330.9 billion on noncapitalized and capitalized information and communication technology (ICT) equipment, including computer software. The Noncapitalized ICT spending in 2013 was $118.0 billion and Capitalized ICT spending in 2013 was $212.9 billion (*United States Census Bureau, 2005*). During the present-day scenario of the Covid-19 pandemic where almost the whole world has shifted to a virtual environment for its survival, the role of ICT and telecommunication systems has amplified beyond measures. This increase in usage has only accelerated the rate of investment in ICT and has led Congress and federal agencies to take policy-related action to ensure that Americans stay connected during the COVID-19 crisis and thus establish a CARES.

Act *(Akin Gump, March 2020)*.

The w H.R. 748, the **Coronavirus Aid, Relief, and Economic Security (CARES) Act** was signed by the U.S. president on 27th March 2020 to provide funding support for Coronavirus related effects taken by different federal agencies to support the telecommunication services and devices *(Akin Gump, March 2020)*.

The following funding support was provided by the respective federal agencies: -

$200 million to the Federal Communications Commission (FCC) to support telehealth services, including devices.

- $25 million for the USDA's Distance Learning, Telemedicine (DLT), and Broadband Program.
- $100 million in funding for the USDA's ReConnect Program

• $13.2 billion to the Education Department for an "Elementary and Secondary School Emergency Relief Fund," which defines eligible uses as including the purchase of educational technology (including hardware, software, and connectivity) for students"

• $75 million for the Corporation for Public Broadcasting (CPB)

• $50 million in funding to the Institute of Museum and Library sciences to help public libraries. expand digital network access, purchase internet accessible devices, and provide technical support to communities *(Akin Gump, March 2020).*

The Federal Communications commission (FCC) under the CARES Act asked the service providers to take the 'Keep Americans Connected Pledge' which included the 60-day service nonterminal commitment in case of non-bill payments and late fee waivers.

Another important decision of FCC included the temporary waiver of certain rules to ensure the continued availability of TRS for deaf and hard-of-hearing consumers during the COVID-19 pandemic, enabling more interpreters to provide remote interpreting from home, rather than in call centers *(Akin Gump, March 2020).*The most important action pertaining to the telecom industry included the wavier of Access arbitrage for conference calling services, additional spectrum access and Temporary Access to Spectrum in the 5.9 GHz band Granted to Fixed Wireless ISPs to Meet Increased Demand for Rural Broadband which kept the economic society up and running *(Akin Gump, March 2020).*

Thus, the above-mentioned policy changes dawned upon due to the COVID-19 pandemic have made a permanent impact on U.S. Policies and have demonstrated the importance of ICT sector and the need for the sectors infrastructure development. These policy trends also showcase the post Covid-19 new normal changes and how the transitional phase will include a major chunk of ICT influence on the society greater than before.

Covid-19 Impacts on telecommunication

The Covid-19 pandemic has more so than ever demonstrated the critical importance of the telecommunication and infrastructure industry and how it has turned out to be a boon for the smooth functioning of a large number of sectors in society during such trying times. Billions of People across the globe relied on the technology and telecom industry for information, social distancing, and for availing work from home privileges.

The telecommunications sector has seen tremendous technological advances over the past few decades, with mobility, broadband, and internet services growing beyond measures, creating a network across the globe. According to the International telecommunication union, there were

about 4 billion internet users by the end of 2019 and has only seen a tremendous increase since the pandemic. The rise of the novel Coronavirus (COVID-19) has brought a series of 'black swan' events for the entire telecom industry *(ComSoc tech blog, August 2020)*. People and businesses are shifting to digital means to manage their workloads, which has led to an unexpected surge in fixed and mobile network traffic and access demands. Thus, along with the gains that the telecom sector experienced due to the pandemic it also had to tackle its fair share of disrupting events. It is of utmost importance to understand the hardships faced by the sector before knowing the gains. The sudden surge in usage and reliability of various has been largely disruptive for the telecommunication industry as within a matter of days it became a primary source of sustenance for medical, government, private sector business as well as schools and colleges.

Following are the few key areas of the telecom industry which were impacted by the outbreak: - **Ensuring resilient connectivity 24/7 -** Wireless Telecom operators are allocating spectrum resources to provide round-the-clock Internet connections to mobile subscribers for which in the

U.S. under the CARES Act (as mentioned above) service providers were given access and temporary waivers for increased spectrum utility.

Increase in Cloud Computing: - As businesses are proceeding with their work remotely, demand for video conferencing services and SaaS[4] applications is continuously rising. Businesses are keen to adopt this new cloud-based model of working as they realize increased productivity with less investment in office space. Therefore, companies gain business benefits over the long-term *(ComSoc techblog, August 2020)*.

Digital payments and transactions: - With all the economic activities functioning virtually it was essential to develop the same environment for financial activities. Following The social distancing norm, the service user or customer nowadays preferred the payments digitally via UPI apps, net banking, or credit/ debit cards rather than in cash thus leading to increased pressure on the service providers especially in terms of transaction security standards.

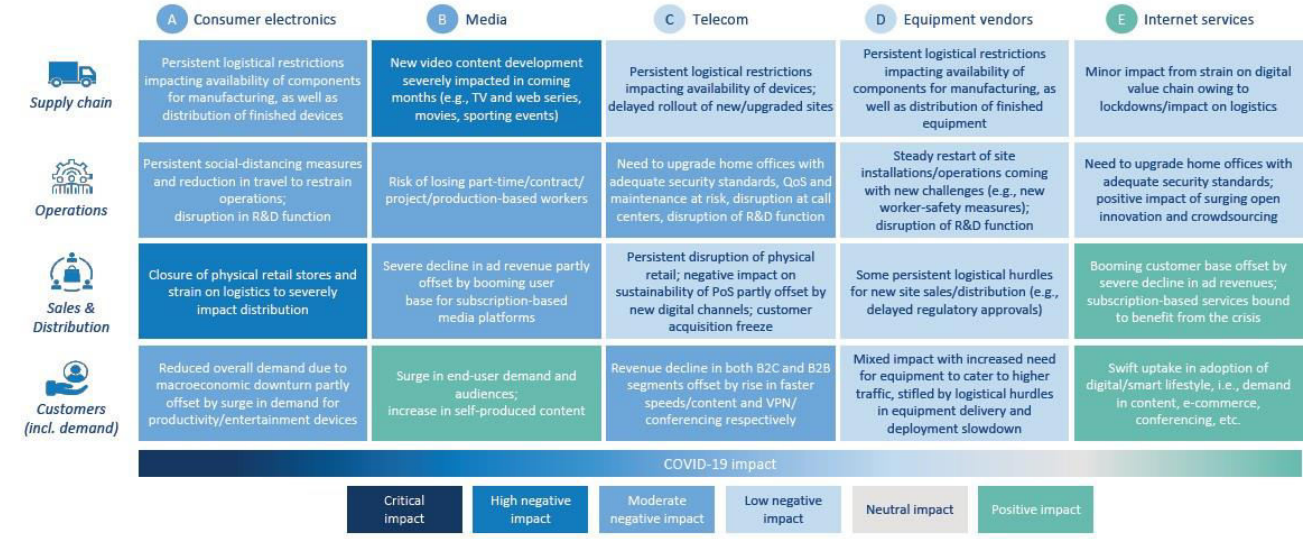
Security to combat vulnerabilities: - Cloud resources are accessed online and ease in restrictions led to an increase in cyber-attacks. Cybersecurity engineers need to act on developing strategies to strengthen remote connectivity with proper authorization procedures and thus the field saw a sudden spike in employment. Mobile customer transactions need enhanced security with mobile intelligence-based approaches to prevent fraudulent transactions *(ComSoc techblog, August 2020)*.

[4] SaaS- Software as a Service.

Resolution of customer queries through a virtualized support solution: - In this virtual environment, along with providing faster service the resolution of customer queries, bugs, and establishment of troubleshooting abilities is also of utmost importance for the service provider. Hence to do so the video conferencing was opted to do so.

On average, each of the telecom, media, and technology sectors showed relatively strong resilience to the short-term adverse impact from COVID-19. However, in the medium term (2020 and 2021 financials), certain sectors are expected to fare better while others are more deeply impacted (Arthur.D. Little, June 2020). The following chart describes five of the ICT sectors based on the four major factors – Supply chain, Operations, Sales & distribution, and Customer.

Figure 1: COVID-19's medium-term impact on the telecom, media and technology sectors



Source: Arthur D. Little analysis

Fig 11: - Describes the COVID-19 Impact on five sectors of ICT based on Four major components

The Positive impact of Covid-19 on ICT-

Even though the pandemic severely affected other sectors of society many telecom sectors have benefited from the surge in data traffic due to increased usage. The telecom industry apart from the health and food industry was considered as an essential service due to increased work from home requirements and reliance on virtual video-conferencing applications.

The telecommunication sector's response to the advent of these events was a prudent one even in the face of uncertainties. Right from developing better-performing systems to tasks of construction new/ additional network facilities were judiciously fulfilled by the sector's major provider. While in the case of the lower-income customer group, an initial reluctance was noticed by the providers but with the increased surge in the pandemic, the companies also advanced their

infrastructure ignoring the financial risk induced by this increase. In the case of Mobile and broadband operators, the outbreak caused a short-term disruption in terms of slowed speed due to increased demand but was tackled in no time due to the expansive nature of this service industry. Also, the Businesses' expenditure on cloud-based infrastructure (public, hybrid clouds, back-up, platform resources) is forecast to increase by c.50% vs pre-Covid levels by the end of 2022 (OC*&C Strategy Consultants 2020*). The curtailing of face-to-face activities, selling, and supporting customers digitally has become paramount: this means moving existing sales resources to the right places, and more emphasis on digital lead-gen, digital marketing events, collaborative sales tools, automated provisioning, and responsive service models are on the forefront of business strategies rather than spatial requirements and material sourcing (OC*&C Strategy Consultants 2020*). With the change in demand patterns and more flexible working expected to be part of the New Normal, it is about time that we as planner get out of the realm of fixed costs/ property/ industrial development and embrace the rising importance of ICT's and incorporate policies and planning norms conducive for their growth.

The following chart shows the impact on various ICT components crucial in the pandemic era and will show their growth rate based on the lockdown, lifted restrictions, and new normal phases.

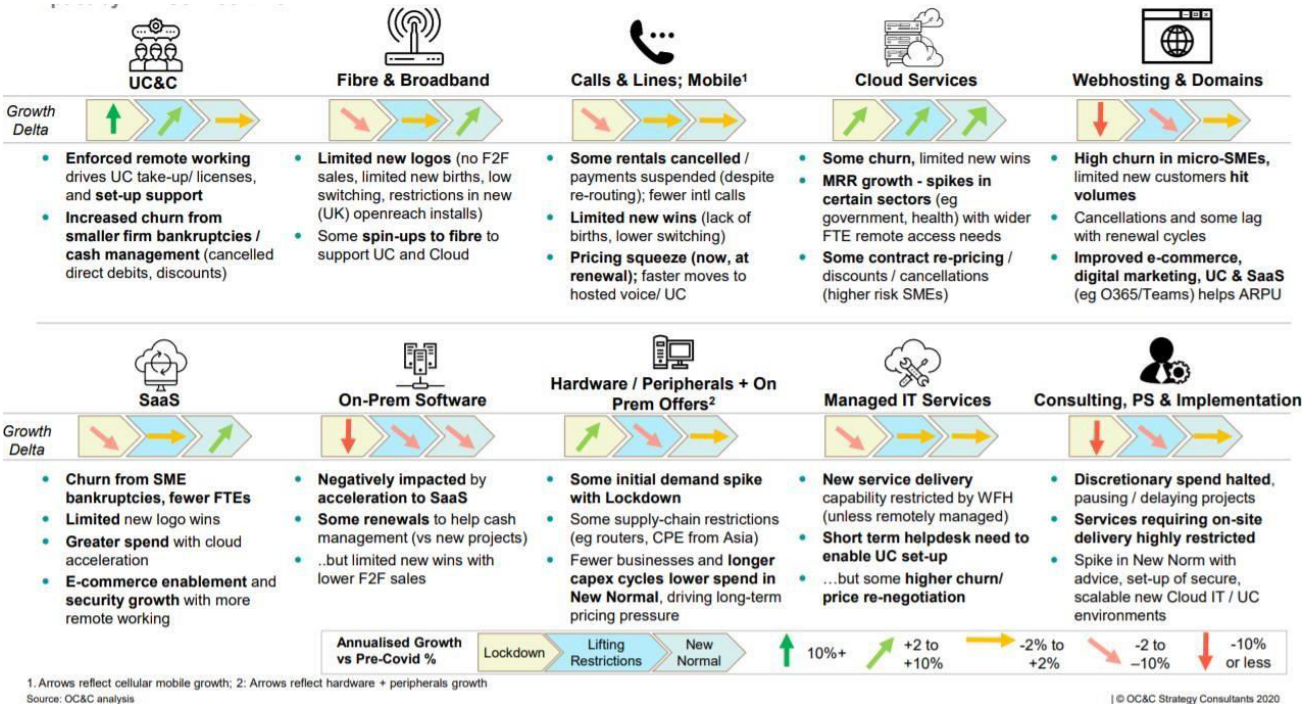


Fig 12: - Shows the bifurcation of ICT components and their growth rate based on the time frame.

Source: - (*OC&C Strategy Consultants 2020.*)

Conclusion – The Covid-19 pandemic since its occurrence has changed the perception and functioning of the society around the global. The literature reviewed in this study makes us understand the pandemics impact on the telecom and ICT sector while presenting situation which demonstrate the lack in planning of the cities. Clearly the cities need to re- evaluate their planning policies and also work on reducing the existing socioeconomic inequalities which threaten the public health by making it difficult to enforce protective measures such as social distancing (Ayyoob Sharifi, December 2020).

The pandemic is expected to fundamentally alter how cities are managed/governed in the future. In this regard, actions taken within the next few years are important and determine whether post- COVID cities will be developed and managed in a more sustainable manner(Ayyoob Sharifi, December 2020). The pandemic has shown numerous opportunities which could be capitalized by planners starting from creating economic development policies. Another one being the shift created in transportation leading to lesser number of public transport users but also providing a unique opportunity cause due to the rise in number of cyclists. Planner's can take advantage of this situation and create policies to promote cycling culture in the cities.

The increase in virtual office, government and school environments should also be considered while planning the new normal by providing due diligence to the ICT sector requirements. Along with the limitations probed due to the dynamic nature of this pandemic the study here highlights the need for critical reflection of the existing conditions to foresee planning requirements of the future.

References

1. Mitchell L. Moss. December 1987. Urban Studies, Vol. 24, No. 6, pp. 534-546, Telecommunications, World Cities, and Urban Policy. https://journals.sagepub.com/doi/10.1080/00420988720080771

2. International finance corporation. COVID-19's Impact on the Global Telecommunications Industry. https://www.ifc.org/wps/wcm/connect/1d490aec-4d57-4cbf-82b3-d6842eecd9b2/IFC-Covid19-Telecommunications_final_web_2.pdf?MOD=AJPERES&CVID=n9nxogP

3. Leo Clifford. March 2020, Coronavirus Impacts the Telecommunications and Technical Services Industry. https://www.linkedin.com/pulse/coronavirus-impacts- telecommunications-technical-leo-clifford/?articleId=6648005935530815488

4. Telecom Council. Published JUNE 25, 2014 · Updated JANUARY 4, 2019. A View from the Top: The Unexposed Evolution of Telecom in Silicon Valley. http://blog.telecomcouncil.com/blog/infographic/

5. Wesley Chai. September 2020. telecommunications (telecom) https://searchnetworking.techtarget.com/definition/telecommunications-telecom

6. Corey Protin, Matthew Stuart, and Matt Weinberger Dec 18, 2020. Animated timeline shows how Silicon Valley became a $2.8 trillion neighborhood. https://www.businessinsider.com/silicon-valley-history-technology-industry-animated- timeline-video-2017-5#:~:text=In%201971%2C%20journalist%20Don%20Hoefler,center%20of%20the%20computer%20industry

7. Ayyoob Sharifi, Amir Reza Khavarian-Garmsir, Dec 2020. The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management, Science of The Total Environment, Volume 749, https://www.sciencedirect.com/science/article/pii/S0048969720359209

8. Akin Gump, March 2020. Supporting the Telecommunications Industry Through the COVID-19 Crisis. https://www.akingump.com/a/web/2nTLnz2oXGzo7JjbQKKmPt/cdpTp/covid-19- telecommunications-update.pdf

9. Denby, Timetoast. The History of ICT https://www.timetoast.com/timelines/27704

10. OC&C Strategy Consultants, April 2020. ICT Services: Financial impacts on a "critical enabler" in a Covid-19 world. https://www.occstrategy.com/media/2678/ict-and-digital-services-covid19-impacts.pdf

11. Arthur.D. Little, June 2020. Telecom, media, and technology – COVID-19 implications and medium-term recovery. https://www.adlittle.com/en/insights/report/telecom-media-and-technology-%E2%80%93-covid-19-implications-and-medium-term-recovery

12. Gregory Gromov, NetValley. Silicon Valley (history & future). http://www.netvalley.com/silicon_valley_history.html

13. United States Census Bureau, March 11, 2015. 2013 Information and Communication Technology Survey Publication. https://www.census.gov/library/publications/2015/econ/2013-icts.html

14. Alan Weissberger, IEEE ComSoc, August 27, 2020.COVID-19 Challenges faced by Telco's and Impact on the Telecom Sector. https://techblog.comsoc.org/2020/08/27/covid-19-challenges-faced-by-telcos-and- impact-on-the-telecom-sector/