Theorizing India's Anomalous Tech Trajectory: Key Trends in Information and Communication Technology Growth in the World's Largest Democracy, 2001-2016

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Abstract: India's communication technologies serve a surging population of 1.36 billion, which is roughly one-sixth of the world's people. This study identified and theorized anomalous trends in India's technology trajectory during the rapid growth in digital technologies from 2001 through 2016, the critical years of digital technology proliferation in India. **Overview:** Detailed analyses of International Telecommunication Union (ITU) data indicated atypical trends in India's information and communication technologies (ICTs) growth. **Theory & Research Method:** Based on the diffusion of innovation theoretical framework, case study analyses of publicly available ITU data provided insights into key trends in India's ICT growth, when compared with corresponding trends worldwide. The first five of the study's 10 research questions explored India's ICT growth. Five additional research questions compared India's ICT growth with worldwide trends in Internet-linked households, Internet users by world regions, global Internet use in developing and developed nations. **Conclusion:** Over the 16-year period studied, India's ICT growth, signified an exponential rise in mobile-cellular subscriptions, moderate growth of Internet users, sharp fall in fixed-telephone subscriptions and moderate fixed broadband subscriptions. Despite anomalous growth, India's ICT growth has empowered India's citizens and fueled the nation's aspirations for a better future with technology through ICT growth.

Keywords (8-12 keywords): information and communication technology growth in India, mobile phones in India, mobile access in India, Internet-linked households in India, Internet users in India, Internet access in India, Internet users by levels of development, Internet users in developing and developed nations, Internet users by world regions.

Introduction

"India's contribution towards the fourth industrial revolution would leave the world stunned… #DigitalIndia has brought data to the villages; India has the highest mobile data consumption in the world and is also the country where data is available at the lowest price."

-- India's Prime Minister Narendra Modi inaugurating the Centre for Fourth Industrial Revolution (Modi, 2018).

Prime Minister Narendra Modi's exuberance about the power of technology to transform India has motivated his resolve that the "fourth industrial revolution" would usher "irreversible positive change" in India (Modi, 2018). A spirit of positive change also inspired Modi to launch in July 2015 a "Digital India" initiative to enhance the nation's digital infrastructure to benefit every citizen with improved governance and services. The Digital India initiative also seeks to transform India with digitally-empowered citizens and a technology infrastructure that bridges India's gaping digital divide.

Modi's technology initiatives embraces a nationwide determination to transform India into a global hub of research and tech prowess by improving its digital infrastructure (Modi, 2018). Modi enunciated his enthusiasm about India's potential in the Fourth Industrial Revolution by articulating how previous industrial revolutions have eluded India. Citing India's colonial rule, Modi observed that India was not an independent nation (being under British rule) during the First Industrial Revolution of 1750-1840 and the Second Industrial Revolution of 1870-1914 (Modi, 2018). After freedom from British rule in 1947, India was struggling with challenges of a newly independent nation during the Third Industrial Revolution of 1969-2000, as Modi observed (Modi, 2018).

Since its independence in 1947 from British rule, India has achieved sustained growth and high levels of information and communication technologies (ICTs) investment and innovation. With 21st century investments in mobile cellular telephony, mobile-broadband, India has increased wider connectivity and implemented continued progress in ICTs. The rapid rise in fixed and mobile-broadband infrastructure has benefited India's citizens with improved Internet access, mobile telephony and online services. Besides documenting such rapid growth, this study theorizes anomalous trends in India's ICT growth.

Research Objectives: Technology Transforms India

Relevant to the *Global Media Journal*'s special issue themed "South Asia in the wake of Communication Revolution," this study analyzed International Telecommunication Union (ITU), this study identified and theorized anomalous trends in India's technology trajectory data from 2001-2016, the critical years of tech proliferation in India. Based on the diffusion of innovation theoretical framework, case study analyses of publicly available ITU data provided insights into key trends in India's ICT growth, when compared with corresponding trends worldwide. The study's first five research questions focused on India's ICT growth. Five additional research questions compared India's ICT growth with worldwide trends in Internet-linked households, Internet users by world regions, global Internet use in developing and developed nations. Over the 16-year period studied, India's ICT growth signified an exponential rise, albeit anomalous, in mobile-cellular subscriptions, moderate growth of Internet users, sharp fall in fixed-telephone subscriptions and moderate fixed broadband subscriptions. This study also compared India's ICT growth with corresponding trends worldwide to conclude that despite anomalous growth, India's ICT growth has empowered India's citizens and fueled the nation's aspirations for a better future with technology through ICT growth.

Significance of India's ICT growth

India provides fruitful ways to explore the evolution of technology in the nation. India attained the moniker of the world's largest democracy based on its surging population of 1.36 billion (Census of India**,** 2011; Worldometers, 2018), which ranks second after China. India's population is projected to exceed China's by 2030 to become the world's most populous country. India's ICT cater to this surging population of citizens from a diverse culture in a nation that is at the cusp of a digital media revolution. India's proliferating news media inform, educate, empower and entertain a burgeoning population of 1.36 billion, which is roughly one-sixth of the world's people. As the world's largest democracy, India provides intriguing insights to research the role of ICTs in a democratic society. It is, therefore, important to theorize India's ICT growth.

Literature Review and Theoretical Framework

ICTs enable audiences to engage with media content shared by friends and family besides direct media interactions for sense-making of public and personal community. Based on the diffusion of innovation theoretical framework, this study incorporated case study analyses of publicly available ITU data to understand and to trace the key trends in India's ICT growth. The diffusion of innovation theory studies the process by which an idea, practice, or object perceived as new by an individual or other unit of adoption is communicated through certain channels over time and among the members of a social system. Diffusion of innovation theory primarily studies how people adopt new products, services and even ideas with time as a primary variable to measure. It is an applicable theory for India's ICT growth new media, because it provides a means of predicting the adoption of new technologies.

Based on a meta-analysis of diffusion studies Rogers, refined diffusion of innovations with a list of characteristics of innovations, categories of adopters of innovations, steps in their decision process, and categories of consequences resulting from adoption (Rogers, 1962; Rogers, 2003). Rogers' five criteria for adoption of innovations may be aptly applied to India's ICT growth, especially in relation to use of technologies. They are: *Relative advantage* (are the new media as accessible, fast or complete? What are the relationships of various advantages and disadvantages when compared to competing media?), *Compatibility* (with previous media and experiences, such as earlier versions of smartphone interfaces), *Trialability* (availability for "preview" use; for example, the low cost mobile phones that are now ubiquitous), *Observability* (of results), and *Complexity* (the learning curve), as enunciated in theoretical constructs of diffusion of innovations in (Rogers, 1962; Rogers, 2003).

Rogers also identified the various stages of how an innovation is adopted. He combined studies on information flow with findings from the flow of how information and personal influence in various fields like anthropology, sociology and rural agricultural extension. Rogers identified five major types of people in regards to adopting new types of innovations: Societal level-innovators, Early adopters, Early majority, Late majority, and Laggards (Rogers, 1962; Rogers, 2003).

Research Questions

Applying a range of theoretical perspectives, analyses of ITU data from 2001-2016, the critical years of tech proliferation in India, were conducted to identify and theorize trends in India's ICT growth through 10 research questions, as listed below:

Research Question #1: Over 2001 through 2016, what characteristics define India's information and communication technology developments comprising changes in mobile-cellular subscriptions, individuals using the Internet, fixed-telephone subscriptions and fixed broadband subscriptions? What are some significant trends?

Research Question #2: Over the 2001-2016 time span, how have India's mobile-cellular subscriptions grown? How do India's mobile-cellular subscriptions compare with worldwide trends?

Research Question #3: How do India's fixed-telephone subscribers compare with global trends worldwide over 2001-2016?

Research Question #4: How do India's Internet users compare with individuals using the Internet worldwide over 2001 through 2016?

Research Question #5: Over 2001 through 2016, how have India's fixed broadband subscriptions changed when compared with other users worldwide?

Research Question #6: Over 2001 through 2016, what significant trends signify Internet users worldwide (per 100 inhabitants)?

Research Question #7: What significant trends characterize Internet-linked households classified by global regions?

Research Question #8: What significant trends characterize Internet users worldwide per 100 inhabitants classified by global regions?

Research Question #9: Over 2001 through 2016, what significant trends signify households worldwide with Internet access categorized by level of development?

Research Question #10: How have Internet users in developing and developed nations changed from 2008 to 2017?

As outlined above, the first five research questions focused on India's ICT growth. Five additional research questions compared India's ICT growth with worldwide trends in Internet-linked households, Internet users by world regions, global Internet use in developing and developed nations. Research Questions 1 through 5 identified key trends in India's ICT developments comprising changes in mobile-cellular subscriptions, individuals using the internet, fixed-telephone subscriptions and fixed broadband subscriptions over a 16-year period, from 2001-2016. Research Questions #6 through 10 analyzed worldwide trends in Internet-linked households, Internet users by world regions and Internet access in developing and developed nations.

Research Method: Case Study of India's ICT Growth

Using a case study research method, analyses of publicly available ITU data focused on the 10 research questions on key trends in India's ICT growth. This study makes an important contribution to the research literature with its detailed analysis of key trends based on detailed analyses of data from the ITU. As the United Nations specialized agency for ICT, the ITU is widely recognized as the sole repository of the world's most reliable and impartial global data and analysis on the state of global ICT development. The ITU data on ICT also provides a unique benchmark of the level of ICT development in countries across the world and is extensively relied upon by governments, international organizations, development banks and private sector analysts and investors worldwide.

The intrinsic value of the case study method is its potential for coherent connections to theory (Glenwick & Jason, 2016; Yin, 2014; Creswell, 2013; Patton, 2002). Eisenhardt (1989) has outlined how case study research can be designed to build theories. The research design for this case study constituted quantitative and qualitative methodological perspectives that formulate an inclusive and detailed analysis of the evolution and significance of India's ICT growth.

Bartlett & Vavrus (2017), Creswell (2014), Maxwell (2013), and Denzin & Lincoln (2011), Merriam (2009) have emphasized that case studies should incorporate the theoretical and philosophical underpinnings of the research paradigm. This case study merges ICT concepts with analyses of multiple cases of India's growth in mobile-cellular subscriptions, individuals using the Internet, fixed-telephone subscriptions and fixed broadband subscriptions. This study focused on increasing the number of compared cases to mitigate research bias because studies based on a single case increase "the risks of misjudging of a single event and of exaggerating easily available data" (Voss, Tsikriktsis, & Frohlich, 2002, p. 202; Ragin, 1987). The research reported in this

study reduced possible methodological flaws by increasing the number of ICT areas for study and analysis. This case study also enhanced its methodological rigor by drawing upon a range of relevant cases, as recommended by pertinent studies (George & Pratt, 2012; Jaeger 2005; Lee, 2014).

The key trends reported in this original research study are based on ITU data. The case study research was enhanced with theoretical constructs that advanced the exploration of free speech in India's democratic society (Price, Verhulst, & Morgan, 2013) and the transformative power of media (Fortner & Fackler, 2010; Price et al., 2013).

Key Trends in India's ICT Growth

With facts and figures arranged in figures, this section provides a discussion of the results. In reporting the results, this section follows the format outlined by Stempel and Westley (1989). The research questions are discussed in sequential order, with a clear statement for each question. The text, interwoven with figures, wherever appropriate, reports differences in analysis findings, focusing on those that are statistically significant.

Results Related to the First Research Question: India's ICT Revolution

The first Research Question analyzed: "Over 2001 through 2016, what characteristics define India's information and communication technology developments comprising changes in mobile-cellular subscriptions, individuals using the internet, fixed-telephone subscriptions and fixed broadband subscriptions? What are some significant trends?"

Based on analyses of ITU's latest available ICT data (ITU, 2017) for this case study, India's information and communication revolution (see Figure 1: India's information and communication technology developments, 2001-2016) indicate a sharp rise in mobile users with moderate increase in India's Internet users.

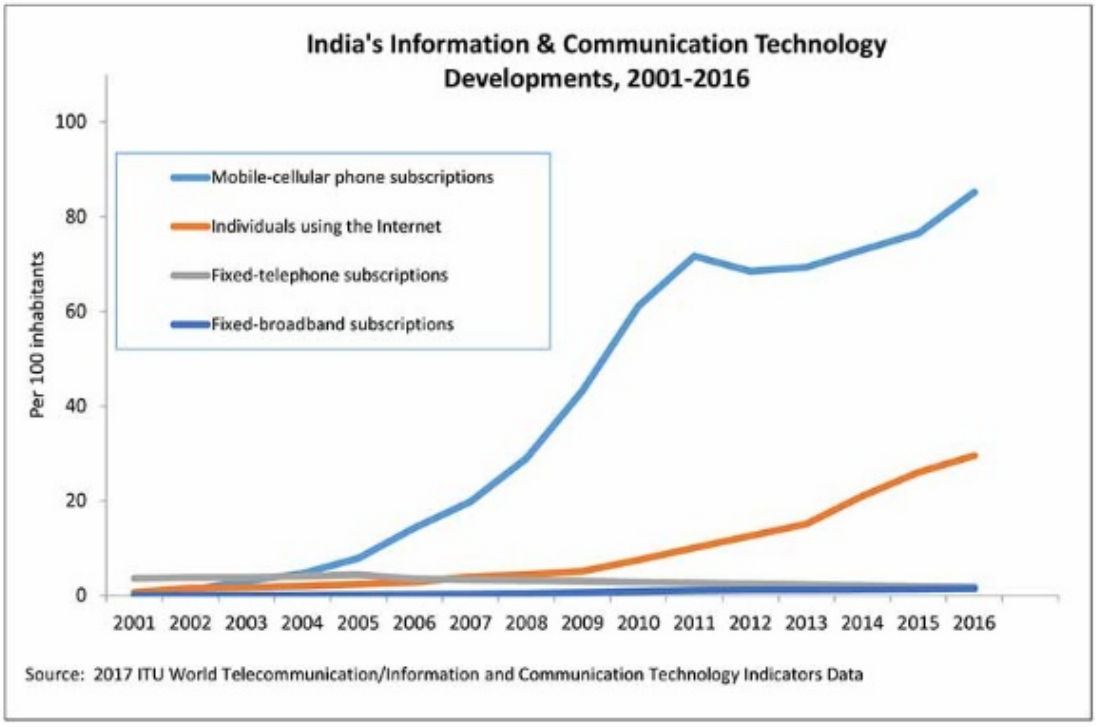

Figure 1: India's information and communication technology developments, 2001-2016

While India's Internet users have increased significantly in 16-year period studied, the mobile phone usage has increased dramatically since 2004, and still shows signs of increasing further. At the same time, a sharp fall in fixed-telephone subscriptions indicates the rise of India's mobile phone users. Although the concept of the smart phone has been in the works since the 1990s, the much-vaunted unveiling of the Apple iPhone in January 2007 led to a worldwide adoption of Internet linked computer-based phones. As a further innovation to the smartphone, India developed inexpensive phones. As a result, India's mobile-cellular subscriptions increased from 1 per 100 inhabitants in 2001 to 80 in 2016. India's Internet users also increased from 1 per 100 inhabitants in 2001 to 23 in 2016. Such trends indicate the popularity of the Internet linked smartphones as the catalyst for growth in mobile subscriptions. Fixed-telephone subscriptions sharply declined due to the advent of smartphones. Fixed broadband subscriptions plateaued over 2001 through 2016, the period researched and reported in this study.

Growth of India's Mobile-Cellular Subscriptions Compared with Worldwide Trends, 2001-2016 (Results Related to the Second Research Question)

Research Question #2 explored: "Over the 2001-2016 time span, how have India's mobile-cellular subscriptions grown? How do India's mobile-cellular subscriptions compare with worldwide trends?" Analyses of ITU's latest available ICT data indicate that mobile phone users in India have sharply increased when compared with worldwide use from 2001 through 2016 (see Figure 2: Growth of India's mobile-cellular subscriptions compared with worldwide trends, 2001-2016), based on analyses of ITU (2017) data. The rising trend of India's mobile users seems more relevant because people in India use their mobile phones to access the Internet. With lower prices for mobile service and reduced prices of mobile devices, consumers in India are using their mobile phones for activities such as connecting with friends and family, accessing media content and engaging in entertainment.

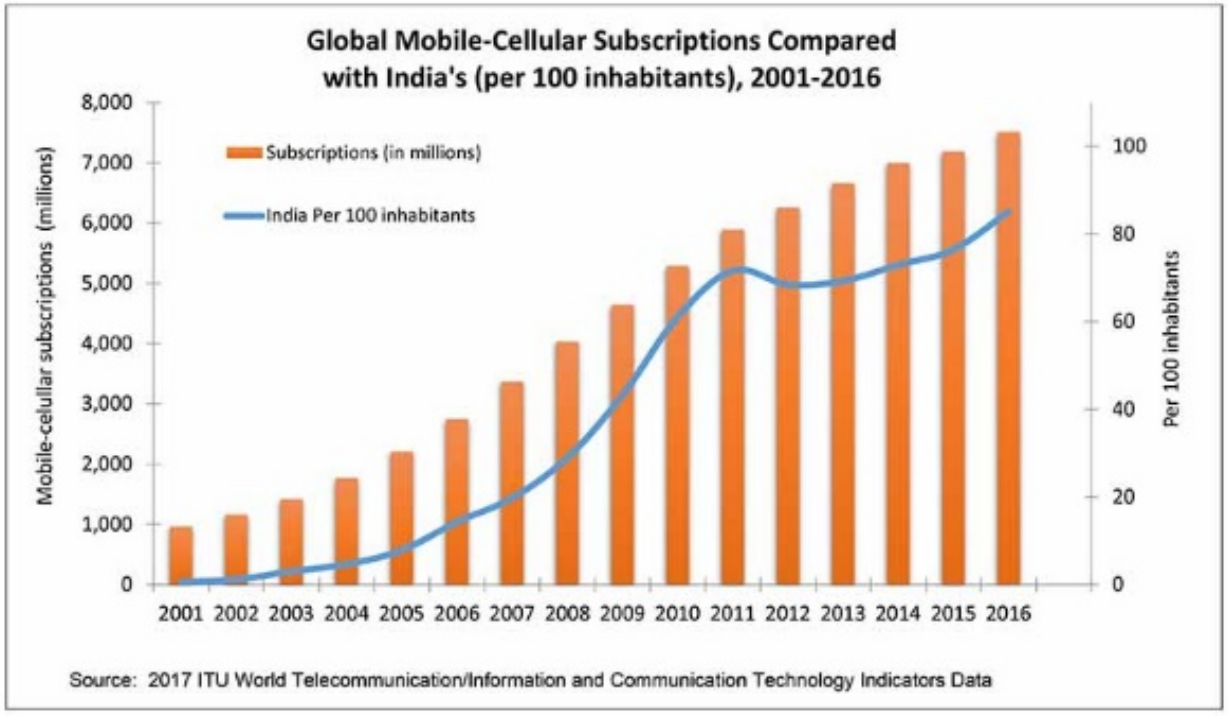

Figure 2: Growth of India's mobile-cellular subscriptions compared with worldwide trends, 2001-2016

The proliferation of mobile phones in India transcends the urban-rural divide. With companies offering various levels of service and apps like WhatsApp making it so easy to connect with the larger family and community, the mobile phone adoption in India has been over 80% of the population, as shown in Figure 6.

India's Mobile-cellular telephone subscriptions per 100 inhabitants is high and on the rise but low (87.28 in 2017, up from 72.96 in 2014 and 1.19 in 2002) but lower in comparison with China (104.58 in 2017, up from 92.52 in 2014 and 15.86 in 2002), and far less than United States (122.01 in 2017, up from 120.68 in 2014 and 49.32 in 2002), and the United Kingdom (119.63 in 2017, down from 120.68 in 2014 and up from 82.95 in 2002), according to latest available ITU statistics (ITU, 2018).

Diffusion of innovation theory posits that innovations follow a bell-curve signifying fall in adoption after a peak. However, the growth of India's mobile-cellular telephones seems to be beating the bell curve. Proliferation of smartphones in 2011 led to a significant spike in mobile-cellular telephone subscriptions, up from less than 1 % in 2001 to 72 71 % in 2011.

India's Declining Fixed-Telephone Subscribers Compared with Global Trends, 2001-2016 (Results Related to the Third Research Question)

Research Question #3 investigated: "How do India's fixed-telephone subscribers compare with global trends worldwide over 2001-2016?" Analyses of ITU (2017) data indicate India's declining fixed-telephone subscribers compared with global trends, 2001-2016 (see Figure 3: India's declining fixed-telephone subscribers compared with global trends, 2001-2016). Like other developing nations, fixed-telephones were more of an urban device. The rise of mobile phones have obviated the need for fixed landline telephones.

As delineated in Figure 3, India was affected by low numbers of fixed-phone subscribers to begin with. Adding more fixed-phone subscribers involves new infrastructure investments to reach individual homes and businesses. Instead, the rise of mobile phones has substituted the lack of fixed-phone subscriptions.

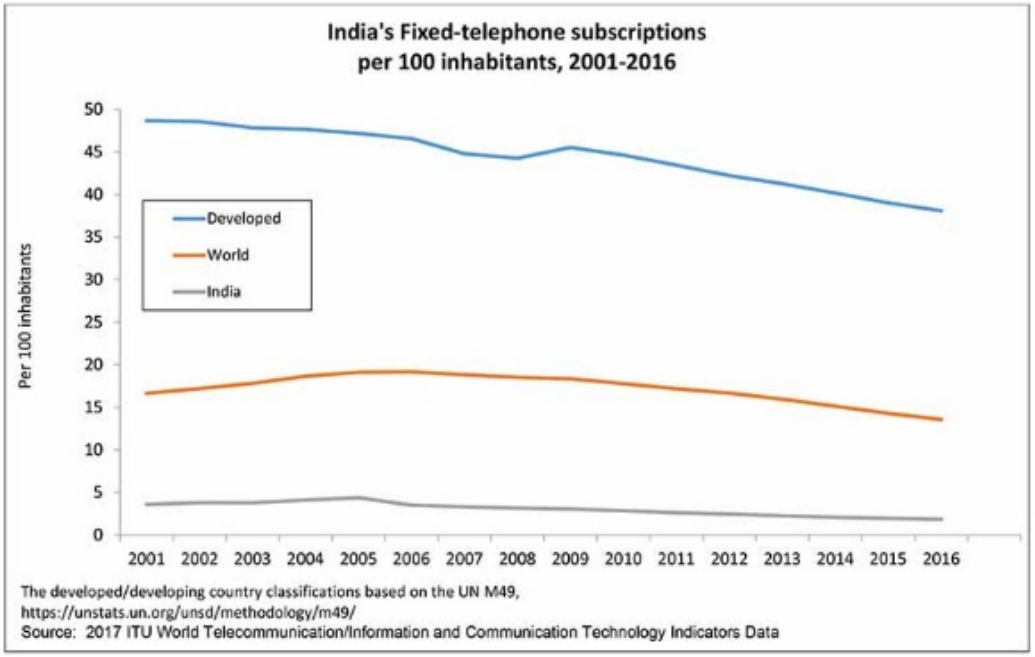

Figure 3: India's declining fixed-telephone subscribers compared with global trends, 2001-2016

Fixed-telephone subscriptions worldwide have declined to 17.64 % or less than one-fifth of the people. Fixed-telephone subscriptions in the Developed nations also declined by 20% or one-fifth. India's fixed-telephone subscriptions have declined to 40%, or two-fifth. India's Fixed-telephone subscriptions per 100 inhabitants was low (1.73 in 2017, down from 2.09 in 2014 and 3.80 in 2002) in comparison with China (13.75 in 2017, down from 17.94 in 2014 and 16.50 in 2002), United States (36.95 in 2017, down from 40.44 in 2014 and 65.82 in 2002), and the United Kingdom (50.08 in 2017, down from 51.12 in 2014 and 58.53 in 2002), according to latest available ITU statistics (ITU, 2018).

Rise of India's Internet Users Compared with Worldwide, 2001-2016
(Results Related to the Fourth Research Question)

Research Question #4 analyzed: "How do India's Internet users compare with individuals using the Internet worldwide over 2001 through 2016?" Compared with global Internet use, India's Internet growth has lagged with levels lower than 30 %. This indicates enormous opportunities for growth of the Internet in India, as illustrated in Figure 4: India's Internet users compared with worldwide, 2001-2016 (ITU, 2017).

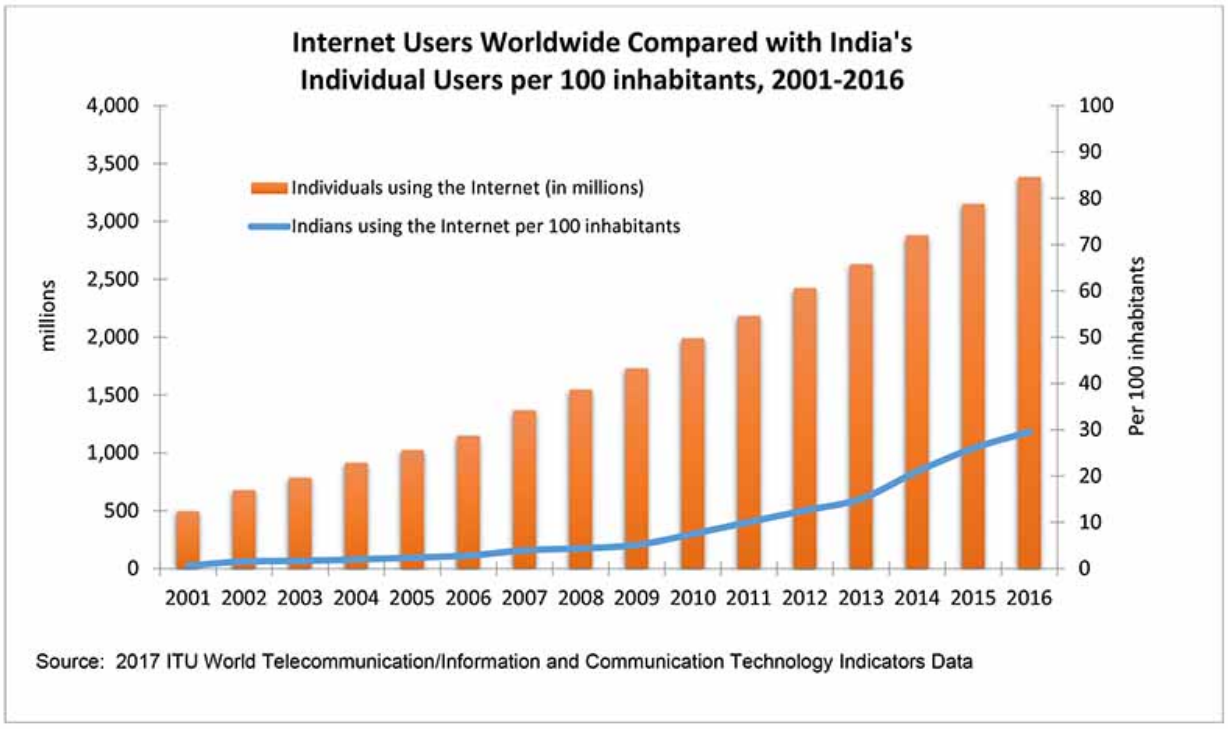

Figure 4: India's Internet users compared with worldwide, 2001-2016

The percentage Internet users in India was low (26.55 % in 2016) when compared to China (53.2 % in 2016), United States (74.6 % in 2015), and the United Kingdom (94.8 % in 2016), according to latest available ITU statistics (ITU, 2018). India's Internet users grew by modest 30% while global growth was 500 %. This compares the absolute number of users worldwide with India's users per 100. While India's numbers must grow for all people to have access to news and information in a democracy, it is clear that, given India's population, that 30 % is nearly 500 million users.

India Lags in Fixed Broadband in Comparison with Subscribers Worldwide, 2001-2016 (Results Related to the Fifth Research Question)

Research Question #5 analyzed: "Over 2001 through 2016, how have India's fixed broadband subscriptions changed when compared with other users worldwide?" While India's fixed broadband access was a tad better than other developing nations, India lagged in fixed broadband subscriptions, when compared with developing nations and subscribers worldwide from 2001 through 2016 (see Figure 5: India lags in fixed broadband subscriptions when compared with developing nations and subscribers worldwide, 2001-2016). Subsequent analyses of ITU (2017) data indicate that fixed broadband usage is more of an urban trend and may be a far cry from rural areas.

It is worth noting that the United Nations classifies 52 nations as Developed and 167 countries as Developing, based on macro geographical regions and selected economic aspects among other groupings, according to the Statistics Division of the United Nations Secretariat's Standard Country or Area Codes for Statistical Use," which is commonly referred to as the M49 standard (UNSD, 2018). The classification lists of names of countries or areas, each with a unique three-digit numerical code as a common reference for statistical processing and international coding to facilitate the standardization of country/area data processing and transmission.

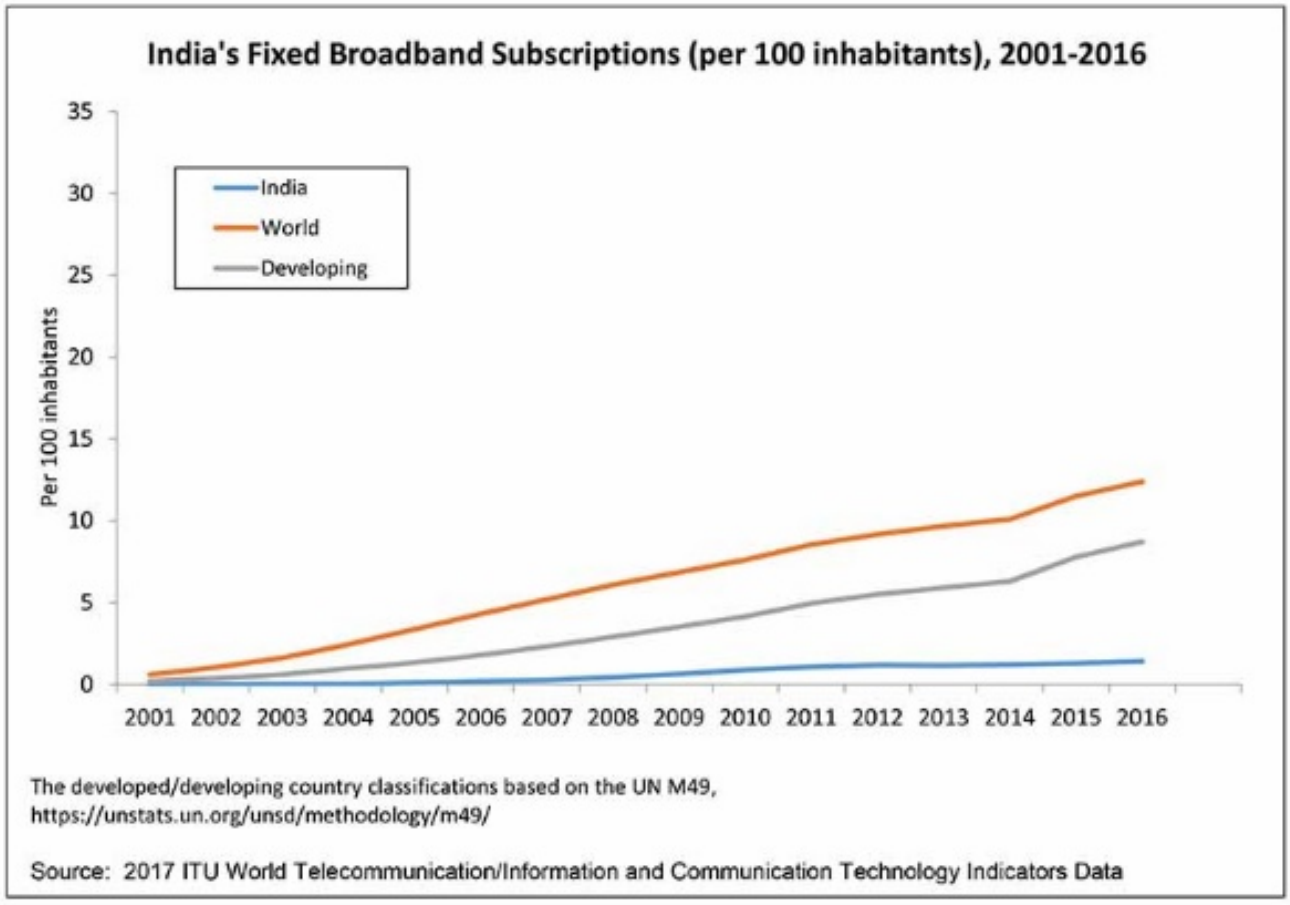

Figure 5: India lags in fixed broadband subscriptions when compared with developing nations and subscribers worldwide, 2001-2016

Mobile phone access is a priority over broadband. Clearly, India's fixed broadband subscriptions are lower than other developing nations. This is likely because of a severe lack of infrastructure in rural areas in India. There is likely a correlation with very low broadband use and fairly high mobile phone usage in these rural areas in India.

India's fixed-broadband subscriptions per 100 inhabitants is low (1.33 in 2017, up from 1.22 in 2014 and 0.01 in 2002) in comparison with China (26.86 in 2017, up from 14.42 in 2014 and 0.25 in 2002), United States (33.85 in 2017, up from 30.79 in 2014 and 6.92 in 2002), and the United Kingdom (39.31 in 2017, up from 36.5 in 2014 and 2.29 in 2002), according to latest available ITU data (ITU, 2018).

Internet Users Worldwide (per 100 inhabitants), 2001-2017
(Results Related to the Sixth Research Question)

Research Question #6 investigated: **"**Over 2001 through 2016, what significant trends signify Internet Users Worldwide (per 100 inhabitants)?" Global Internet usage is estimated to grow at steady levels, according to analyses of the ITU (2017) data. Figure 6: Internet users worldwide (per 100 inhabitants), 2001-2017, illustrates the disparities in Internet use worldwide. Developed nations witnessed 170 % rise in Internet users in Developed nations. The worldwide growth rate was 500 % for Internet users. Developing nations witnessed 1965 % (20 times) rise in Internet users.

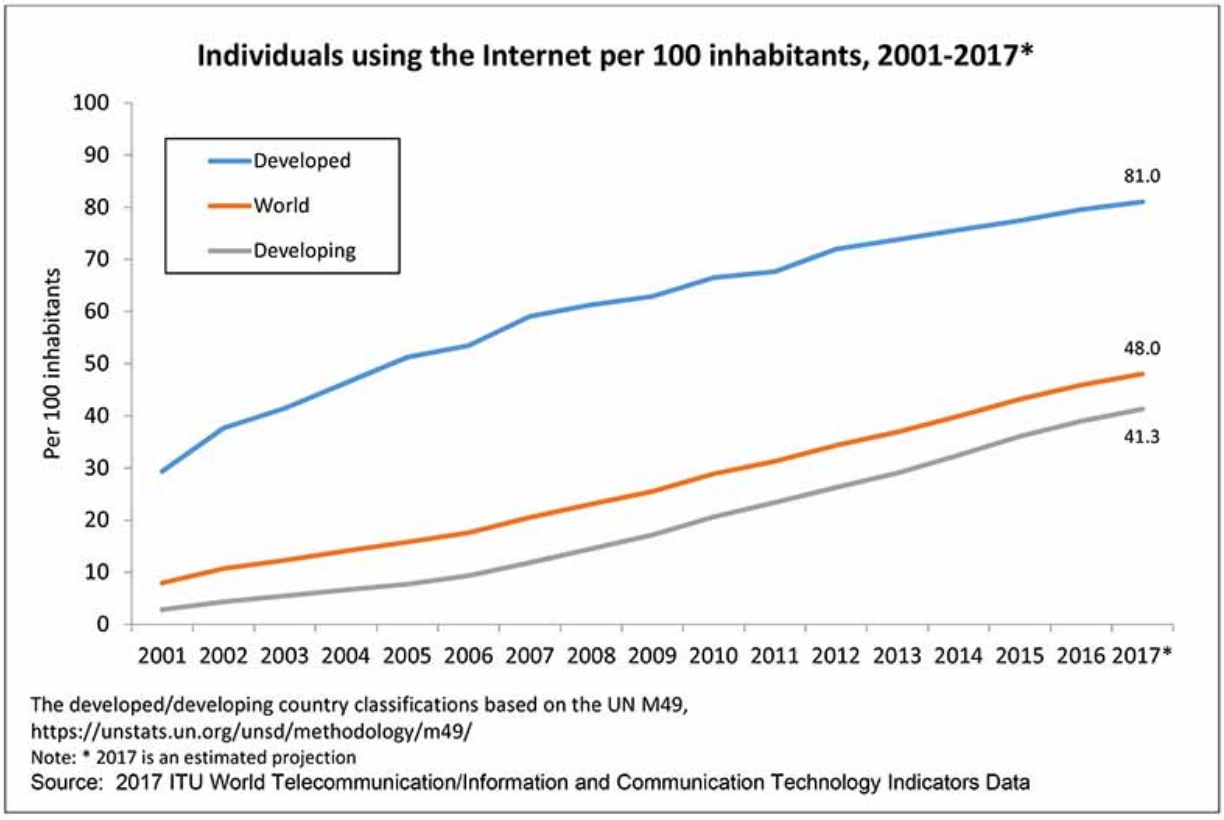

Figure 6: Internet users worldwide (per 100 inhabitants), 2001-2017

Although the developed countries' usage is the highest and shows significant increase over this period, the growth in developing countries, given their starting point, is just as dramatic. Given the

greater density of population in developing countries, it is likely the raw numbers will be higher there. The density of population, which is a measure of population per unit area, is greater in developing countries. For instance, according to Density of India State of Population Census 2011, India's the population density is 382 people per square kilometer, which considerably higher than the average population density of the world 2011, which is 46 per square kilometer, according to the "Density of India" (Census of India, 2011)

According to World Bank data on Population density (people per sq. km of land area), India's population density was 450.42 in 2017, up from 154.21 in 1961. Population projections indicate that by 2030, India would become the most populous country of the world leaving China behind. One of the primary causes of the steep increase in India's population is illiteracy.

Percentage of Internet Households Worldwide, by Global Regions
(Results Related to the Seventh Research Question)

Research Question #7 explored, "What significant trends characterize Internet-linked households classified by global regions?" This study's analyses of ITU's latest available projected estimates of 2017, as delineated in Figure 7: Percentage of Internet-linked households worldwide global regions, 2017, provide ample evidence of the dominance of the world's western regions such as the Europe, Commonwealth of Independent States and The Americas, in that order, in Internet-linked households.

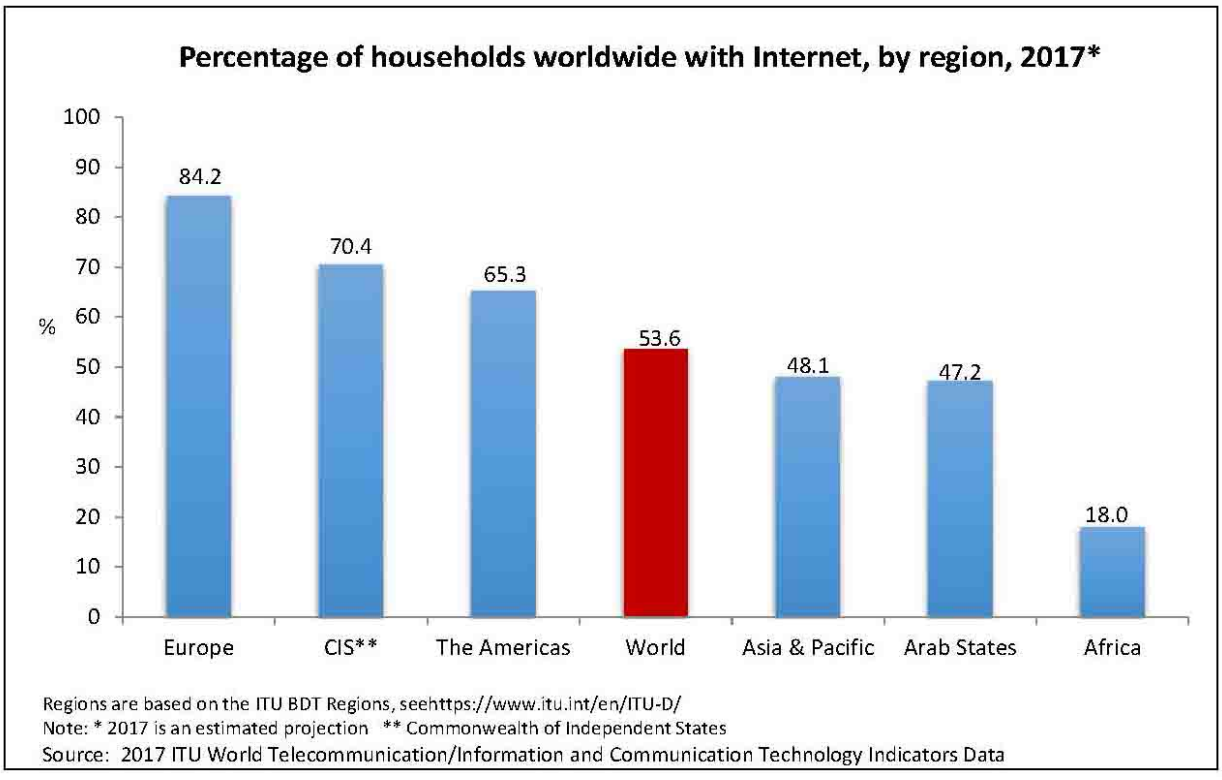

Figure 7: Percentage of Internet-linked households worldwide by global regions, 2017

According to 2017 estimates, more than half (53.3 %) households worldwide were linked to the Internet. When sub-grouped by global regions, as illustrated in Figure 7, four-fifth (84.2 %) of homes in Europe (45 nations) are linked to the Internet followed by seven-tenths (80.4 %) households in the

Commonwealth of Independent States (10 nations) and two-thirds (65.3 %) homes in the Americas (35 nations).

The three global regions that may benefit for better Internet connectivity are global regions with less than half of homes connected to the Internet. They are Asia & Pacific (48.1 % in 38 nations) Arab States (47.2 % in 22 nations), followed by less than one-fifth (18%) households in Africa (42 nations) with Internet connections. Such trends indicate the potential for growth in Internet-linked households in these regions. The projected estimates give credence to the North-South divide in Internet adoption worldwide. The North, comprising Europe, Commonwealth of Independent States and a significant part of the Americas have more households linked to the Internet. On the other hand, the South, comprising Africa, several influential regions of the Asia & Pacific and the Arab States lag behind.

Internet Users (per 100 inhabitants) Worldwide, by Global Regions, 2017
(Results Related to the Eighth Research Question)

Research Question #8 explored: "What significant trends characterize Internet users worldwide per 100 inhabitants classified by global regions?" This study's analyses of ITU's latest available projected estimates of 2017, as delineated in Figure 8: Internet users worldwide per 100 inhabitants, categorized by global regions, 2017, provide ample evidence of the dominance of the world's western regions such as the Europe, Commonwealth of Independent States and The Americas, in that order. Users per 100 inhabitants must be understood with the idea that the density of the population matters a lot.

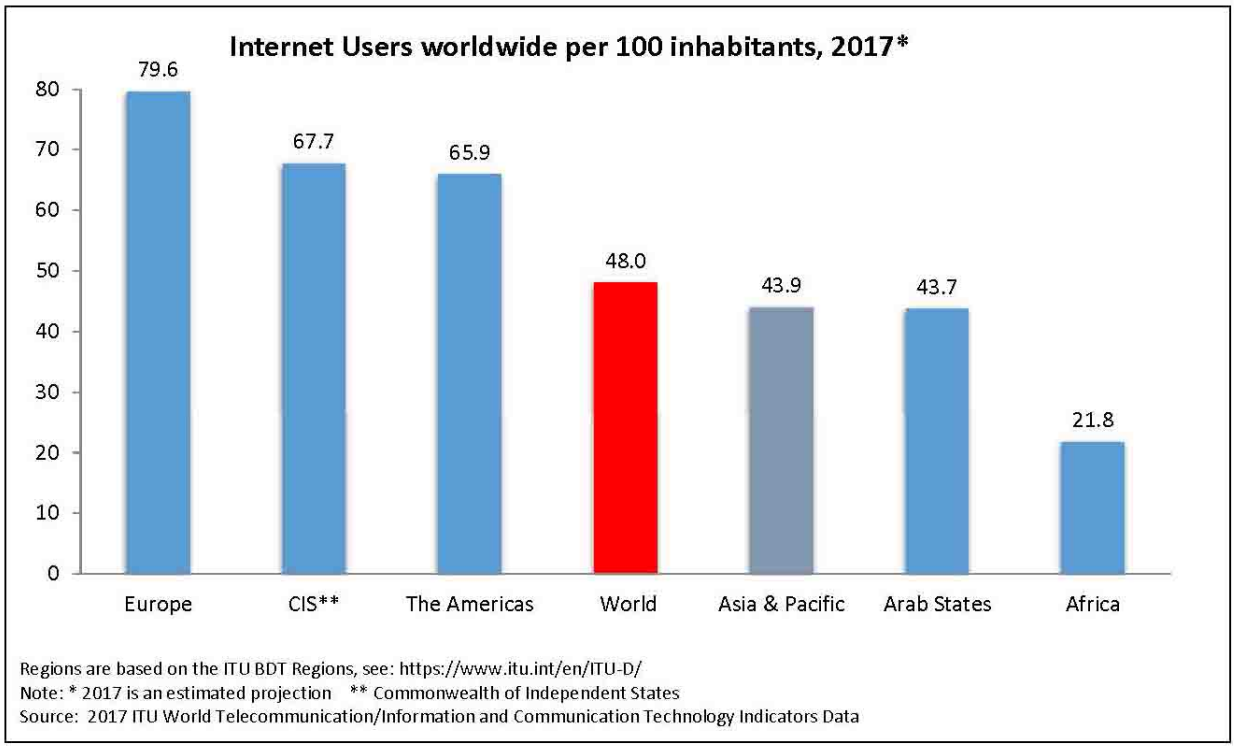

Figure 8: Internet users worldwide per 100 inhabitants, categorized by global regions, 2017

According to 2017 estimates, less than half Internet users, or 48 per 100 inhabitants, worldwide reflect a significant digital divide. When sub-grouped by global regions, as illustrated in Figure 8,

four-fifth Internet users, or 79.6 per 100 inhabitants, in Europe's 45 nations followed by over two-thirds Internet users in the Commonwealth of Independent States (67.7 per 100 inhabitants in 10 nations) and 65.9 per 100 inhabitants in the Americas constituting 35 nations.

The three global regions that may benefit for better Internet connectivity are regions with less than half of homes connected to the Internet. They are four-fifth Internet users in the Asia & Pacific (43.9 per 100 inhabitants in 38 nations) and Arab States (or 43.7 per 100 inhabitants in 22 nations), followed by over one-fifth Internet users in Africa (21.8 per 100 inhabitants in 42 nations). Such trends indicate the potential for growth in Internet users in these regions.

These projected estimates give credence to the North-South divide in Internet adoption worldwide. The North, comprising Europe, Commonwealth of Independent States and a significant part of the Americas have more households linked to the Internet. On the other hand, the South, comprising Africa, several influential regions of the Asia & Pacific and the Arab States lag behind.

Internet Households Worldwide by Development Levels
(Results Related to the Ninth Research Question)

Research Question #9 explored, "Over 2001 through 2016, what significant trends signify households worldwide with internet access categorized by level of development?" As delineated in Figure 9: Percentage of households worldwide with Internet access by level of development, 2002-2017.

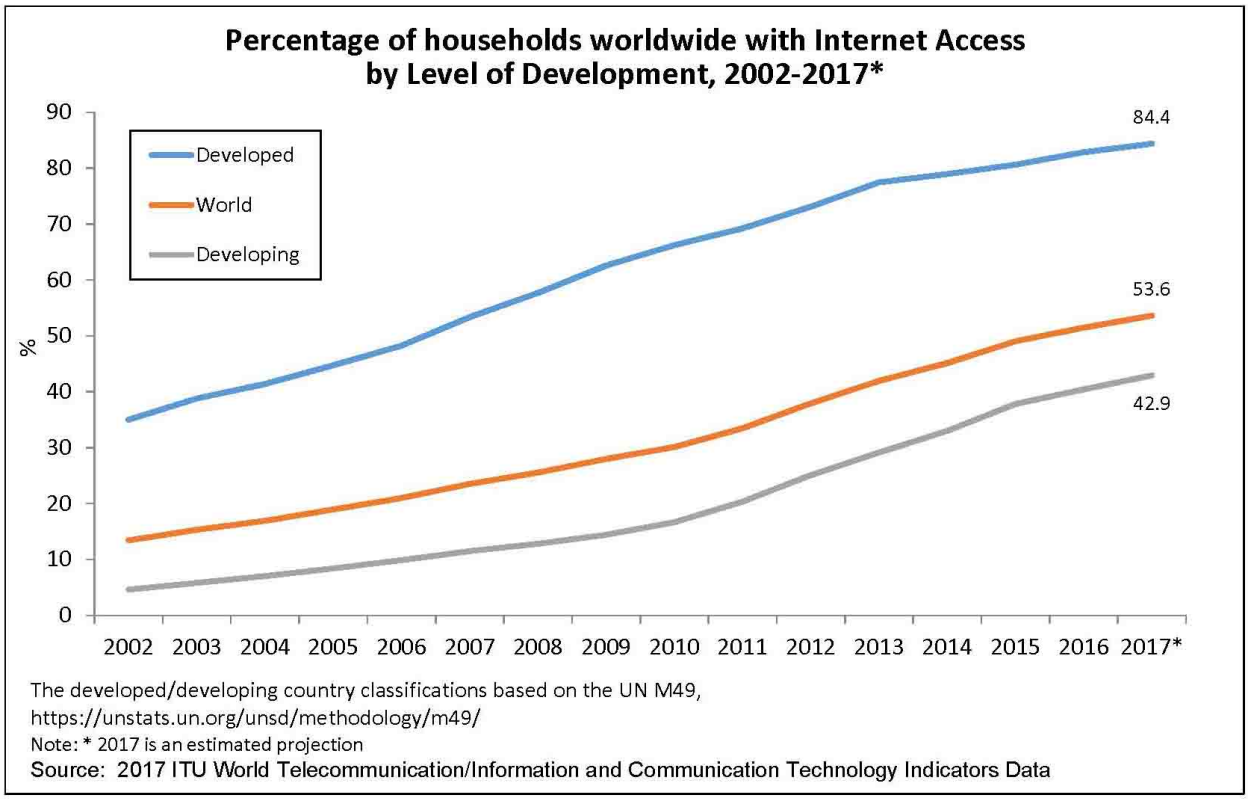

Figure 9: Percentage of households worldwide with Internet access by level of development, 2002-2017

It is interesting to note that less than 50% of households in developing nations have access to the Internet. According to 2017 estimates of Internet-linked households, the more than four-fifth (84.4 %) homes have access to the Internet in Developed nations, two-fifth (42.9 %) in Developing compared to (53.6 %) Internet-linked households worldwide.

The development categories are based on United Nations classification of 52 nations as Developed and 167 countries as Developing, based on macro geographical regions and selected economic aspects among other groupings, according to the Statistics Division of the United Nations Secretariat (UNSD, 2018).

Growing Share of Internet Users in Developing Nations over Developed Countries (Results Related to the Tenth Research Question)

Research Question #10 analyzed, "How have Internet users in developing and developed nations changed from 2008 to 2017?" As delineated in Figure 10: Growing segment of Internet users in developing nations over developed countries, 2008 to 2017, developing nations marked greater growth in Internet users.

These pie charts in Figure 10 clearly show that the share of Internet users in the developing world has steadily increased by two fifth (40 %) while the slice of Internet users in developed countries has reduced by nearly half (46 %) indicating that Internet consumption in developed countries have plateaued due to widespread adoption of the Internet as an essential tool for daily life and work.

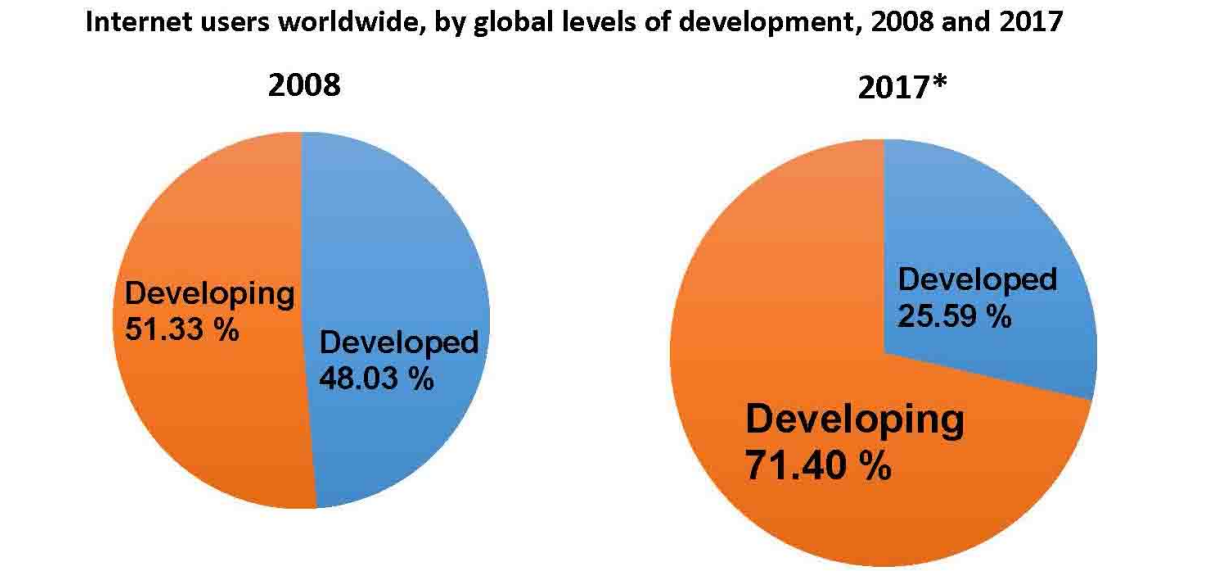

Figure 10: Growing segment of Internet users in developing nations over developed countries, 2008 to 2017

Anomalous Trends in India's ICT Growth

Besides providing visually relevant data delineations for each research question, the informative figures in this results section provide critical insights into India's ICT growth in relation to countries at different development levels. This study's analyses of ITU data enabled comparisons of India's ICT growth with worldwide trends. This study also analyzed information and communication technology growth worldwide by global regions and, more significantly, Internet access by level of development including a comparison of Internet users in developing nations over developed countries 2008 to 2017.

The findings bring out aspects of inclusion and exclusion relating to India's ICT developments from 2001 through 2016, comparative trends in the growth in India's mobile-cellular subscriptions matched with worldwide trends, India's declining fixed-telephone subscribers, and varying growth patterns of India's Internet users. India lags in fixed broadband subscriptions when compared with developing nations and subscribers worldwide and recent trends indicate that India needs to invest in its fixed broadband to enable people in rural areas access the Internet. This study also concluded that despite its anomalous trajectory, the rapid growth of ICTs have empowered India's bid for relevance in the Fourth Industrial Revolution by accomplishing a better future with technology through ICT growth.

Limitations, Caveats and Directions for Future Research

As with any study, certain research limitations should be recognized while interpreting the study's implications, the contributions of the findings and the results reported here. Although the strength of the study is the relatively large data from 2001-2016, some limitations and related insights from this study should guide future research directions.

The present study had certain limitations, and our conclusions and the results on which they are based should be tempered by the research design for this study. This study examined ITU data from 2001-2016, the critical years of tech proliferation in India, to theorize trends in India's ICT growth. It would be interesting to explore years earlier than the 16-year period studied. Further, the research reported in this study examined only ICT growth in India. It would be worthwhile to compare the results of this study with ICT growth in other countries of South Asia.

Conclusion and Discussion: India's Anomalous Tech Trajectory

Besides documenting India's progress in key ICT indicators, this study's analyses of the ITU data also provides ample evidence of India's anomalous tech trajectory. India's ICT growth in the 16-year period studied is atypical with an exponential rise in mobile-cellular subscriptions but with low levels of Internet users. In addition, the low levels of fixed broadband subscriptions indicate that users are primarily accessing the Internet through their mobile phones, instead of computers, at their homes or offices. The sharp fall in fixed-telephone subscriptions matches global trends.

Another anomalous aspect of India's ICT trajectory is the rapid growth of mobile-cellular subscriptions that indicates that mobile telephony has transformed India even as we find low levels of Internet use and low Internet access when compared to other nations. Instead of being alarmed over these unusual trends, technologists feel that India's somewhat low consumption of ICTs, barring mobiles, indicates its potential for enormous growth.

India's Unusual Growth in ICTs

Despite lagging ICT consumption in significant parts of the nation, India's unusual growth in ICTs represent a resolve of the nation's leadership to bridge digital divides. It is for this reason

that India persists in its ICT investment in key areas although major parts of the nation seem deprived of ICT.

The opening epigraph of this study quoted India's Prime Minister Narendra Modi as declaring: "India's contribution towards the fourth industrial revolution would leave the world stunned…." on October 11, 2018, while inaugurating of the World Economic Forum's Centre for Fourth Industrial Revolution in India. Modi also observed "…emerging fields like artificial intelligence, machine learning, Internet of Things, Blockchain and Big Data can take India to new heights of development and improve the quality of life of its citizens" (Modi, 2018).

The anomalous nature of India's ICT growth should be examined with the implementation of ICTs in the rural areas. The World Bank recorded India's rural population at 66 % in 2017, down from 82 % in 1962. Based on such figures, while critics may contend that artificial intelligence, machine learning, Internet of Things, Blockchain and Big Data are tools of India's urban population, estimated at 44 %, several ICT initiatives benefit people in the rural areas. That's another significant reason for India's rural population to drop by a whopping 16 % in 55 years. Such trends indicate India's rapid urbanization and the role ICTs play in it. India is among leading developing nations where ICT innovations have empowered marginal communities and other people confined to the lower or peripheral edge of the society and thereby deprived of mainstream economic, political, cultural and social gains.

India's Unusual Strength in ICT Numbers

With its surging population of 1.36 billion (Census of India**,** 2011; Worldometers, 2018), India ranks second after China. India's population is projected to exceed China's by 2030 to become the world's most populous country. With such large population numbers, even minuscule growth percentages amount to millions of people and products.

India's Prime Minister Modi has frequently boasted about India's strength in numbers as an added advantage of critical mass to transform the nation with digitally-empowered citizens and a technology infrastructure that bridges India's urban-rural divide. In his resolve to transform India with the power of technology, Modi has aggressively pursued ICT growth with initiatives such as "Digital India," which seeks to benefit every citizen by dint of improved digital infrastructure (Modi, 2018).

Although the task of ICT growth seems gargantuan in a nation of 1.36 billion people, Modi has enunciated his exuberance over the potential of Digital India initiatives by highlighting the rapid rise in ICT adoptions. His enthusiasm has infectiously affected official in his administration to relentlessly pursue ICT growth instead of complaining about seemingly unsurmountable ICT adoption challenges, which are multifaceted and formidable.

In this October 11 speech, Modi bragged about Digital India achievements in rapid succession. Teledensity, or the number of telephone connections for every 100 individuals, increased to 93% in 2018. Nearly 500 million Indians subscribe to mobile phones (Modi, 2018). A significant reason for such strong numbers are multifold. India ranked as the world's largest mobile data consuming country with the cheapest data rates (Modi, 2018). Mobile data consumption had increased 30 times from 2014 through 2018 (Modi, 2018).

Modi has also bragged about the impact of ICTs by pointing that over 1.2 billion Indians are registered with Aadhaar, India's ICT-powered unique identification system. India is poised to connect the nation's 250,000 panchayats (or village units) to the optic fiber network. As a significant step, optic fiber networks connected more than 100,000 village units in 2018, up from

59 panchayats in 2014 (Modi, 2018). Such growth matches Modi's determination to astonish the world with Fourth Industrial Revolution accomplishments.

India's Pursuit of ICT Success in the Fourth Industrial Revolution

The opening lines of this study cited Prime Minister Modi's resolve to transform India with the power of technology and his motivation to usher "irreversible positive change" through "fourth industrial revolution" innovations (Modi, 2018).

Modi referred to the significance of the Fourth Industrial Revolution for two significant reasons. One, India is home to the fourth center with San Francisco (US), Tokyo (Japan) and Beijing (China) in the World Economic Forum's Centre for Fourth Industrial Revolution (C4IR), which seeks to forge collaborations among government and business leaders to pilot emerging technology policies. Two, German engineer and economist Klaus Schwab, who founded in 1971 the World Economic Forum and spurred C4IR, has predicted that the Fourth Industrial Revolution will "fundamentally alter how we live and work*"* with "a range of new technologies that are fusing the physical, digital and biological worlds, the developments are affecting all disciplines, economies, industries and governments, and even challenging ideas about what it means to be human" (Schwab, 2016).

Informed by perspectives on technological evolution, Schwab credits the Fourth Industrial Revolution with "ramifications more profound" and "more significant" than in any prior period of human history" and with the evolution of succeeding innovations (Schwab, 2016). While the First Industrial Revolution mechanized production with water and steam power, the Second Industrial Revolution created mass production with electric power. The Third Industrial Revolution automated production with electronics and information technology (Schwab, 2018, para 2). Schwab placed the Third Industrial Revolution to the middle of the 20th century when the digital revolution began. Schwab predicted that the effect of the Third Industrial Revolution will catalyze the Fourth Industrial Revolution's fusion of technologies that blurs physical, digital, and biological spheres" (Schwab, 2018, para 2).

In his 2016 book, Schwab envisioned the Fourth Industrial Revolution as an opportunity to implement innovative ideas to harness change and shape a better future with technology empowering people instead of replacing them, progress serving society but rarely disrupting it; and innovators respecting moral and ethical boundaries instead of flouting them. Envisioning the fourth industrial revolution as "different in scale, scope and complexity from any that have come before," Schwab called for developing new frameworks that advance progress (Schwab, 2016). As enunciated in this study, India seems aspired to accomplish a better future with technology through ICT growth.

Acknowledgments

The author thanks Dr Padma Rani, School of Communication, Manipal Academy of Higher Education, Manipal, India, and four anonymous reviewers for their critiques that helped focus the study. Thanks also to Dr. Jay Aikat, Renaissance Computing Institute & Department of Computer Science, University of North Carolina at Chapel Hill, USA, Ms. Jennifer Ferguson-Mitchell, International Telecommunication Union, Geneva, Switzerland, and Mr. Brahima Sanou, ITU Telecommunication Development Bureau, Geneva, Switzerland, for their assistance with this project.

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