Emerging 5G Wireless Network and Deployment Challenges[1, 2]

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ABSTRACT

The world's economy is a pivotal moment as artificial intelligence is the future generation. The catalyst for growth is wireless connectivity by 5G—a new standard for wireless telecommunications. 5G is not simply an 4G it merely a faster wireless capability. 5G makes the connection and interaction of billions of devices. Indeed, 5G connectivity leads consumers and industries, to new frontiers of productivity and innovation.

In this paper, we examine how the 5G technology deployment challenges are overcome to the implementation of the network .We consider a range of actions and problems that may help overcome deployment challenges and enable rapid and extensive 5G deployment, including a light-touch policy framework that urges carriers and the ecosystem partners to negotiate without government intervention and involve carriers to operate at grander scale and economic efficiency.5G technology marks the beginning of a new era in connectivity that will impact almost daily life.

Keywords: 5G Implementation, Vendor Disputes, Effective Strategy of 4G Implementation, Spectrum Issues, Market Adaptability, Infrastructure, Regulation and Licensing, Security

INTRODUCTION

4G LTE is still making a sufficient impact in the network lifecycle: Historically, cellular technologies have adhered to associate degree approximate 20-year cycle from launch to peak penetration, with around 10 years between the launch of every new technology (see Figure 2). The first business 4G LTE networks went board 2009 and supported historical precedent we might not expect the technology to achieve a peak level of connections until around 2030.

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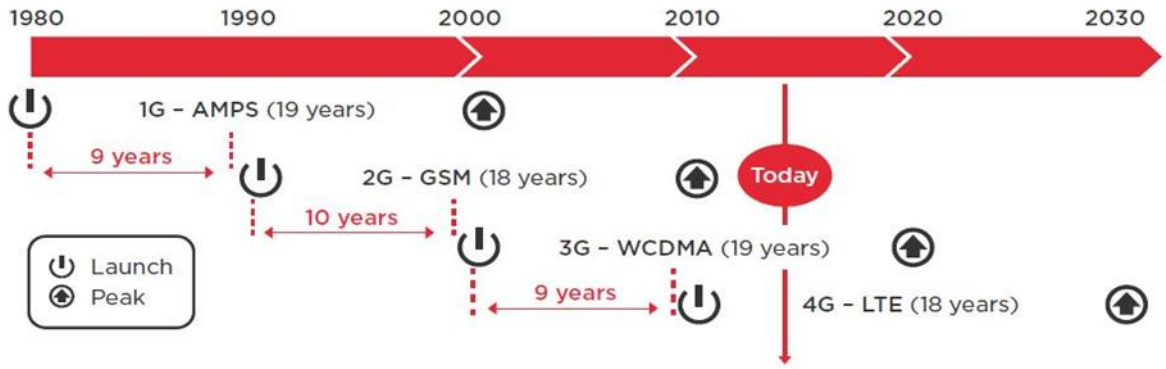

Figure: 1: Network lifecycle [3]

Comparing 4G and 5G

5G mobile communication technology with performance enhancements of many orders of magnitude over today's networks. 5G won't replace 4G, its large diversity of tasks that 4G cannot perform. The figure below shows the comparing the 5G and 4G will continue in parallel with 5G, support more routine tasks. 5G can service nevertheless to be enforced, in a very world economy square measure driven by refined communications networks.[4]

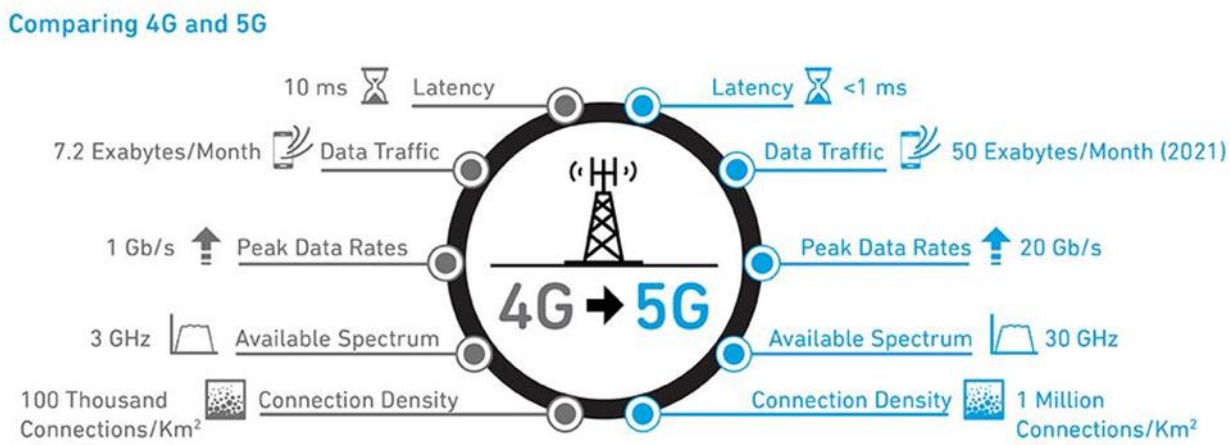

Figure 2

[3] *Intelligence, G. (n.d.). GSMA Intelligence — Research — Global cellular market trends and insight — Q2 2014. Retrieved from https://www.gsmaintelligence.com/research/2014/06/global-cellular-market-trends-and-insight-q2-2014/435/*

[4] *Comparing 4G and 5G: https://www.qorvo.com/design-hub/blog/getting-to-5g-comparing-4g-and-5g-system-requirements*

Project: An investment that requires a set of logically linked and coordinated activities performed over a finite period in order to accomplish a unique result in support of the desired outcome.[5]

Example: Telemedicine technology-enabled healthcare is an area where 5G make a massive difference. In low latency, it is remote operating over a video link and the ability to carry out surgical procedures across a 5G network using robotic instruments could become more of a reality. Wearable sensors for patient monitoring that can integrate with IoT capability within 5G change how patients receive care and the data generated could better inform healthcare practitioners.

Program:

Strategic program: Deliver assets and benefits that are directly linked to attaining the sponsoring organization's future state.[6]

Example: A program deployment 5G network, prepare spectrum, fixed-access network, build application ecosystem is a set of related projects and organizational changes put in place to achieve a strategic goal.[7]

Operational program: deliver assets and benefits that are critical to the sponsoring organization's day to day operations.[8]

Example: A connected community software platform will support developers in new 5G applications and services. Real-time information about essential public services in an area including bus, tram and train actual arrival times, parking availability and pre-booking could be made available to mobile and online applications.[9]

Multi-Project Program: Achieve synergies from projects with common traits such as shared resources, similar clients or product technology.[10]

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[5] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

[6] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

[7] *Program Classifications: GAPPS. (n.d.). Retrieved from https://globalpmstandards.org/tools/complexity-rating/program-typology/*

[8] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

[9] How 5G and IoT contribute to the UK's world-class vision. (2018, July 16). Retrieved from https://www.itproportal.com/features/how-5g-and-iot-contribute-to-the-uks-world-class-vision/

[10] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls

Example: Take the popular example of a smart city, it is a place where all the devices are connected, speaking to each other and sharing data and allowing informed decisions to be made It is anticipated that 5G can offer a platform of practical property giving these devices a quick and reliable suggests that of communicating; this can be a key think about the success of such ventures.[11]

Program Characteristic	Type of Program			
	Strategic Program	Operational Program	Multi-Project Program	Mega-Project
General Purpose	Deliver assets and benefits that are directly linked to attaining the sponsoring organization's future state	Deliver assets and benefits that are critical to the sponsoring organization's day to day operations	Achieve synergies from projects with common traits such as shared resources, similar clients or product technology	Deliver a specific asset to the sponsoring organization
Key Differentiating Feature	Link to a specific business goal or strategic initiative	Relative interdendence of constituent projects	Relative interdendence of constituent projects	Significantly larger than the sponsoring organization's typical projects
Reason for Grouping Projects	Early results influence decisions about later projects	Minimize negative impact to ongoing operations	Benefits expected from synergy	So much larger than the organization's typical projects.

Figure 3: Types of Programs[12]

Mega-Project: A delivery of a project-specific asset the promote organization.[13]Example: The improved level of connectivity that comes with 5G could make driverless cars more of an everyday reality than at present. The technology exists in terms of the vehicles and the software, but reliable and fast connectivity is essential before we will begin to see these cars and lorries on our roads. The transmission of data from the car to the roadside is equally important.[14]

Portfolio of Projects: Fact of minimizing the risk and maximizing the return. Any organization, be it owner or contractor has a portfolio of assets available to dedicate to projects, with the

[11] How 5G and IoT contribute to the UK's world-class vision. (2018, July 16). Retrieved from https://www.itproportal.com/features/how-5g-and-iot-contribute-to-the-uks-world-class-vision/
[12] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[13] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[14] How 5G and IoT contribute to the UK's world-class vision. (2018, July 16). Retrieved from https://www.itproportal.com/features/how-5g-and-iot-contribute-to-the-uks-world-class-vision/

objective being to develop the best "mix" of projects which will generate the most favorable return on those "assets".[15]

Example: 5G is only one part of the UK's broader vision of world-class connectivity and it will provide a backbone of possibilities, helping to make smart cities, towns and villages a reality.

ASSET:

Information Assets: controlled by functional groups like IT, engineering.[16]

Human assets: controlled by HR.[17]

Physical Assets: controlled by either operation ("plant manager") or other functional entities such as "heavy equipment shop"[18]

Financial Assets: controlled by accounting or finance.[19]

Intangible assets: Difference between a company's book value and market capitalization value.[20]

Here are some examples of the assets Telecom Expense Management (TEM) providers typically track for their clients: Conferencing services and equipment, Data communications lines, Lease and maintenance agreements, Local exchange services, Long distance services including dedicated, private line and virtual services, Mobile devices, MPLS, Network equipment, PBX and key systems, Software Licenses, Voicemail systems, VOIP equipment and services, Network equipment , Human resources, financial assets are the assets of telecom.[21]

[15] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[16] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[17] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[18] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[19] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[20] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[21] Bouk, J. (n.d.). Why Telecom Inventory Management is Vital to Enterprises. Retrieved from https://www.casstelecom.com/blog/why-telecoms-inventory-management-is-vital-to-enterprise

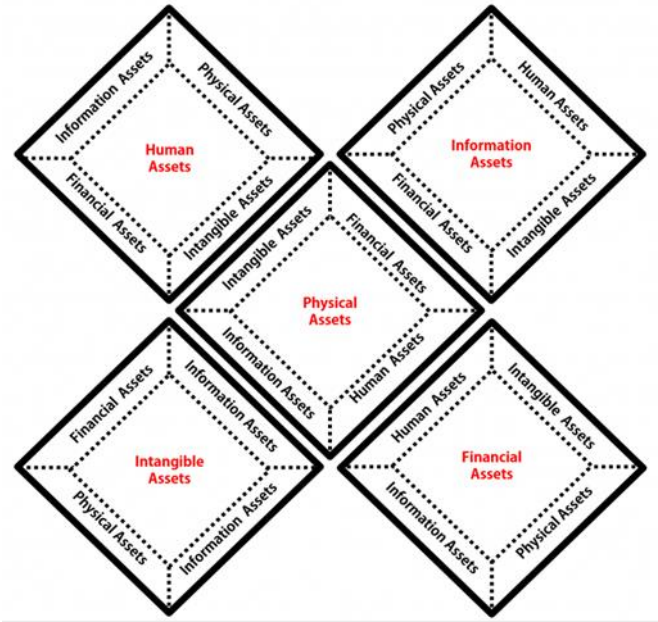

Figure 4: Assets[22]

Types of contracts in EQUIPMENT MANUFACTURERS and SUPPLIERS are:

I. **FIXED PRICE (FP):** As the name suggests, the worth is mounted for the desired PRODUCT, SERVICE or RESULT. This contract kind needs clear and non-volatile needs.[23]

a) **Firm Fixed Price Contracts (FFP):** The price is mounted firm. Most typically used contract kind. Favoured by a customer if the scope if firm.[24]

b) **Fixed Price Incentive Fee contracts (FPIF):** The price is mounted, with the incentive for over performance and penalty for beneath performance.[25]

c) **Fixed Price with Economic Price Adjustment Contracts (FP-EPA):** Applicable for long-term projects. It is a hard and fast worth contract, with special provision for final worth adjustment because of inflation; tied to clear monetary index like inflation index, share market index, dollar rate etc.,[26]

[22] GUILD OF PROJECT CONTROLS COMPENDIUM and REFERENCE (CaR) | Project Controls - planning, scheduling, cost management and forensic analysis (Planning Planet). (n.d.). Retrieved from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-project-controls
[23] *Secrets of Telecom Cost Reduction. (2018, November 1). Retrieved from https://www.nojitter.com/6-secrets-telecom-cost-reduction*
[24] *Mandy, D., Laffont, J., & Tirole, J. (2001). Competition in Telecommunications.* Southern Economic Journal*, 68(1), 190. :10.2307/1061523*
[25] *Project Management by Praveen Malik. (n.d.). Retrieved from https://www.pmbypm.com/fixed-price-incentive-fee-contract/*
[26] *Project Management by Praveen Malik. (n.d.). Retrieved from https://www.pmbypm.com/fixed-price-with-economic-price-adjustment-contract/*

Types of contacts in EQUIPMENT MANUFACTURERS and SERVICE PROVIDER are:

II. **Cost Reimbursable (CR) contracts:** In these contracts, all applicable COSTs are reimbursed along with an agreed FEE representing seller profit. These contracts are inherently flexible to requirement changes.

a) **Cost Plus FIXED FEE contracts (CPFF):** More well-liked over CPFF, as merchandiser gets reasonable fee supported the volume of labor.[27]

b) **Cost Plus Percentage of cost contracts (CPPC):** Reimburses actual costs and agreed on percentage fee on actual expenses. More popular over CPFF, as seller gets a reasonable fee based on the volume of work.[28]

c) **Cost Plus incentive fee contracts (CPIF):** Reimburses actual prices and united fee (fixed or percentage) adjusted with incentive or penalty fee.[29]

Root cause analysis

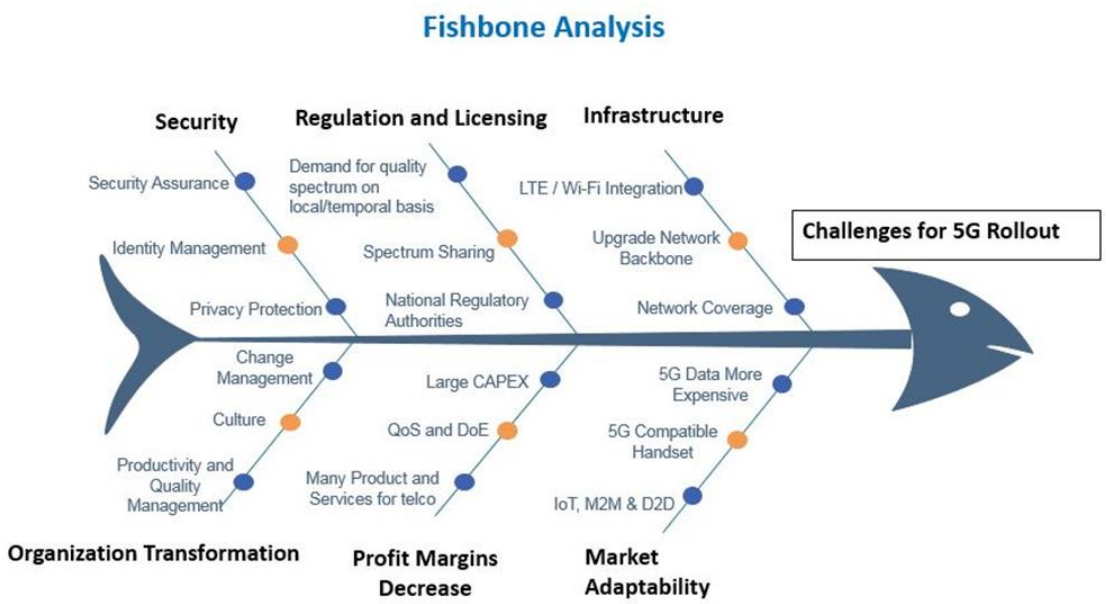

Figure 5: Fishbone Analysis[30]

[27] *Rodriguez, J. (2011, August 2). A Simple Guide to Cost-Plus Contracts and Variations. Retrieved from https://www.thebalancesmb.com/all-about-cost-plus-contract-basics-plus-4-more-options-844913*
[28] *(2012, February 16). Retrieved from https://govtribe.com/opportunity/federal-contract-opportunity/it-and-telecom-other-it-and-telecommunications-w15p7t12rc913*
[29] *Cost-Plus-Percentage of Cost (CPPC). (2016, May 6). Retrieved from https://project-management-knowledge.com/definitions/c/cost-plus-percentage-cost-cppc/*
[30] Source: By Author

In summary, there are five critical questions that this report will ask:[31]

- What are the real challenges for 5G implementation?
- What are the critical success factors for the effective strategy of 4G implementation?
- How future 5G technology transform society.
- What is the future of 5G technology?
- When will 5G be available?

STEP 1-PROBLEM RECOGNITION, DEFINITION, AND EVALUATION

➢ **Methodology**

Key Challenges for 5G Rollout:[32]

- Infrastructure.
- Regulation and Licensing- Spectrum issues.
- Security.
- Market Adaptability.
- QoS of telco companies are increasing, profit margins are decreasing.
- Organisation Transformation.

STEP 2 -DEVELOPMENT OF FEASIBLE ALTERNATIVES

Telecom operators classify 5G projects around six key Areas:[33]

1. Build an application ecosystem
2. Prepare spectrum for future macro 5G network
3. Prepare for future small-cell 5G network
4. Fiberization of fixed-access system
5. Prepare the computing and networking infrastructure

5G can bring new interactive and immersive experiences to customers. On the remote side shopper applications, enterprises square measure actively work however they will get pleasure from 5G. , however, to be seen what role operators can play in these ecosystems. For the primary

[31] Source: By Author
[32] *Butler, J. (2015). 5G* Spectrum *Challenges.* 5G Radio Technology Seminar. Exploring Technical Challenges in the Emerging 5G Ecosystem. *:10.1049/ic.2015.0028*
[33] *Pogorel, G. (2018). Spectrum 5.0: Re-Thinking Spectrum Awards for Optimal 5G Deployment. SSRN Electronic Journal. :10.2139/ssrn.3262740*

time, operators will play a key role in transferal corporates and trade verticals along, to deliver not merely property, however additionally solutions.

5G preparation models area unit crystallisation. New 5G pilots or technology updates area unit proclaimed monthly. ELISA became the primary operator within the world to start business use of a 5G network and begin marketing 5G subscriptions. The 5G network was used for the central time within Finland

Initially observed 5G rollout models

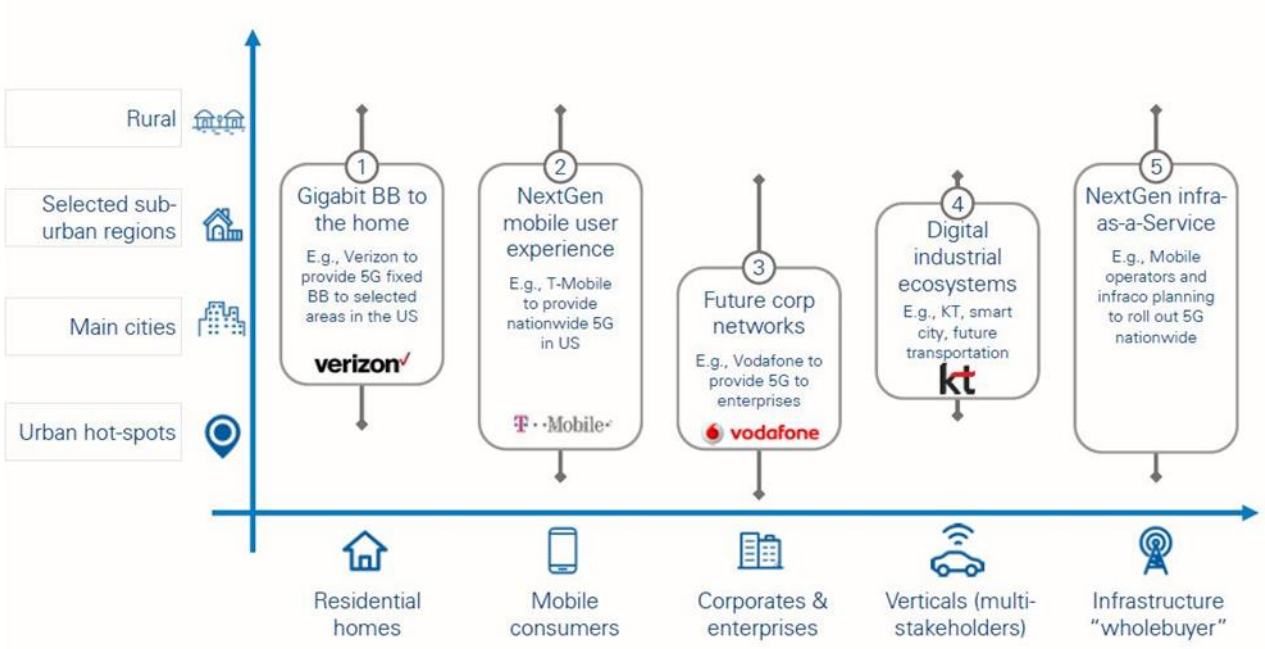

Figure 6: 5G Roll Out Models[34]

STEP 3 - DEVELOPMENT OF THE OUTCOME OF EACH ALTERNATIVE

Telecom operators ought to move quickly to put their stakes within the 5G ground. They'll take two approaches to arrange for future 5G: They can take two methods to prepare for next 5G: A big-bang approach, investing heavily in future 5G technologies, or an evolutionary approach, moving from 4G to 4.5G to 5G sequentially. The boundary between 4G to 5G is not always clear.. we tend to believe that 5G isn't close to gigabit speeds however additionally time unit latency, network slicing to manage a quality of service and improved corporate security.[35]

[34] *(2012, February 16). Retrieved from https://govtribe.com/opportunity/federal-contract-opportunity/it-and-telecom-other-it-and-telecommunications-w15p7t12rc913*
[35] *2012, February 16). Retrieved from https://govtribe.com/opportunity/federal-contract-opportunity/it-and-telecom-other-it-and-telecommunications-w15p7t12rc913*

1.1 Build an application ecosystem

I. Successful 5G depends not just on fast connectivity, but also on an ecosystem of next-generation applications built upon that connectivity.

a) The life cycle of applications is much shorter and riskier than the life cycle of investing in a telecom network and providing connectivity.
b) Telecom operators usually find it difficult to be sufficiently agile and responsive in developing applications on their own. A partnership approach helps both the telecom operator and the application provider in the deployment of the 5G network.[36]

1.2 Prepare spectrum for future macro 5G network

II. Preparing the macro access network for 5G involves obtaining the right spectrum in both low band and high band.

a) Telecom operators should prepare for re-farming of existing low-band spectrum, especially in the 700-, 800-, 900- and future 600 MHz bands that can then be deployed for 5G coverage in the future.
b) Operators should also re-farm high-band spectrum in the 2,500-, 2,600- and 3,500 MHz bands, which can be used for future small-cell deployment.
c) Additionally, operators should engage in discussions with their telecom regulators and related spectrum authorities to start the process of future releases in the millimetre wavelength bands. Current bands being used for 5G pilots are 5.2GHz and 28/39/60 GHz.[37]

1.3 Prepare for future small-cell 5G network

III. Future 5G will require not just thousands of macro sites, but hundreds of thousands of small cells, each of which will be backhauled with a fibre connection.

a) A key challenge to invest in small cells is to have access to hundreds of thousands of locations on the ground (e.g., public areas, public buildings, shopping malls, corporate sites, main streets, side streets, street-side infrastructure and inside people's homes)
b) Each of these locations should have high-speed (preferably fibre) backhaul Telecom operators can start deploying "Wi-Fi home spot"-ready CPEs to their customers' homes.[38]

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[36] *Pogorel, G. (2018). Spectrum 5.0: Re-Thinking Spectrum Awards for Optimal 5G Deployment. SSRN Electronic Journal. :10.2139/ssrn.3262740*
[37] *Are you ready for 5G? (n.d.). Retrieved from https://www.mckinsey.com/industries/telecommunications/our-insights/are-you-ready-for-5g*
[38] *Slinger, M. (2018, October 11). Small Cell Forum to Accelerate Densification with New Work Program Focused on Siting Policy, Enterprise Engagement and Technologies for the 5G Era - Small Cell Forum. Retrieved from*

1.4 Fiberization of fixed-access network

IV. 5G requires gigabit speeds to be delivered to the handset.

a) Each mobile site (both macro and small cell) needs to backhaul multi-gigabit throughputs to the aggregation network — the only technologies that may deliver such backhaul output over distances of over a couple of hundred meters area unit fibre and DOCSIS (cable).
b) 5G will require an extensive and capillary network of fibre in the countries. The process of investing in fibre – FTTH, FTTB, FTTC, FTTN, etc. to provide secure system for 5G implementation.[39]

1.5 Prepare the computing and networking infrastructure

I. Networks need to be able to handle multigigabit traffic.

a) Operators will need to prepare their computing and networking infrastructure New technologies such as virtual cut-through (VCT) and wormhole (WH) routing might be needed in the future to provide multigigabit connectivity to multiple nodes.[40]

Incremental Implementation of 5G

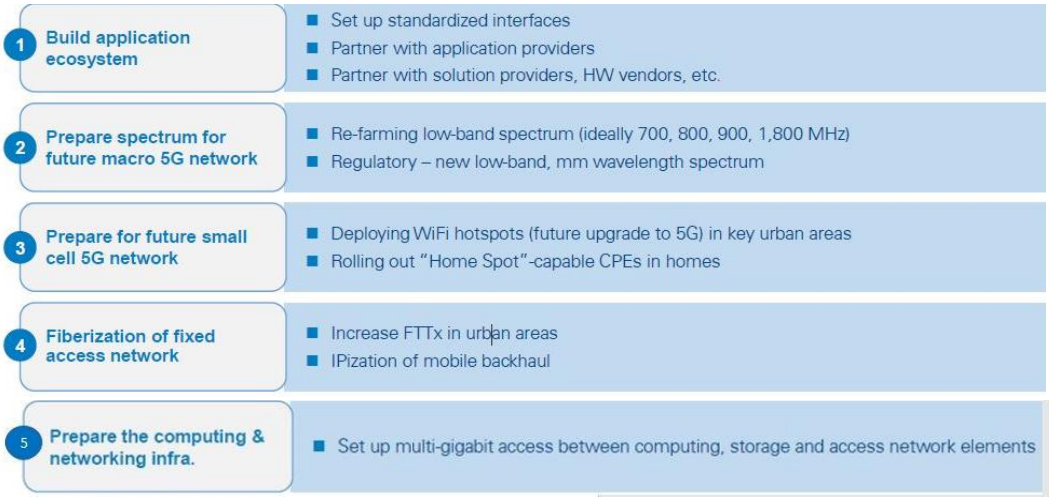

Figure 7: Incremental Implementation of 5G[41]

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https://www.smallcellforum.org/press-releases/small-cell-forum-to-accelerate-densification-with-new-work-program-focused-on-siting-policy-enterprise-engagement-and-technologies-for-the-5g-era/

[39] *The 5G revolution is nearly here, but is the Telecoms workforce ready? (n.d.). Retrieved from https://www.fircroft.com/blogs/the-5g-revolution-is-nearly-here-but-is-the-telecoms-workforce-ready-82271517827*

[40] *Kozma, R. B., & Vota, W. S. (2013). ICT in Developing Countries: Policies, Implementation, and Impact.* Handbook of Research on Educational Communications and Technology, *885-894. :10.1007/978-1-4614-3185-5_72*

[41] *Nesse, P., Svaet, S., Strasunskas, D., & Gaivoronski, A. (2013). Assessment and optimisation of business opportunities for telecom operators in the cloud value network.* Transactions on Emerging Telecommunications Technologies, 24*(5), 503-516. :10.1002/ett.2666*

Step 4 - SELECTION OF THE ACCEPTANCE CRITERIA

To check the performance, we will use the Multi-Attribute Decision Making (MADM) process. This analysis will allow the sponsor to select the right alternative to manage dispute in a sponsoring relationship.

We will accept alternatives which more than one green case. According to this we can already reject *Fiberization of fixed-access network and Prepare the computing and networking infrastructure.*

Attributes

- Infrastructure.[42]
- Regulation and Licensing- Spectrum issues.[43]
- Security.[44]
- Market Adaptability.[45]
- QoS of telco companies are increasing, profit margins are decreasing.[46]
- Organisation Transformation.[47]
- Massive MIMO[48]
- 5G Will Accelerate IoT[49]
- Ultra Reliable Low-Latency Communications[50]
- Artificial Intelligence in 5G[51]

[42] *Butler, J. (2015). 5G Spectrum Challenges.* 5G Radio Technology Seminar. Exploring Technical Challenges in the Emerging 5G Ecosystem. *:10.1049/ic.2015.0028*
[43] *Telecommunications - Laws, Regulations and Licenses | Public-private partnership. (n.d.). Retrieved from https://ppp.worldbank.org/public-private-partnership/sector/telecom/laws-regulations*
[44] *Network and Telecommunication Security. (n.d.). Retrieved from http://www.provision.ro/area/security/threat-management/network-and-telecommunication-security*
[45] *How a 5G Network Will Impact Marketing | Maropost. (2018, April 17). Retrieved from https://www.maropost.com/blog/how-5g-network-will-impact-marketing/*
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[47] *Read @ATKearney: Getting Lean, Agile, and Strong: Transformations in the Telecom Industry. (n.d.). Retrieved from https://www.atkearney.com/communications-media-technology/article?/a/getting-lean-agile-and-strong-transformations-in-the-telecom-industry*
[48] 5G mobile networks: A cheat sheet. (2018, January 18). Retrieved from https://www.techrepublic.com/article/5g-mobile-networks-a-cheat-sheet/
[49] 5G mobile networks: A cheat sheet. (2018, January 18). Retrieved from https://www.techrepublic.com/article/5g-mobile-networks-a-cheat-sheet/
[50] 5G mobile networks: A cheat sheet. (2018, January 18). Retrieved from https://www.techrepublic.com/article/5g-mobile-networks-a-cheat-sheet/
[51] Artificial Intelligence-based 5G network capacity planning and operation - Semantic Scholar. (n.d.). Retrieved from https://www.semanticscholar.org/paper/Artificial-Intelligence-based-5G-network-capacity-P%C3%A9rez-Romero-Sallent/b6d9899499c657b3c4a475e40ac2afa13702e20d

- Enhanced Mobile Broadband[52]

Attributes	Build application ecosystem	Prepare spectrum for future 5G network	Prepare for future small-cell 5G network	Fiberization of fixed-access network	Prepare the computing and networking infrastructure
Infrastructure	High	Very High	Medium	High	Very High
Regulation and Licensing	Low	High	Medium	Medium	Medium
Security	High	High	Medium	Low	Very High
QoS of telco companies	High	Medium	Very High	Low	Low
Organization Transformation	Medium	High	Medium	Medium	Very High
Massive MIMO	High	High	High	Medium	Medium
5G Will Accelerate IoT	Medium	Medium	Very High	Medium	Very High
Ultra-Reliable Low-Latency Communications	Medium	Very High	Very High	High	Medium
Artificial Intelligence in 5G	Medium	High	Medium	Medium	High
Enhanced Mobile Broadband	Medium	High	High	Very High	Low

- **Figure 8: Multi-Attribute Decision-Making Analysis[53] [54] [55]**

[52] 5G mobile networks: A cheat sheet. (2018, January 18). Retrieved from https://www.techrepublic.com/article/5g-mobile-networks-a-cheat-sheet/

[53] *Papantoni-Kazakos, P., & Burrell, A. T. (n.d.). Traffic and Network Performance Monitoring for Effective Quality of Service and Network Management.* Intelligent Quality of Service Technologies and Network Management, *201-227. :10.4018/978-1-61520-791-6.ch011*

[54] *Fait, Y. (2018, September 7). How The 5G Revolution Will Drive Future Innovations Of IoT. Retrieved from https://www.forbes.com/sites/forbestechcouncil/2018/09/07/how-the-5g-revolution-will-drive-future-innovations-of-iot/#50e94f76637e*

[55] *Podcast: Ribbon Communications sets transformational course as newly merged company launches. (2018, May 4). Retrieved from https://telecomreseller.com/2017/11/21/podcast-ribbon-communications-sets-transformational-course-as-newly-merged-company-launches/*

Findings

Step 5 - Analysis and Comparison of the Alternatives

I. Now that we have only three feasible solutions to improve our contract, which is Build application ecosystem, prepare spectrum for the future macro 5G network, prepare for next small-cell 5G network...[56]

Before going to the next step, we must know the ranking of each criterion, using **Non-Compensatory Model Technique, Disjunctive Reasoning.** This is a simple pairwise comparison that will help us know which criteria are the most important.[57]

Attributes	Infrastructure	Regulation and Licensing	Security	QoS of telco companies	Organization Transformation	Massive MIMO	5G Will Accelerate IoT	Ultra Reliable Low-Latency Communications	Artificial Intelligence in 5G	Enhanced Mobile Broadband	Total	Rank
Infrastructure		0	1	1	0	1	0	1	1	0	5	7
Regulation and Licensing	1		0	0	0	0.5	1	0	1	0	3.5	10
Security	1	0		0.5	0	1	0	0	1	1	4.5	8
QoS of telco companies	1	0	1		0	0	1	1	0	1	5	6
Organization Transformation	0	1	0	1		1	0.5	0	1	0	4.5	9
Massive MIMO	1	1	1	1	0		1	1	1	1	8	1
5G Will Accelerate IoT	1	1	1	1	0	0.5		1	1	1	7.5	2
Ultra Reliable Low-Latency Communications	0.5	1	0	1	1	1	0		1	0	5.5	5
Artificial Intelligence in 5G	1	1	1	1	1	1	0.5	0		0	6.5	3
Enhanced Mobile Broadband	0	0	0	1	1	1	1	1	1		6	4

Figure 9: Disjunctive reasoning analysis[58]

II. To use compensatory models to analyse those alternatives they will be represented quantitatively. To do so the relative options (low, medium, high, very high) will be turned into dimensionless values.

Attributes	Infrastructure	Regulation and Licensing	Security	QoS of telco companies	Organization Transformation	Massive MIMO	5G Will Accelerate IoT	Ultra Reliable Low-Latency Communications	Artificial Intelligence in 5G	Enhanced Mobile Broadband
Very High	0.6	0	1	0.6	0.3	0	1	1	1	1
High	1	0.6	0.6	0.3	0.6	0.6	1	1	0.6	0.6
Medium	0.6	0.3	0.3	1	0.3	0.3	0.3	0.3	0.3	0.3
Low	0.6	0.3	0	0.3	0.3	0.3	0	0	0	1

Figure 10: Quantitative representation of the attributes[59]

[56] Source: By Author
[57] Source: By Author
[58] Source: By Author
[59] Source: By Author

III. Values are next used to create the **"relative weighting"** of the alternatives.

Attributes	Build application ecosystem	Prepare spectrum for future 5G network	Prepare for future small-cell 5G network
Infrastructure	0.6	1	0.3
Regulation and Licensing	0	0.6	0.3
Security	0.6	0.6	0.3
QoS of telco companies	0.6	0.3	1
Organization Transformation	0.3	0.6	0.3
Massive MIMO	0.6	0.6	0.6
5G Will Accelerate IoT	0.3	0.3	1
Ultra Reliable Low-Latency Communications	0.3	1	1
Artificial Intelligence in 5G	0.3	0.6	0.3
Enhanced Mobile Broadband	0.3	0.6	0.6
Total	3.9	6.2	5.7

Figure 11: Relative weighting[60]

IV. Finally, we use the **"additive weighting technique"** by ranking each attribute by importance. The sum of each alternative can be compared to the normalised weight of 1, which is the score to reach. The characteristics are ranked as following (Most significant to least important):

[60] Source: By Author

Additive Weighting Technique			Build application ecosystem		Prepare spectrum for future 5G		Prepare for future small-cell 5G	
Attributes	Relative Rank	Normalized Weight (A)	(B)	(A) x (B)	(C)	(A) x (C)	(D)	(A) x (D)
Infrastructure	7	0.13	0.60	0.08	1.00	0.13	0.30	0.04
Regulation and Licensing	10	0.18	0.00	0.00	0.60	0.11	0.30	0.05
Security	8	0.15	0.60	0.09	0.60	0.09	0.30	0.04
QoS of telco companies	6	0.11	0.60	0.07	0.30	0.03	1.00	0.11
Organization Transformation	9	0.16	0.30	0.05	0.60	0.10	0.30	0.05
Massive MIMO	1	0.02	0.60	0.01	0.60	0.01	0.60	0.01
5G Will Accelerate IoT	2	0.04	0.30	0.01	0.30	0.01	1.00	0.04
Ultra Reliable Low-Latency Comm.	5	0.09	0.30	0.03	1.00	0.09	1.00	0.09
Artificial Intelligence in 5G	3	0.05	0.30	0.02	0.60	0.03	0.30	0.02
Enhanced Mobile Broadband	4	0.07	0.30	0.02	0.60	0.04	0.60	0.04
Sum	55	1.00	3.6	0.34	5.6	0.60	5.1	0.45

Figure 11: Additive Weighting Technique[61]

Step 6: Selection of Preferred Alternative

Finally, the **"relative weighting"** analysis shows that the worst solution is "Build application ecosystem" Better choice to " Prepare for future small-cell 5G network" by **24%**. The "relative weighting" also shows that other alternatives is "**Prepare for future small-cell 5G network** ". What is interesting in the **"Additive Weighting Technique"** is the best solutions is Prepare spectrum for a future 5G network for 5G deployment . On the other hand, the distance between the best and the worst is bigger in this analysis with "Prepare spectrum for future 5G network" **43% better** than "Build application ecosystem"[62]

We come finally to this ranking (best to worst):

Prepare spectrum for future 5G network > Prepare for future small-cell 5G network > > Build application ecosystem[63]

[61] Source: By Author
[62] Source:By Author
[63] *Source: By Author*

Step 7- Performance Monitoring and post evaluation of results

This analysis has been performed to find the best solution for deployment of a 5G network concerning best 5G Contracts. To monitor the performance, the following must be kept in mind good management of that kind of situation will result of a limited loss of revenue — some of the biggest challenges to the telco sector to rollout of 5G network. As per the paper **Prepare spectrum for future 5G network** is the biggest challenge for rollout of 5G in different countries.[64]

Figure 12: Connected Device[65]

But some countries successfully implement the 5G network with good data speed. In 2019 will be the year that 5G takes off. 5G networks area unit presently being deployed in many regions worldwide and business launches area unit already going down. As 5G smartphones become offered throughout 2020, many service suppliers area unit expected to commercially launch 5G.[66]

- Increased mobile data traffic in North East Asia drives the global year-on-year growth rate to 79 percent. In 2024, 5G networks can carry twenty-five percentage of world mobile information traffic Monthly mobile information traffic per smartphone continues to extend all told regions, driven by improved device capabilities and cheaper information plans, similarly as a rise in data-intensive content.[67]

- North America has the highest monthly usage, reaching 8.6 gigabytes (GB) at the end of this year, and is set to reach 50GB by the end of 2024.[68]

[64] *Source: By Author*
[65] *Butler, J. (2015). 5G Spectrum Challenges.* 5G Radio Technology Seminar. Exploring Technical Challenges in the Emerging 5G Ecosystem. *:10.1049/ic.2015.0028*
[66] *Ericsson Mobility Report November 2018? Ericsson. (2018, November 28). Retrieved from https://www.ericsson.com/en/mobility-report/reports/november-2018*
[67] *Ericsson Mobility Report November 2018? Ericsson. (2018, November 28). Retrieved from https://www.ericsson.com/en/mobility-report/reports/november-2018*
[68] *Ericsson Mobility Report November 2018? Ericsson. (2018, November 28). Retrieved from https://www.ericsson.com/en/mobility-report/reports/november-2018*

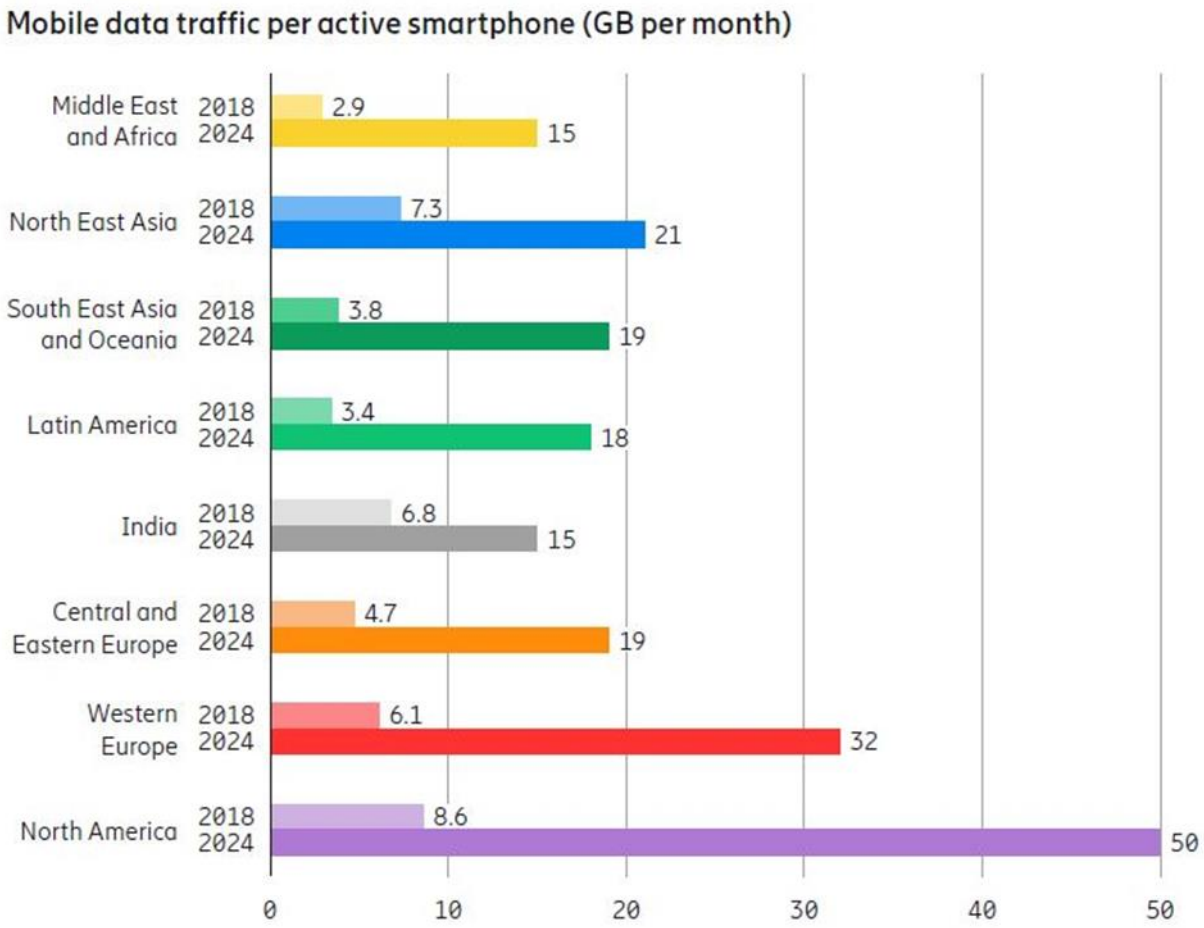

Figure 13: Mobile data traffic[69]

CONCLUSIONS

- This paper has been written in order to highlight the difficulties to deployment of 5G network in different countries. In India, GSM/EDGE-only has remained the dominant technology throughout 2018, accounting for around 56 % of total mobile subscriptions at the top of this year.

- However, the country has toughened robust growth within the range of LTE subscriptions over the last couple of years, and at the end of 2018 LTE will account for close to 30 percent of all mobile subscriptions [70]

[69] Ericsson Mobility Report November 2018? Ericsson. (2018, November 28). Retrieved from https://www.ericsson.com/en/mobility-report/reports/november-2018
[70] *Ericsson Mobility Report November 2018? Ericsson. (2018, November 28). Retrieved from https://www.ericsson.com/en/mobility-report/reports/november-2018*

- Deployments in existing LTE bands is chop-chop upgraded to support 5G services in several networks by installing new software; for example, **spectrum sharing between LTE and 5G in low to mid-bands**[71]

- There is sustained momentum toward the build-out of LTE networks, driven by the demand for internet access and video streaming as well as a variety of other terms of population coverage, LTE is presently at over sixty percentage and is forecast to achieve around ninety percentage in 2024.[72]

- 74% Globally, mobile broadband subscriptions currently frame 74 percentage of all mobile subscriptions [73]

- 55% of mobile subscriptions in North America are expected to be for 5G in 2024.

- Traffic growth is driven by both the rising number of smartphone subscriptions and an increasing average data volume per subscription.[74]

- **5G is projected to cover 40 percent of the world's population in 2024.**[75]

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