New perspectives of a 5G operating model

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Abstract. The way 5G operators manage infrastructure, enterprise and customers will be radically different compared to preceding generations. This paper aims to provide new perspectives on the 5G operating model by presenting a visual guide on how mobile network operators should deliver value to their prospective 5G customers. The model presented enriches the eTOM framework by elaborating on the implications of virtual network operations, the consequences of an mmWave band, the value of the non-human customer, the security concerns, the role of the content provider in a new ecosystem, and the anticipation of the next generation technological platform.

Keywords. 5G, Operating Model, network management, eTOM, TMN.

1. Introduction

By definition, an operating model is a visual representation of how an organization delivers value to its customers or beneficiaries as well as how an organization actually runs itself [1]. The Telecommunication Management Network (TMN) model and the Enhanced Telecom Operation Map (eTOM) framework are the best examples of how such operating models were standardized. Operators used them as references when deploying the services underlying 2G, 3G, and 4G mobile network. Both TMN and ETOM satisfied the generic requirement of an operating model that had to be flexible to cope with a changing ecosystem during the evolution of mobile technology.

However, 5G mobile technology comes with radical changes, since 5G not only enhances the data speed of mobile broadband (eMBB), but also provides a platform for ultra-reliable-low latency services (uRLLC) and massive machine-type communications (mMTC) [2]. The formulation of three-used case scenarios ultimately made a difference to preceding mobile generations, and as a consequence the operating model would have new perspectives. This has several crucial implications, which should be strategically handled by operators to ensure the success of delivering services and maintaining the enterprise in the competitive market.

This paper aims to provide a new perspective on the 5G operating model. The model is developed based on an eTOM framework, by enriching the technical perspective that 5G shall come with a virtual network [3] and will run over a millimeter wave (mmWave) band [4][5]. The service values concern the machine (things) as non-human customer [6] and the importance of a secure process at the level of network operation [7]. Meanwhile, the new perspectives emphasize the significant role of the content provider in the 5G ecosystem, who may act both as competing players or partners to operators, and the anticipation of the next generation technological platform.
This work contributes by offering visual guidance for mobile network operators to deliver value to their prospective 5G customers. The rest of this paper is organized as follows: Section 2 discusses how the operating models have shifted as they adapted to changing needs during the movement of the mobile generation from 1G to 4G. The new perspective of the 5G operating model is discussed in detail in Section 3, and the conclusion of our work is presented in Section 4.

2. The Shifting Operating Models

2.1. From 1G to 2G

The change from 1G to 2G was considered radical because of its digitalization of the technical platform with the implementing of GMSK modulation and convolutional error coding in the GSM standard. Service value was created with better voice services and some additional value-added services like text messaging. Therefore, we can classify the shifting characteristic from 1G to 2G to be technology-driven, where the development of technology was previously dominated by the drive for the emergence of service values. The implication is that the operating model worked on bottom up mechanism in which the requirements needed to manage network equipment and networks are prioritized before other operational-related concerns.

In 1996, the ITU-T released recommendation M.3010 [8], which introduced the concept of the Telecommunication Management Network (TMN). It was developed as a framework for service operators to manage their service delivery networks and consisted of four management layers at different levels of abstraction: Functional, Physical, Informational, and Logical [8]. Figure 1 illustrates how the Logical layers are harmonized with the Physical realization of the TMN architecture. It shows that certain levels of logical layers are actually realized in the physical architecture supporting the operation of the network. However, it should be noted that since it originates from the bottom layers of the changing technology, the TMN does not map very well to service management [9]. Nevertheless, in the era of 2G, service operators were still be able to perform some strategic choices and implement some limited action.

![Figure 1. An example of harmonization between the TMN layers on the realization of Physical Layers based on the Logical Layers concept.](image-url)
2.2. To 3G and 4G

Enabled by the shift in the platform to 3G and 4G, the new technical enhancement of a larger bandwidth, multiple access mechanism, and a channel coding scheme. The Internet platform becomes general purpose technology [10], which facilitates the growth of various new types of service applications. Like the co-evolution mechanism [11], technology creates services that then require new technology to support their consecutive enhancements. For example, in the beginning the Internet facilitated the creation of a mobile messenger, and the service was broadly adopted by the market. Due to such massive popularity, the market raises security concerns. This pushes technology developers to further enhance technical capabilities to ensure more secure communication.

Therefore, we can classify the shifting characteristic from 2G to 3G and 4G as market-driven, in which the market exhibit a service demand, thereby driving supporting technological development. As a result of this, the market is getting unpredictable and the challenge for operators is to quickly provide customer with new, innovative services. To facilitate this, an operating model should be developed based on the top-down perspective, where there is a need to support the business process of the entire enterprise of service operators. One framework satisfying this is the enhanced Telecom Operation Map (eTOM) that focuses on the customer aspects, strategy infrastructure, product, operations, and enterprise management, as seen in figure 2.

![Figure 2. eTOM framework.](image)

eTOM was developed in the early 2000s and was also released as ITU-T Recommendation M.3050 [12]. eTOM describes and analyzes different levels of enterprise processes according to their significance and priority for the business [13]. The framework is defined as generically as possible so that it remains organization, technology, and service-independent [13]. There are four main elements: Customer, Strategy-Infrastructure-Product, Operations, and Enterprise Management. Each element of eTOM has sublayers that facilitate a swift response to rapid market changes. From a business perspective, eTOM sublayers include billing management, supplier relations, customer relationship management, and other necessary business operating concerns.

3. The New Operating Model for the 5G Ecosystem

This paper provides the operating model of 5G services as seen in figure 3. The basis for this view is that eTOM should be enriched by new perspectives, addressing some important operational consequences which may determine the success of 5G service implementation. Details on this perspective are elaborated in the following sub sections.
3.1. Infrastructure and enterprise management underlying a virtual resources operation

Similar to the operating models of TMN and eTOM, our model has a network infrastructure underlying the means of technical and non-technical operations and enterprise management. However, the 5G infrastructure may run over virtualized computing, storage, and network resources deployed on high-volume servers or cloud infrastructure instead of on specialized hardware [14]. The processing operations of a 5G Radio Access Network is handled using a cloud-based mechanism. This presents a new perspective: an operator may not have a physical device since 5G can work in the cloud. To ensure higher service quality, the operator’s strategic concern shifts from how to build a proper physical infrastructure to how to efficiently allocate virtual resources. Research by [15] and [16] have discussed some prime challenges, including network slicing management and spectrum-sharing mechanism.

![Figure 3. The new perspective enriching the eTOM framework for 5G operators.](image)

3.2. Service operation run using a reliable network on a small coverage mmWave band

Since 5G will deliver an extremely high-speed data rate, its requirements for a larger bandwidth will only be satisfied by utilizing operations in the millimeter waveband. The specific bands to be considered are 24.25–27.5 GHz, 31.8–33.4 GHz, 37–43.5 GHz, 45.5–50.2 GHz, 50.4–52.6 GHz, 66–76 GHz, and 81–86 GHz [17]. In contrast to preceding generations, service products are delivered through a carrier frequency below 6 GHz, structuring a wider cell coverage. Meanwhile, 5G offers much smaller coverage on network operations because of the technical characteristic of mmWave bands. The product and services offered are becoming more personal and targeting a highly segmented customer base due to a smaller coverage consequence, as if in the structure of femto-cell [18]. Achieving a reliable network, then, is necessary to ensure the quality of such highly personalized service.

3.3. Monetizing the customer that is Non-Human/Things

In principle, the eMBB with 5G is similar to that of the preceding generation, which focused on how to increase the data rate to satisfy the human users’ experience. Philosophically, mMTC and uRLLC will have machines (things) as the end-users. It is expected that mMTC shall satisfy a massive connection of the Internet-of-Things (IoT). The future market will be indicated by an escalation of the number of machines as 5G customers, but the utilization of bandwidth per-unit will be much smaller than when
human-customers utilize the eMBB services. For that theoretical conception, our previous work [6] proposed the term Average Revenue Per Machine (ARPM), reflecting a changing orientation in how 5G service operators value their customers. The number of machines will be important in reflecting the commercial success of an operator. Instead of using Average Revenue Per User (ARPU), we argue that the new term of ARPM would more appropriately reflect the financial performance of a 5G business, as seen in Equation (1).

\[
ARPM (x, y, z) = \frac{R(x, y)}{z}
\]  

(1)

In this view, an operator’s revenue (R) will depend on three factors: type of 5G service application (x), such as robotic-based surgery; type of sector (y), such as the health-sector; and number of machines (z). Detailed elaboration of the term of ARPM is presented in [6]. It was discussed that these three factors signify the radical changing technological perspective of 5G; operators should not only be concerned with connectivity, but also with the type of service applications (factor of x). Unlike its predecessors, whose tariffs were simply measured on the basis of data rate (typically bit per second), 5G tariffs will vary depending on the type of service. For example, the tariff for a hospital deploying a robotic-based surgery service will be different to a farm operating an IoT machine with vegetation-related sensor [6]. Subsequently, the robotic-based surgery is belong to the health-sector (factor of y). A significant consequence of such a factor is that operators may choose which sectors need to be prioritized for the sales and infrastructure deployment. Finally, the number of machines (factor of z) indicates that machines will behave as an autonomous 5G customers. Following the linearity concept of human customer, the more the number of machines, the more revenue obtained.

3.4. The importance of security is in all operating parts

With 5G technology facilitating aggregated high bandwidth utilization, a massive amount of data traffic would densely travel over the network. The operational mechanism includes data generation, collection, processing, and other data management activities. Even though mechanisms and supporting techniques make 5G more secure and reliable than its predecessor, the task of ensuring security and privacy is still challenging, in particular when facilitating mMTC [19]. On the network side, the challenge are vulnerability, multi-standards connectivity, alignments and injustice, and ownership and misuse of data. Some identification of privacy problems and security challenges are discussed in [20]. On the user side, there is the concern that the more markets that are connected to 5G network platforms, the more there is a need for secure transactions. Since data travels from end-to-end, security should be a main concern at all levels of 5G operating activities. An example of how the ecosystem responds to this perspective is that the rise of 5G development coincides with the emergence of new supporting technologies, such as the blockchain [21].

3.5. Service innovation in relation to the content provider

In the current ecosystem, the main role of an operator tends to be to provide infrastructure, while most content providers use the operator’s network as a way to deliver their service values. Hence, a key player in the 5G ecosystem is the content provider, who do not build infrastructure but rather provide the content running over the operator’s network. A prominent case is that the subscribers of many operators prefer using WhatsApp to make a voice communication rather than traditional circuit-switch-based voice services. Meanwhile, YouTube, as purveyors of the most-accessed content, is managed by Google, an enterprise that does not deploy the network on which YouTube runs. Operators are now facing a dilemma in that they are finding it difficult to monetize their physical network resources, while other business entities, in this case content providers, can.

In such a situation, new services are absolutely necessary to ensure the sustainability of operators’ businesses and to open up potential revenue streams. Service innovation may come from content providers, both local and international, while business operations could be developed by either forming partnerships with content providers or creating new services under the operators’ own enterprise. It is important that operators realize a technological innovation theory: that products build upon one another
and are interconnected in technological systems [22]. Such an interconnected system stresses the importance of innovative service designs which should combine the global trend with the local market, bringing in the perspective of local innovation. As a result, opportunities may appear when they are matched with the local market situation [23].

3.6. Tactile Internet and possibility developed into 6G Terahertz

Finally, the technological phase is getting shorter, such that the 5G operation model must also keep in mind the development of 6G. Although 6G has not been determined, its development is not far away, requiring the consideration of the need for greater bandwidth, the exploitation of artificial intelligent technology, the Terahertz spectrum, and the Tactile Internet. Some characteristic of future technology have already been anticipated. For example, Terahertz would have the consequence of network coverage getting much smaller, so the operating model should be prepared for increasingly more specific and intimate applications. On the other hand, ITU defines the character of the Tactile Internet, having extremely low latency in combination with high availability, reliability, and security [24]. Eventually, numerous new opportunities for emerging technology markets and the delivery of essential public services will open up, bringing more benefit to business and society [24].

4. Conclusions

We have discussed the new perspectives of the 5G operating model. It is built on the visual model that works on the basis of an eTOM framework. First, the perspective of virtual resource has shifted the strategic concerns of operators from how to build a proper physical infrastructure to how to efficiently allocate virtual resources. Second, the 5G carrier frequency over a mmWave band has led to much smaller coverage, increasing the importance of personal services. Third, the operation of 5G will introduce the concept of ARPM as it reflects the economic success of serving non-human customers. Fourth, security becomes a main concern at all level of the operational system. Fifth, 5G elevates the role of the content provider such that they should partner with operators to generate potential revenue streams. Sixth, the operating model should anticipate the next generation technological platform. This work can provide visual guidance to mobile network operators on how to deliver value to their prospective 5G customers.

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