BIF Response to TRAI CP on Review of Quality-of-Service Standards for Access Services (Wireless and Wireline) *and* Broadband Services (Wireless and Wireline)

PREAMBLE

At the outset, BIF lauds the Authority for releasing an important Consultation Paper on Quality of Service for both Fixed and Mobile Access & Broadband Services**.**

At the outset, we wish to bring to the kind notice of the authority unique challenges faced by Telecom Service Providers (TSPs) in India:

These include -

a) Right of Way (RoW) issues, the presence of illegal repeaters/boosters, handset quality, the cost and availability of spectrum, etc., because of which QoS provided by Service Providers are affected.

b) The resilience and capabilities of the Indian Telecom network, which effectively served 1.2 billion people during the COVID-19 pandemic, should not be overlooked.

c) Complexities involved in shifting from LSA based reporting to district based reporting.

d) Change in Reporting Periodicity from Quarterly to Monthly.

We urge the Authority to kindly keep these challenges being faced by telcos in mind, while changing the QoS parameters and before imposing any new QoS guidelines upon them.

India's current QoS regulations and parameters were based in the 2G & 3G era and the early stages of the 4G era. With rapid march of technology and the arrival of LTE-Advanced and now 5G, coupled with the burst of the video revolution which includes live streaming of events, the rapid rise of short videos and the huge video downloads, the bundling of voice and video with data; with the lines separating the different applications and services blurring, the QoS regulations are less relevant and need revision and updation to keep pace with the changing requirements. ought to undergo changes. Also the QoS requirements are closely intertwined with the changes in consumer preferences and experience and the

QoS of the Telcos must reflect these changes over time. translate into better Quality of Experience (QoE) for the consumers and overall consumer satisfaction.

The time is ripe to review of Quality-of-Service Standards for Access Services (Wireless and Wireline) and Broadband Services (Wireless and Wireline).
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1. Please find below our question-wise response to the Consultation Paper.

Question-1: What are the possible reasons for increasing gaps between the QoS reported by the service providers and the QoS experienced by the consumers? How this gap can be bridged?

BIF RESPONSE

Let us first understand the difference Quality of Service (QoS) and Quality of Experience (QoE).

2.1: Quality of Service (QoS) is a set of techniques used to manage and optimize the performance of a network. The main goal of QoS is to ensure that network resources are allocated in a way that guarantees a certain level of performance for specific network traffic.

2.2: (QoS) mechanism controls the performance, reliability and usability of a telecommunications service. Mobile cellular service providers may offer mobile QoS to customers just as the fixed line PSTN services providers and Internet service providers may offer QoS.

2.3: A crucial part of QoS in mobile communications is Grade of Service, involving outage probability (the probability that the mobile station is outside the service coverage area, or affected by co-channel interference, i.e. crosstalk) blocking probability (the probability that the required level of QoS cannot be offered) and scheduling starvation. These performance measures are affected by mechanisms such as mobility management, radio resource management, admission control, fair scheduling, channel-dependent scheduling etc.

2.4: One of the key benefits of QoS is that it enables network administrators to ensure that mission-critical applications and services receive the resources they need to function properly. This can lead to improved productivity, reduced downtime, and a better user experience.

2.5: Quality of Experience (QoE) is a term used to describe the overall satisfaction of a user when using a network. This would include factors such as network speed, reliability, and usability.

2.6: In today's digital age, where technology is constantly advancing, it is essential for communication networks to provide a high QoE. Another important factor is network reliability. A reliable network is one that ensures that users are able to access the network at all times, without interruption or downtime. This is crucial for businesses that rely on the internet to conduct their operations, as even a short period of downtime can lead to lost productivity and revenue.

2.7: Usability is also a key factor in determining QoE. A user-friendly network makes it easy for users to access and navigate the network, leading to a more efficient and productive work environment.

Table below illustrates the difference between Quality of Service (QoS) as reported by the TSPs and Quality of Experience (QoE) as experienced by the Consumer of the Data Services.

Quality of Service (QoS)	**Quality of Experience (QoE)**
Focuses on the technical aspects of network performance, such as bandwidth, delay, and jitter.	Focuses on the perceived quality of the service from the user's perspective, including factors such as ease of use, reliability, and satisfaction.
Typically measured using objective metrics, such as packet loss and throughput.	Typically measured using subjective metrics, such as customer satisfaction surveys and user feedback.
Aimed at ensuring that network resources are utilized efficiently and effectively.	Aimed at ensuring that users are satisfied with the service they are receiving.
Typically used by network administrators and engineers.	Typically used by marketers, customer service representatives, and user experience designers.

2.8: From the above table, it is evident that while QoS measures key network performance metrics, QoE focuses on the actual individual user experience.

2.9: Good service quality leads into customer satisfaction and, therefore, makes the firms more competitive in the market. High service quality can be achieved by identifying problems in service and defining measures for service performances and outcomes as well as level of customer satisfaction.

2.10: QoS in short is network performance at bit/ level and is more concerned about network and terminal equipment upto customer premises. **It is narrow in scope and takes into account only access and core equipment within the TSP domain while excluding transport outside the TSP network, ISP and**

terminal performance. QoE on the other hand, is service performance at application level and at the device level.

There are several reasons for the increasing gaps between QoS reported by the TSPs and the QoE experienced by the consumers. These are summarized as below:

1. The standards of Quality of Service (QoS) for wireless & wireline access & data services were notified in the era of 2G and 3G. There are more than 861 mn broadband connections as per latest TRAI data (June 2023), majority of which is mobile broadband subscribers. Change in access technology from 2G & 3G to 4G and now 5G, change in Core technologies from Circuit Switch to Packet Core to all IP network or at least a majority IP based network, has led to increasing gaps between QoS reported by the TSPs and the QoE of the consumers as QoS have not been reviewed for the new era. There have been an increasing number of complaints on service quality, particularly call drops, call muting, low data throughput etc., which have adversely affected QoE of consumers.
2. With sharp rise in growth of data subscribers, access to unlimited content, and data hungry consumers (with India becoming the largest data guzzling nation in the world with per capita data consumption rising exponentially), network designing and provisioning of required network resources was required to cater to the needs of the data hungry consumers. As per the existing norms, call drops should be less than 2%. However, when reviewed over an LSA instead of the entire country, the call drops were found to be above the desired level. Hence, there is a need to review the criteria. This requires norms to measure network performance at a district level instead of at the LSA. It will involve measuring the quantum of packet drop rate for 5G networks, and take a combined approach to fixed line and wireless services instead of segregating them and categorizing them under different heads with different performance levels. Thus, if the norms are not revised periodically, gaps between QoS reported by the TSPs and the QoE of the consumers are bound to increase.
3. Traditionally, quality of connectivity has been measured using a simple quality of service (QoS) measure called network speed (or downlink throughput). However, every use case has a different QoS requirement. For example, a study by Mozark shows that even within Video, a VoD streaming requires high initial peak throughput for filling up the initial buffer but subsequently the requirement to refill video buffers drops dramatically. However, for video conferencing, the consistency of network speeds is more critical than peak network speed. So, while QoE of experience is based on multiple factors, the QoS reported does not capture most or all of them, the gap between QoS reported by the TSPs and the QoE of the consumers are bound to increase.
4. India is a mobile first nation and data access happens predominantly through the mobile network. Given the high population density, high per capita data

consumption, and low per capita spectrum availability focusing on simple measures like network speed requires levels of infrastructure spending that may be unrealistic for India. Thus, we must look at much smarter measures of quality of connectivity. The study by Mozark (copy attached) shows that every use case has a minimum operating threshold (MoT) for various QoS KPIs. For example, to deliver a world-class video experience, the network needs to deliver network speeds of 14 Mbps which is achievable rather than chasing speeds of 50 Mbps that just shows us as one of the top countries in a network speed ranking and will drive us down the path of wasteful infrastructure investments. Additionally, focusing on end to end-user experience metrics by use case rather than last-mile network speeds incentivizes stakeholders such as cloud providers, content delivery networks, and application owners to also contribute to improving the quality of connected experience across the country. This compendium of research done by MOZARK examines the concept of end-user quality of experience measurement in detail and how networks, CDNs, and application owners need to come together to deliver a superior connected experience. So, if the QoS matrix reflects only a few of the parameters experienced by consumers, gap between the two will increase.

2.11: Over time, Quality of Service (QoS) requirements have increased due to the fact that customers are using high-end-applications such as online gaming applications, Video-conferencing, video streaming, Video-on-demand, Packet-switched voice (VoLTE & VoNR), YouTube, IPTV etc. which are more data demanding and seek low latency for better user experience. With better or higher service quality there is higher expectations of customers as QoE expectations increase, despite same network performance. However, due to net neutrality, Operators can only provide a standard set of network QoS to all subscribers.

2.12: QoS are defined for a territory while QoE would be for a particular Service or at an individual level. QoE is dependent upon large number of factors viz capacity of the Application in handling the load, bandwidth provided by the ISP to the application, number of hops to the application, number of customers present in the cell site, etc. User preferences are also dependent upon age, type of customers (Students, Businessmen, Individual in leisure), events of larger interest eg Cricket or football sports events etc., time of day, location.

2.13: QoE is also dependent upon quality of User Equipment (UE) being used by customer, signal availability at that location etc. QoE is also dependent upon quality, age, level of maintenance of Customers' UEs, which are independent of Service providers' network performance. Therefore, it may not be always correct to blame the Service Provider alone for poor QoE experience by customer.

Question-2: To support emerging applications and use cases please suggest a transparent framework for measurement and reporting of QoS and QoE especially in 4G and 5G networks considering relevant standards and global best practices.

BIF RESPONSE

Since 3GPP has a well-defined QoS and QoE Measurement framework which is based on relevant standards and global best practices, the 3GPP framework may be considered.

Even though the components for QoE are specific to users, geographies and applications, QoE models are being devised by operators and self-customized for key applications (say Snapchat, Instagram, twitter, YouTube) by creating a customized dash board.

Some of the components important for different application areas are as under:

1. Download Speed - important for VOD
2. Consistency of network speed - important for applications and services like Video conferencing
3. Security/Privacy
4. Business Intelligence via Data Analytics – Continuous Feedback from Customer
5. 5G special services - latency is more important
6. AI/ML model to extract data driven approach on Deployments for Backbone/Edge Servers on User Demand – latency is important

It must be noted that different markets have different expectations from service providers eg in UK and Japan, data allowance is an important factor while in Norway and Finland, consistency of connection speed is a key differentiator for the customer.

Question-3: What should be the QoS parameters and corresponding benchmarks for ultra-reliable low latency communication (uRLLC), and massive machine type communications (mMTC)?

BIF RESPONSE

3.1: Machine-type communication (MTC) is a rapidly growing technology which covers a broad range of automated applications and propels the world into a fully connected society. Two new use cases of MTC are massive MTC (mMTC) and ultra-reliable low latency communication (URLLC), where mMTC supports a large number of devices with high reliability and low rate connectivity while URLLC refers to excessively low outage probability under very stringent latency constraint. 5G communication technology should be flexible enough to support ultra-reliable low latency communications by guaranteeing reliability greater than 99.999%

3.2: MTC takes advantage of several distinctive properties such as group-based communications, low mobility, and time-controlled, time-tolerant, and secure connection which are at the same time challenging tasks since technically advanced solutions are needed to deliver the required tasks.

3.3: Current technologies cover a small range of applications and services while MTC should be able to cover a broad range of services with multiple forms of data traffic in order to deal with different service requirements as data rate, latency, reliability, energy consumption, and security. In mMTC, a huge number of devices in a specific domain are connected to the cellular network with low-rate and low-power connectivity, different quality-of-service (QoS) requirements, e.g., smart meters and actuators Hence, we can define the reliability as the probability of successful transmission under the predetermined delay constraint.

3.4: In URLLC, high probability of successful transmission indicates low outage probability (or packet drop) while the opposite does not always hold as the reliability is restricted to a specific latency budget due to the limited amount of channel uses. Hence, one of the major requirements of URLLC is an extremely low outage probability under a very demanding latency budget where retransmissions are not always available. In the use of short messages under URLLC, new robust channel codes are needed; otherwise, the performance of the system will be even further away from the Shannon limit with long data packets.

3.5: Another key characteristic of wireless communications that highly affect the performance of 5G networks is the energy efficiency (EE) due to the limited energy resources in energy-constraint networks EE, which has been widely studied recently in literatures, is defined as the ratio of successfully transmitted bits to the total consumed energy. Hence, reducing the amount of energy per bit improves EE at low SNR regime, particularly in wireless networks where the batteries which are not rechargeable or easy to charge supply the wireless components

QoS Parameters:

3.6: In some contexts, extremely high reliability is needed. For instance, for remote control of process automation, a reliability of 99.9999% is expected, with a user experienced data rate up to 100 Mbps and an end-to-end latency of 50ms.

3.7: Services requesting a shorter latency were the interactive ones, mostly (video)telephony, where it was acceptable to have a reduced reliability. So (higher) Reliability and (lower) Latency have traditionally "mutually rejected" each other because of contradicting solutions.

3.8: Other non-radio specific aspects required to be measured are QoS Monitoring, Dynamic division of Packet Delay Budget, Packet Delay Budget (PDB) and enhancements of session continuity.

3.9: As regards benchmarks for uRLLC & mMTC, it is suggested to follow 3GPP standards

Question-4: Will there be any likely adverse impact on existing consumer voice (VoLTE/VoNR) and data services (eMBB) upon rollout of enterprise use cases of uRLLC or mMTC? &

Question-5: Question-5: If answer to Question-4 is 'No' then please explain how and if the answer is 'Yes' please suggest measures to ensure minimum guaranteed QoS for voice and data service for consumers.

BIF RESPONSE

Using the Network Slicing capability, Enterprise Use Cases in 5G can be rolled out easily. It is generally believed that by doing so, this would not impact the QoS of the public 5G services and hence it is unlikely that there would be any adverse impact on existing voice and data services upon rollout of Enterprise use cases. However, some resources would get used for these enterprise use cases and hence resources available for normal use cases may reduce. Thus better network planning and increase of resources would be required in the network.

Justification:

4.1: Operators may need to dedicate part of their network to meet enterprise use cases. Since resources are finite, it is believed that to cater to special needs of the enterprise use cases, to ensure little or no impact on regular services, one would need better network planning and increase in resources. Thus additional resources for enterprise customers may aid better service experience for retail consumers as well.

4.2: The main driver behind the development of 5G networks has always been improved data services such as higher mobile data rates and reduced latency. However, the legacy services of voice and video communications remain key elements for mobile services, and subscribers continue to demand them. The demand for voice services among mobile subscribers will ensure these services remain part of the packages and business models of service providers.

4.3: Prior to this latest migration of voice over 5G networks (5G voice over New Radio or 5G VoNR), the migration of voice services from 3G and circuit switched mobile networks to the 4G Long Term Evolution (LTE) network was initially slowed by technical challenges. Part of the ability of voice over LTE (VoLTE) to overcome its early technical challenges was the fact that it was based on the IP multimedia subsystem (IMS) architecture. To a certain extent, the adoption of IMS by service providers can be correlated with the rise of VoLTE. This IMS architecture will play an increasingly important role in 5G VoNR.

4.4: Like 4G LTE networks, 5G voice calls are implemented as end-to-end voice over IP (VoIP) connections managed by the IMS core. Voice and video communications services in these networks ride on top of the IP data connection. Unlike voice services provided by external applications (i.e. so-called OTT speech services), voice over IMS supports quality of service (QoS) management across the entire 5G system (5GS). While IMS can provide voice services for any type of access (fixed, cable and 2G/3G) as well as for any 5G deployment model, 5G is not as flexible and must have an IMS network to handle voice services no matter what type of deployment is involved. Just as we could correlate the adoption of

IMS with the rise of VoLTE, the introduction of 5G serves as a catalyst to accelerate voice core modernization to IMS from older technologies in networks.

4.5: VoNR has to adapt to the existing deployment modes, i.e. non-standalone (NSA) or standalone (SA). The NSA deployment mode, known as option 3, involves LTE plus NR with an evolved packet core (EPC). In contrast, the SA deployment involves NR with the 5G core (5GC). This deployment mode is known as option 2. Once it has been determined whether the RAT is 5G NR or E-UTRA, it is necessary to consider whether co-existing SA networks are involved or a dual connectivity scenario, i.e. E-UTRAN New Radio dual connectivity (EN-DC) or NR-E-UTRA dual connectivity (NE-DC). Of course, it is also important to know whether the RAT even supports voice services.

4.6: Most recent 5G deployments have employed option 3, meaning the network providers basically have an existing 4G LTE network and have deployed a 5G network alongside it. In this way, 5G NR serves as a secondary cell and the core technology remains the evolved packet core (EPC). During operation of option 3, a UE registers to the IMS via the evolved packet system (EPS). When the 5G UE launches (or receives) a voice call, typical VoLTE procedures are followed over the EPS system. When a service provider chooses option 2, they deploy the 5G network as an SA network without relying on any other network. In this option, the IMS core provides voice as a 5G application service. Voice services on this kind of network are known as voice over new radio (VoNR). Even this option 2 presents challenges.

4.7: In this nascent stage of 5G, geographic coverage for 5G will be incomplete. When a mobile device moves out of a 5G NR coverage area, a VoNR voice call in progress will require a handover to use VoLTE in a 4G network. Meticulous network planning is required taking coverage into consideration. Since there is no need for full 5GC support yet, EPS can serve as an interim step to speed up the time to market for voice services. The benefits of 5G VoNR for voice-only calls are obviously the quality and ultra-high definition of the calls.

4.8: 5G VoNR also has an important role to play in the new data services provided by 5G. 5G VoNR provides a point of integration with applications and content such as announcements, music, conferencing and more. It will also provide enhanced support for real-time communications, including Rich Communication Services (RCS) integration. For example, RCS integration will allow 5G VoNR to enable interactive features such as real-time language translation. Many of the more advanced functions will work only in a 5G NR environment with support from the 5GC infrastructure.

4.9: Some finite resources would get used for these enterprise use cases and hence resources available for normal use cases may reduce. Thus better network planning and increase of resources would be required in the network to cater to additional needs such as in the case of 5G VoNR.

Question-6: To achieve QoS and QoE end-to-end, it is essential that all network segments deliver the minimum level of QoS required by respective service, application or use case. In this context, please suggest QoS parameters and corresponding benchmarks for National Long Distance (NLD) and International Long Distance (ILD) segments of the network with supporting global benchmarks.

BIF RESPONSE

QoS will remain the same with technologies like Fiber, CPRI, Lease-lines etc. Key parameters are "time delay", jitter, "error ratio" which we need to take care as per Link-budget. It may subjectively increase as we increase the distance in case of specific scenarios like NLD, ILD.

Question-7: What should be the approach for adoption of 'QoS by Design' framework by the service providers to ensure that new generation wireless networks are planned, implemented and maintained to deliver required level of measurable QoS and QoE?

BIF RESPONSE

7.1: QoS framework is well defined by 3GPP for technologies like NR. It needs to be adopted as per design, basis the following parameters:

- Resource Type – GBR, NON GBR
- Default Priorty level
- Packet Delay budget
- Packet Error Ratio
- Default Averaging Windows.

7.2: Transport network and engineering play vital role in designing these all values with proper Test Frameworks, based on distance on Mobile Edge Computing based networks, a link-budget will be aligned for Front-haul and Backhaul interface, Switches, Servers to be aligned based on their locations. QoS measurement is based on

- User data Commitment [MBPS/GBPS]
- Network Availability
- Bandwidth Availability
- Frequency Bands
- Number of User in Network.

7.3: Wireless networks are ubiquitous and essential for many applications and services, but they also pose challenges for ensuring quality of service (QoS) and quality of experience (QoE) for users and providers. QoS and QoE are two related but distinct concepts that measure the performance and satisfaction of wireless networks from different perspectives.

QoS metrics

7.4: QoS metrics are objective and quantifiable indicators of the network's ability to deliver data packets with certain levels of reliability, delay, jitter, throughput, and error rate. These metrics are typically measured at the network or transport layer and can be employed to evaluate if a network is meeting service level agreements (SLAs) or to compare different network architectures or protocols. Common QoS metrics for wireless networks include packet loss, which is the percentage of packets lost or discarded due to congestion, interference, or other causes; delay, which is the time it takes for a packet to travel from its source to its destination; jitter, which is the variation in delay between consecutive packets; throughput, which is the amount of data that can be transferred per unit of time; and error rate, which is the percentage of packets containing errors caused by noise, interference, or other factors.

QoE metrics

7.5: QoE metrics are subjective and qualitative indicators of the user's perception and satisfaction of the network's performance and usability. These metrics are usually measured at the application layer or the user interface layer, and they can be used to assess the user's expectations, preferences, and feedback on service quality. Common QoE metrics for wireless networks include the Mean Opinion Score (MOS), which is a numerical rating of the user's overall impression of quality from 1 (bad) to 5 (excellent); the User Satisfaction Score (USS), which is a numerical rating of satisfaction with service quality, reliability, availability, and security from 1 (dissatisfied) to 5 (satisfied); the Net Promoter Score (NPS), which is a numerical rating of likelihood to recommend the network's service from -100 (detractors) to 100 (promoters); and User behaviour, which is a set of indicators that reflect user actions, interactions, and engagement with the network's service such as usage frequency, duration, intensity, and loyalty.

QoS and QoE standards

7.6: QoS and QoE standards are guidelines, recommendations, or specifications that outline the levels of QoS and QoE metrics for wireless networks. These standards can be created by various organizations, such as industry associations, regulatory bodies, or academic institutions, and vary in accordance with the type, purpose, and context of the wireless network. Examples of QoS and QoE standards for wireless networks include IEEE 802.11 – a family of standards that define the physical and medium access control layers of WLANs – ITU-T G.114 – a recommendation that defines the maximum acceptable one-way delay for voice applications over IP networks – ITU-T P.800 – a recommendation that defines the methods and procedures for subjective evaluation of speech quality – and ETSI

TS 102 250 – a technical specification that defines the methods and procedures for subjective evaluation of video quality.

QoS and QoE improvement

7.7: QoS and QoE improvement is the process of enhancing wireless network metrics and standards, allowing users to enjoy better performance and usability, while also helping providers to improve their efficiency and competitiveness. This can be achieved through various approaches, such as network monitoring - collecting and analysing data on the network's QoS and QoE metrics -, network testing - measuring and evaluating the network's QoS and QoE metrics -, and network optimization - adjusting and improving the network's configuration to enhance QoS and QoE metrics.

Question-8: What measures are required to accelerate the adoption of AI for management of QoE to reduce consumer complaints protectively and to enable near real time reporting of QoS performance to consumers?

BIF RESPONSE

AI based network performance measurement and monitoring on a real time basis, is extremely important in today's context. Some of the measures that are required to be taken to accelerate and augment the adoption of AI in this area are given below:

8.1: AI requirement is to process QoS requirements on different applications and allocate resources based on User activities, understanding Pattern, Understanding situations like Football match, Yearly Sale and much more.

8.2: Network need be designed dynamically based on the pattern. Here, AI can play a vital role where criteria can be data-driven using dynamic QoS management and predicting likely performance degradation and taking measures in advance.

8.3: QoS parameters needs to be defined at application level for bridging the gap between QoE and QoS.

8.4: Communications service providers (CSPs) strive for relentless efficiency, business agility to address new revenue opportunities, and to meet or exceed customer expectations through a superior experience. This continues with the introduction of 5G programmable networks, which enable new revenue-creating opportunities through both enhanced user experience as well as the tailoring of telecommunications networks to provide differential services for both existing and new types of enterprise customers (e.g Industry 4.0, Automotives, Fixed Wireless etc). The introduction of new technologies viz. AI is becoming increasingly important to cater to complexities arising out of need for additional services for customers on a dynamic basis, densification of networks to support macro and micro coverage, and the need to ensure services with differing requirements.

8.5: AI technologies can make many CSPs' system functions more capable as well as enable new system functions and approaches. Some example applications include:

- improving network performance though better radio scheduling, paging and so on
- improving assurance of offered services and resources, moving from reactive to proactive — even in the face of increasing network complexity and heterogeneity
- improving optimization and use of existing resources, such as spectrum, transport, cloud infrastructure and network functionality
- improving experience management through both increased customer understanding as well as increased tailoring of the offered experience
- improving product and service definition, design, planning and offerings
- improving network and performance planning (such as radio, data center location and transport)

8.6: The maturing capabilities of AI have resulted in increased attention within standardization and open source communities, both from a purely technology evolution perspective as well as from an architecture definition perspective. While open source and standardization are enablers for increased AI adoption, the fragmentation which occurs in the early phases of industry specification can hinder adoption due to the uncertainty it creates, which occurs between different industry bodies as well as in different groups within industry bodies.

8.7: There are many AI-related activities taking place in the industry, such as those in the IT domain, among standardization bodies, and on the open source front. Both technology and the ecosystem are evolving rapidly. In order to accelerate the adoption of AI, it is important to have an overall view of the industry and establish an understanding of the driving organizations, including the challenges facing them.

8.8: When it comes to compelling business-driven use cases, analytics use cases can be categorized into three areas, where the primary area is reduction of operational expenses (opex) and capital expenses (capex) and increased efficiency.

(i) New technologies require networks to be operated in an efficient manner, and this cannot be possible without utilization of AI.

(ii) The second area is enhanced customer experience, where CSPs want to differentiate themselves through a better customer experience in their network services.

(iii) The third area is new revenues, where CSPs offer new capabilities to enterprises or consumers, resulting in new business.

8.9: While the journey of the application of AI/ML technologies in telecommunications networks has already begun, it has involved disparate and isolated approaches and has been applied within the current industry definition only as an afterthought. The step towards mass adoption and industrialization is yet to come and can be accelerated with the right level of industry alignment, supporting a multivendor ecosystem while still encouraging innovation enabled by the adoption of rapidly evolving technologies.

8.10: The industry has recognized that in order to transition to an industrialization phase and enable mass adoption of AI/ML, industry alignment is required. This results in all the major industry bodies trying to work out how they can leverage the technologies and claim their stake in the AI/ML landscape, leading to multiple and somewhat diverging directions being taken. To accelerate the coming industrialization phase and mass adoption, the industry must choose which guidance to follow.

8.11: AI/ML should be adopted at all levels of a network architecture. While enabling movement towards an aligned platform approach, service providers can benefit from a business-driven and use case–driven approach to the deployment of AI, covering required data, required insights and required actions.

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