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자동 생성된 설명**

**APT REPORT ON**

**FUTURE NETWORK SERVICES IN 6G AND BEYOND**

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**No. APT/ASTAP/REPT-59**

**APT Report on Future Network Services in 6G and beyond**

This document contains the draft APT report on Future network services in 6G or beyond based on INP-55 of ASTAP-37 and the conclusion of discussion of EG-FN&NGN meeting.

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**apt Report on Future Network Services in 6G and beyond**

# **Scope**

This document reports the result of the questionnairnaire about for problems and requirements to future network services in 6G and beyond in Asia-Pacific region. It also describes specific actions and needs of the member countries toward the stadardization and implementation of 6G and beyond in this region.

# **References**

None.

# **Terms and Definitions**

3. 1. **Terms defined elsewhere**

None.

* 1. **Terms defined in this Report**

None.

# **Abbreviations and Acronyms**

None.

# **Introduction**

In Asia-Pacific region, some countries are implementing 5th generation mobile network (5G) infrastructure and others are planning to introduce it. Lots of new network services using 5G network are expected to be launched in future. As new services and new technologies about network and devices will progress in future, ideas of new services will be born and these will need more network bandwidth for higher quality and, for example, video streaming captured by 360-degree camera, ultra-reliable low latency, and much higher massive connections for more IoT devices. Such future network is called “6G and beyond” (or Beyond 5G). To satisfy the above future requirements to the future network services, it is important for network service providers to introduce not only AI assisted network managements but also autonomous network management that allow networks to autonomously respond to application service requests and coordinate various services while operating stably. And the future services using the future network will be implemented in the cloud environment and virtualized network environment.

In ASTAP-36 and ASTAP-37, the questionnaire for problems and requirements to future network services in 6G and beyond era was approved and it was circulated in Asia Pacific region twice.

As B5G includes 6G or later generations and it is not so popular with Asia-Pacific region, “6G and beyond” is used in this report.

# **6. Questionnaire outline**

## **6.1 Objective of the Questionnaire**

The objective of this questionnaire is to gather the current problems and requirements about networks and their expectation about the future services and technologies such as virtualized network services, cloud services, AI assisted network service, and autonomous network services. The gathered information will be contained into the new APT/ASTAP report on “Future network services in 6G and beyond”, which aims to be one of the guidelines for implementing the new networks including 6G and beyond in APT countries.

## **6.2 Responsible Group**

Expert Group on Future Networks and New Generation Networks (EG FN&NGN)

## **6.3 Rapporteur of the Questionnaire**

|  |  |  |
| --- | --- | --- |
| Hideki YAMAMOTO | OKI, Japan | yamamoto436[at]oki.com |

## **6.4 Meetings at which the Questionnaire were approved**

* + First version: ASTAP – 35
  + Second version: ASTAP – 36

## **6.5 Target Responder**

The APT members, including affiliate members, that are responsible for developing/enforcing/implementing 5G networks.

# **7. Result of the questionnaire**

* 1. **Availability of the respond country**

Table 1 shows the countries which responded to the questionnaire.

Table 1 – Respond countries to questionnaire.

|  |  |  |
| --- | --- | --- |
| No. | Country | Country code (ISO 3166-1) |
| 1 | Republic of the Union of Myanmar | MMR |
| 2 | Australia | AUS |
| 3 | Bhutan | BTN |
| 4 | Singapore | SGP |

* 1. **Future network questionnaire response**

### **Myanmar**

* + - 1. **Current mobile network generation and migration plan to new generation in Myanmar**

In Myanmar, 2G, 3G and 4G are in use. There is no plan to migrate to the new generation as of the end of 2024.

* + - 1. **Current operational and service problems**

**There is no problems.**

* + - 1. **Effective future technologies to solve the above problems**

**N/A**

* + - 1. **Issues for standardization in the 6G and beyond era**

**N/A**

### **Cambodia**

* + - 1. **Current mobile network generation and migration plan to new generation in Cambodia**

In Cambodia, 2G, 3G and 4G are in use. Cambodia plans to migrate their network to the new generation, 5G, by 2025, following phases of infrastructure preparation, pilot testing and full-scale deployment.

* + - 1. **Current operational and service problems**
         1. **Problem case 1: Limited rural problem**

|  |  |
| --- | --- |
| Name of problem | Limited rural problem |
| Victims | Local users (residents, tourists, authorities, service providers) |
| Description | Network infrastructure is inadequate in rural areas, leading to poor connectivity and exclusion from digital services.  Some locations are difficult to access, no electricity, no transmission link, road condition, etc. |
| Starting date |  |
| Possible measures against the above problems in future networks | Infrastructure sharing among MNOs, and encourage MNOs to deploy/expand their mobile services to the rural areas by subsidizing costs or providing support using USO funds. |

* + - * 1. **Problem case 2: Overloaded urban networks**

|  |  |
| --- | --- |
| Name of problem | Overloaded urban networks |
| Victims | Urban population, businesses relying on high-speed internet |
| Description | Network infrastructure is inadequate in rural areas, leading to poor connectivity and exclusion from digital services.  Some locations are difficult to access, no electricity, no transmission link, road condition, etc. |
| Starting date |  |
| Possible measures against the above problems in future networks | Increase bandwidth with frequency re-farming, AI-traffic management, and capacity expansion through 5G infrastructure. |

* + - 1. **Effective technologies to solve the above problems**

Cambodia thinks the following technologies are effective measures in future networks to their problems:

Cloud, virtualized networks, AI assisted networks, and other technologies.

Other technologies in the above includes followings:

* 5G/6G technologies: Advanced features such as terahertz waves for high-speed data transfer and integration with IoT ecosystems.
* Non-terrestrial Internet: To extend connectivity to remote or rural areas.
  + - 1. **Issues for standardization in the 6G and beyond era**
* Network compatibility: It will be essential to provide smooth compatibility between different network generations as networks advance from 5G to Beyond 5G (6G). In order to provide seamless transitions and uninterrupted device and application functionality across various network technologies, standardization will be required.
* AI and Autonomous Network Management: Standardized protocols will be required to regulate how AI handles network traffic, resources, and quality of service as AI-assisted and autonomous networks gain traction. These standards should address security, data privacy, and the ethical use of AI in decision-making processes.
* Network Virtualization and Cloud Integration: To enable flexible, scalable, and cost-efficient network deployment, standardizing cloud infrastructure and virtualized network technologies is crucial. Interoperability between different cloud providers, data centers, and network function virtualization platforms should be standardized to ensure smooth operation across geographies.
* Security Standards for IoT and 6G and beyond: It's essential to have strong security standards as networks get increasingly interconnected and support more IoT devices. Communication security, device authentication, data privacy, and encryption should be the primary focus of standardization, especially in light of new technologies like quantum communication.
* Spectrum Allocation: The allocation and management of spectrum for 6G and beyond technologies will need clear international standards to prevent interference and ensure fair use. Standardization should focus on harmonizing spectrum policies for global consistency and better frequency utilization.
* Sustainability and Energy Efficiency: There will be an increasing focus on making future networks energy-efficient and sustainable. Standardization of energy consumption metrics, eco-friendly infrastructure, and resource management practices will be essential to ensure that future networks align with global sustainability goals

**N/A**

### **Bhutan**

* + - 1. **Current mobile network generation and migration plan to new generation in Bhutan**

In Bhutan, 2G, 3G, 4G and 5G are available. Bhutan will plan to migrate their network to the new generation, 6G and beyond, based on the need, evolving technology and rapid growth of advancement in the world.

* + - 1. **Current operational and service problems**
         1. **Problem case 1: Poor mobile Internet speed**

|  |  |
| --- | --- |
| Name of problem | Poor mobile Internet speed |
| Victims | Residents/Consumers |
| Description | Poor mobile Internet speed towards evening and night and during peak hours |
| Starting date | 13/04/2022 |
| Possible measures against the above problems in future networks | Network densification and continuous monitoring and compliance by operators, better tools for monitoring the network speed and improving QoS |

* + - * 1. **Problem case 2: Poor network**

|  |  |
| --- | --- |
| Name of problem | Poor network |
| Victims | Public/Consumers |
| Description | Poor call and internet service |
| Starting date | 04/01/2022 |
| Possible measures against the above problems in future networks | Optimization and deploy additional sites and using fixed and wireless technologies as per feasibility |

* + - * 1. **Problem case 3: High Tariff rates for Mobile networks**

|  |  |
| --- | --- |
| Name of problem | High Tariff rates for Mobile networks |
| Victims | Public/Consumers |
| Description | High Consumption of tariff on the use of Mobile Networks |
| Starting date | 2017 |
| Possible measures against the above problems in future networks | Revising tariffs for Mobile Networks  Equal or reasonable tariffs  Common method or formula to determine the tariff rates |

* + - 1. **Effective technologies to solve the above problems**

Bhutan thinks the following technologies are effective measures in future networks to their problems:

Virtualized networks.

* + - 1. **Issues for standardization in the 6G and beyond era**

Discussing future generation networks (such as 6G and beyond), there are several potential issues and challenges that might arise in terms of standardization:

* Technological Diversity: Future generation networks are likely to incorporate a wide range of technologies.
* Spectrum Management: With increasing demand for wireless connectivity and new applications, spectrum management becomes crucial.
* Global Interoperability: To enable seamless communication across borders and between different networks, standardization efforts must be coordinated internationally.
* Inclusion and Accessibility: Standardization efforts should prioritize accessibility for all users, including those with disabilities or in underserved communities.
* Regulatory Compliance: Different regions and countries may have varying regulatory requirements for network deployment

### **Singapore**

* + - 1. **Current mobile network generation and migration plan to new generation in Singapore**

In Singapore, 5G are in use. Singapore plans to migrate their network to the new generation, 6G and beyond.

* + - 1. **Current operational and service problems**
         1. **Problem case 1: Lack of performance requirement in existing mobile networks to support future renewable energy management system**

|  |  |
| --- | --- |
| Name of problem | Lack of performance requirement in existing mobile networks to support future renewable energy management system |
| Victims | Human and environment ecosystem |
| Description | Electricity produced by distributed energy resources, such as solar, wind installations and energy storage systems, plays an important role in de-carbonization and energy sustainability.  A virtual power plant integrates[[1]](#footnote-1) distributed energy resources to function like a single power station and brings about greater flexibility and scalability to the power grid. The sustainability drive will also see increase of electric vehicles (EVs) and EV charging facilities. Vehicle-to-grid technology, as a smart charging technology, allows car batteries to give back to the power grid. In essence, it treats these high-capacity batteries as not only tools to power EVs but backup storage cells, or distributed energy resources, for the electrical grid. |
| Starting date | TBC |
| Possible measures against the above problems in future networks | Future networks 6G and beyond era are envisioned to provide the required performance requirement to support:   1. virtual power plant to acquire information for remote monitoring and data collection, and to remotely control the distributed energy resources including the automatic generation control in order to optimize the power system; and   future vehicle-to-grid high density and high precision synchronization connectivity needs. |

* + - 1. **Effective technologies to solve the above problems**

Singapore thinks Autonomous networks are effective measures in future networks to their problems.

* + - 1. **Issues for standardization in the 6G and beyond era**

Networks in 6G and beyond era could consider this requirement of incorporating the performance metrics needed for future renewable energy management system when developing its future technical specifications/ standards.

# **8. Consideration**

Three of four responses to the questionnaire includes the useful information for the future networks. The standardization topics should be considered in not only ASTAP but also other standard bodies as ITU-T SG13.

Almost all issues for standardization in the 6G and beyond era are being studied in ITU-T SG13. SG13 is outputting several Recommendations and other documents for the future networks. It is expected that the standardization in SG13 will be continued and will cover the whole issues in 7.2.2.4.

To implement the new network after 5G and to operate it in Asia-Pacific region, there will be lots of things to be done. However, these points were not clarified by this questionnaire.

It is expected that the future survey about the expectation to ASTAP to implement the 6G and beyond networks in Asia Pacific region. More discussion on this matter are necessary.

# **9. Conclusion**

Regarding the questionnaire to survey the problems and requirements to future networks were circulated in Asia Pacific region based on the decision ASTAP-35 (2023) and ASTAP-36 (2024). After circulation, we REPORT ON THE PROBLEMS AND REQUIREMENTS TO FUTURE NETWORK SERVICES IN 6G and beyond ERA

One of two responses to the questionnaire includes the useful information for the future networks.

# **Appendix: Questionnaire for problems and requirements to future network services in beyond 5G era**

**Section 1: Elementary Part**

1. **Introduction:**

In Asia-Pacific region, some countries are implementing 5th generation mobile network (5G) infrastructure and others are planning to introduce it. Lots of new network services using 5G network are expected to be launched in future. As new services and new technologies about network and devices will progress in future, ideas of new services will be born and these will need more network bandwidth for higher quality and, for example, video streaming captured by 360-degree camera, ultra-reliable low latency, and much higher massive connections for more IoT devices. Such future network is called “Beyond 5G” (B5G) or 6G. To satisfy the above future requirements to the future network services, it is important for network service providers to introduce not only AI assisted network managements but also autonomous network management that allow networks to autonomously respond to application service requests and coordinate various services while operating stably. And the future services using the future network will be implemented in the cloud environment and virtualized network environment.

1. **Objective of the Questionnaire:**

The objective of this questionnaire is to gather the current problems and requirements about networks and their expectation about the future services and technologies such as virtualized network services, cloud services, AI assisted network service, and autonomous network services. The gathered information will be contained into the new APT/ASTAP report on “Future network services in beyond 5G era”, which aims to be one of the guidelines for implementing the new networks including beyond 5G networks in APT countries.

1. **Responsible Group:**

Expert Group on future networks and new generation networks (EG FN&NGN)

1. **Rapporteur of the Questionnaire:**

|  |  |  |
| --- | --- | --- |
| Hideki YAMAMOTO | Oki Electric Industry Co., Ltd. (OKI), Japan | yamamoto436[at]oki.com |

1. **Meeting at which the Questionnaire was approved:**

ASTAP - 35.

1. **Target Responder:**

The APT member states’ agencies that is responsible for developing/enforcing/implementing 4G/5G/Beyond 5G(6G) networks.

1. **Deadline for Responses: *31 December 2023***

**Section 2: Questionnaire Part**

The following questionnaire intends to gather information about problems and requirements to foture network services in 5G and beyond in Asia-Pacific region. The kind input from your administration will facilitate to find the best way to address the needs of your administration through the platform of APT.

**Question 0: Contact information of respondent**

|  |  |
| --- | --- |
| Name |  |
| Country |  |
| Organization |  |
| Department/Division |  |
| Telephone |  |
| E-mail |  |

**Question 1: Which generation is your country using as mobile network?**

2G

3G

4G

5G

**Question 2: When do you plan to migrate your network to the new generation?**

**Question 3: Which generation do you consider from the current generation to?**

3G

4G

5G

6G (Beyond 5G)

**Question 4: Regarding the current network services, what is your operational problems and service problems in your country?**

Please describe the following tables, if more than one.

1. **Problem case 1**

|  |  |
| --- | --- |
| Name of problem |  |
| Victims |  |
| Description |  |
| Starting date | DD/MM/YYYY |
| Possible measures against the above problems in future networks |  |

1. **Problem case 2**

|  |  |
| --- | --- |
| Name of problem |  |
| Victims |  |
| Description |  |
| Starting date | DD/MM/YYYY |
| Possible measures against the above problems in future networks |  |

1. **Problem case 3**

|  |  |
| --- | --- |
| Name of problem |  |
| Victims |  |
| Description |  |
| Starting date | DD/MM/YYYY |
| Possible measures against the above problems in future networks |  |

(If you have more than 3 use cases, please copy and paste above tables)

**Question 5: Which technologies do you think is effective measures in future networks to your problems?**

Please select one or more.

Cloud

Virtualized networks

AI assisted networks

Autonomous networks

Other technologies

If you select “other technologies”, please explain them in the following box.

|  |
| --- |
|  |

**Question 6: What do you expect issues for standardization?**

Please feel free to explain issues if you use future generation network in your country, and/or what do you expect issues to be solved by standardization.

|  |
| --- |
|  |

**On behalf of ASTAP chair, thank you for your collaboration on ASTAP work.**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Energy fluctuations due to intermittent solar power could be automatically balanced out by the virtual power plant. A virtual power plant would also allow for more clean and distributed energy resources to be integrated into a country’s energy mix, to more efficiently meet the energy and sustainability needs of the nation. [↑](#footnote-ref-1)