

A STUDY ON THE CONFORMITY ASSESSMENT PROVISIONING FOR 5G CONVERGENCE SERVICE

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ABSTRACT. *With the worldwide launch of 5G services, related markets continue to grow, and 5G testbeds are being provided to enable devices/convergence service providers to test their products in 5G networks. This paper studies the conformity assessment system, addressing whether the device/convergence service providers comply with specifications for 5G testbeds based on the KOREN network and provide services for a certain period. First, we found that most of the 5G testbeds are focused on evaluating the suitability of devices. The KOREN network-based 5G testbed presented an application plan for conformity assessment for devices and convergence services. In this paper, the concept of conformity assessment specified in the ISO/IEC 17000:2020 standard was applied to the 5G testbed environment and the concept of validation was extended to the operation performance certificate report. This study provides evidence that the operating body of the KOREN network-based 5G testbed has public confidence in the future.*

Keywords: 5G testbed, Conformity assessment, KOREN, Testing report, Operating result

1. **Introduction.** The 5G market is rapidly expanding in South Korea; in 2020 it accounted for 5% of the total mobile telecommunication service market share, and is estimated to reach 69% by 2026. The global markets related to 5G are estimated to reach 407 trillion Korean won for telecommunication services, 1,307 trillion Korean won for convergence services, and 37 trillion Korean won for telecommunication equipment [1,2].

Conformity assessment is a high-value added service for stable growth of the manufacturing industry. Recently, the global market has also been growing rapidly as the demand for conformity assessment in new areas, such as new convergence products, has expanded, on the wave of the fourth industrial revolution. The global market for conformity assessment is expected to reach 165 trillion won as of 2016, with an average annual growth rate of 5.1%, reaching 321 trillion won in 2024. With the rapid growth of the conformity assessment market, countries around the world are fiercely competing for international standards that affect their markets. Accordingly, the Korean government has been trying to secure the competitiveness of the domestic testing and certification industry, and the

Act on the Management of Conformity Assessment was enacted in 2020 to systematically support the management of conformity assessment [1,3].

Like the GSM (Groupe Spécial Mobile) based PTCRB (PCS Type Certificate Review Board), most terminals and equipment are certified, and some apps and services are also being certified. The body responsible for managing PTCRB certification is CTIA (Cellular Telecommunication & Internet Association). GCF and PTCRB are testing and certification bodies for 3GPP (3rd Generation Partnership Project) based mobile communication technology. The GSMA (GSM Association) based GCF (Global Certification Forum) conducts accredited tests by ISO standard certification procedures and certification bodies, and performs validation, but it is understood that the concept of operational performance certificates for equipment and services has not yet been applied. The overseas cases are summarized in Table 1 below. X in a cell means not supported, and O means support.

TABLE 1. 5G testbed examples

Titles	Country	Interworking	Conformity assessment	Accreditation	5G testbed	Notes
GCF [4]	EU	GSMA	3GPP	ISO 17025	Validation	Terminal
PTCRB [5]	North America	GSM	3GPP	CTIA	X	Terminal
Triangle Project [6]	EU	O	O	ISO 17025	O	Device/App
5GTN (5G Test Network) [7]	Finland	O	O	NA	O	Sandbox
Deutsche Telekom & Dekra [8]	Dutch	O	NA	NA	O	Mobility
ENCQOR 5G testbed [9]	Canada	O	NA	NA	O	Prototype

5G convergence services require a variety of devices and software in addition to mobile communication terminals. In particular, the certification of 5G convergence services requires testing, verification, and validation using testbeds in addition to technical specification-oriented lab tests. Accordingly, a conformity assessment system for 5G convergence services where devices and services are combined is required [10,11].

Korea's 'Basic Law on National Standards' defines conformity assessment as "referring to calibration, certification, testing, and inspection that assesses whether products, etc. meet national and international standards", which can be explained as an act of determining whether products, processes, and systems comply with standards. On the other hand, ISO/IEC defines conformity assessment as "proving whether the specified requirements related to a product, process, system, person or organization are being complied with". Conformity assessment verifies performance, quality, and safety in research and development, manufacturing, distribution, delivery, and export. It provides consumers with a standard for judging the safety and quality of purchased products, and the government can play a role in solving social problems and protecting consumers, including securing safety and protecting the environment through conformity assessment [3,12].

Korea maintains consistency with international standards by designating ISO/IEC 17000, which defines the concept of conformity assessment, as the national standard KS Q ISO/IEC 17000. The concepts related to conformity assessment, as defined in the Framework Act on National Standards and the Act on Management of Conformity Evaluation, are based on the concepts delineated by national standards. ISO/IEC 17000 was established in 2004, KS Q ISO/IEC 17000 in 2007, and ISO/IEC 17000 was revised in 2020. As a result, a partial revision of KS Q ISO/IEC 17000 is expected [13-15].

Testing and inspection are the main assessment activities in the existing testing and certification services, while other activities such as verification and validation are not clearly specified. Therefore, in addition to testing and inspection, this study seeks to

explore systems that provide certification services, such as testing, verification, and validation, focused on the 5G convergence services under the ISO/IEC 17000:2020 standard, which further defines activities such as verification and validation. Chapter 2 presents the requirements and conformity assessment system for 5G convergence service certification. Chapter 3 presents the object, operating systems and certification procedures for 5G convergence services. Finally, Chapter 4 concludes the paper.

2. Conformity Assessment Framework for 5G Convergence Service Certification.

2.1. Certification requirements for 5G convergence service. To apply the conformity assessment system for 5G convergence service certification, several requirements related to 5G convergence service certification must be elucidated first. From the perspective of the testing environment, tests and verifications are performed in a testbed called 5G/KOREN. There is a difference in that the existing testing and certification programs are conducted through a lab test centered on technical specifications. This implies that, from the conformity assessment perspective, evaluation activities that extend not only to tests but also to verification and validation should be performed. Verification activities that have been conducted in the testing and certification programs so far have been provided as voluntary activities that are not clearly specified in the international standards for conformity assessment. To perform the newly defined verification activities, a lab testing report related to the device and service to be evaluated must also be provided. Finally, it is necessary to provide a comprehensive log of the results of 5G convergence service operation over a certain period. This will constitute a particularly useful authentication service for convergence service providers who do not have a reference for 5G convergence service operation [16,17].

2.2. Conformity assessment system for 5G convergence service certification. Conformity assessment activities for 5G convergence service certification can be classified as follows: These conformity assessment activities apply the concepts defined in ISO/IEC 17000:2020 [13,14].

- **Testing and verification:** The testing reports from the lab test on the testbed are verified through testing on items requested by the applicant organization, such as devices and services for providing 5G convergence services. For this purpose, an approved testing report must be provided. The statement of conformity to review and certify the results of testing and verification activities is provided in the form of a “verified testing report”.
- **Validation:** The effectiveness of the service is validated through the operating result of the 5G convergence service requested by the applicant organization for a certain period on the testbed. An approved testing report for the object to be validated must be provided. The statement of conformity to certify the validation result is provided in the form of a “validated operating result”.

The process of performing conformity assessment activities was defined and analyzed from the functional point of view, and the 5G convergence service certification system was described using the IDEF0 functional model. Functions/activities to be performed are represented as rectangles in an IDEF0 model. The arrows entering from the left represent the input to the function/activity, and the arrows emanating to the right are the results (outputs) of performing the functions/activities. The arrows entering from the top denote controls that guide, direct, and restrict the performance of the function/activity. The arrows entering from the bottom refer to the mechanisms representing subjects or means that perform the function/activity. Figure 1 provides the context that defines the entire conformity assessment activity for 5G convergence service certification; that is, the object and scope of conformity assessment.

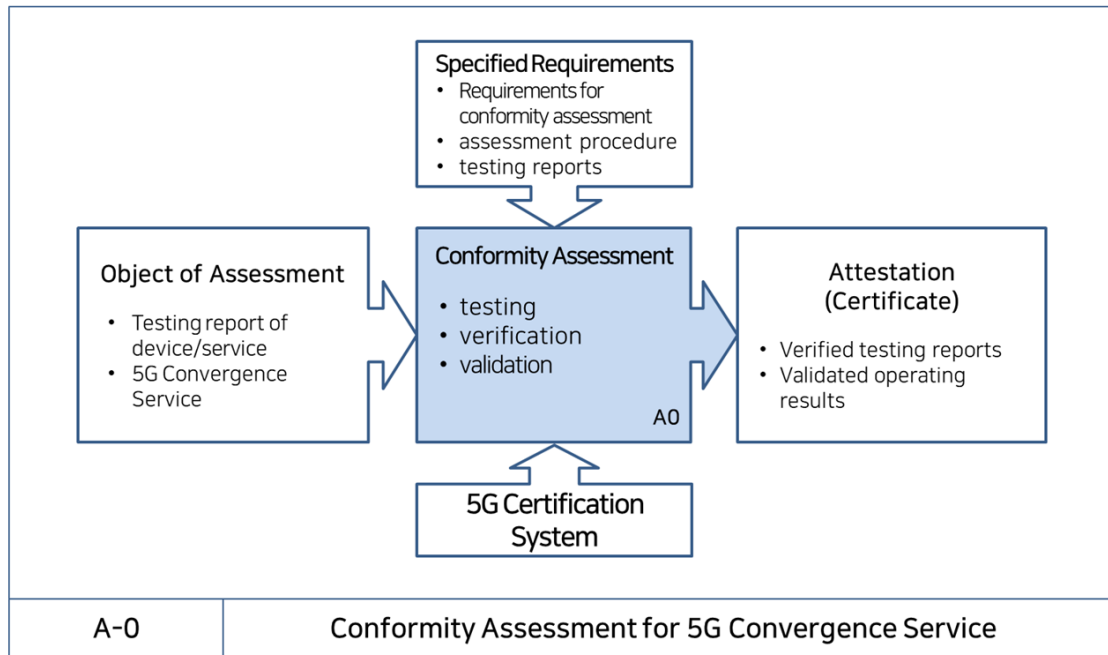


FIGURE 1. IDEF0 context model of conformity assessment

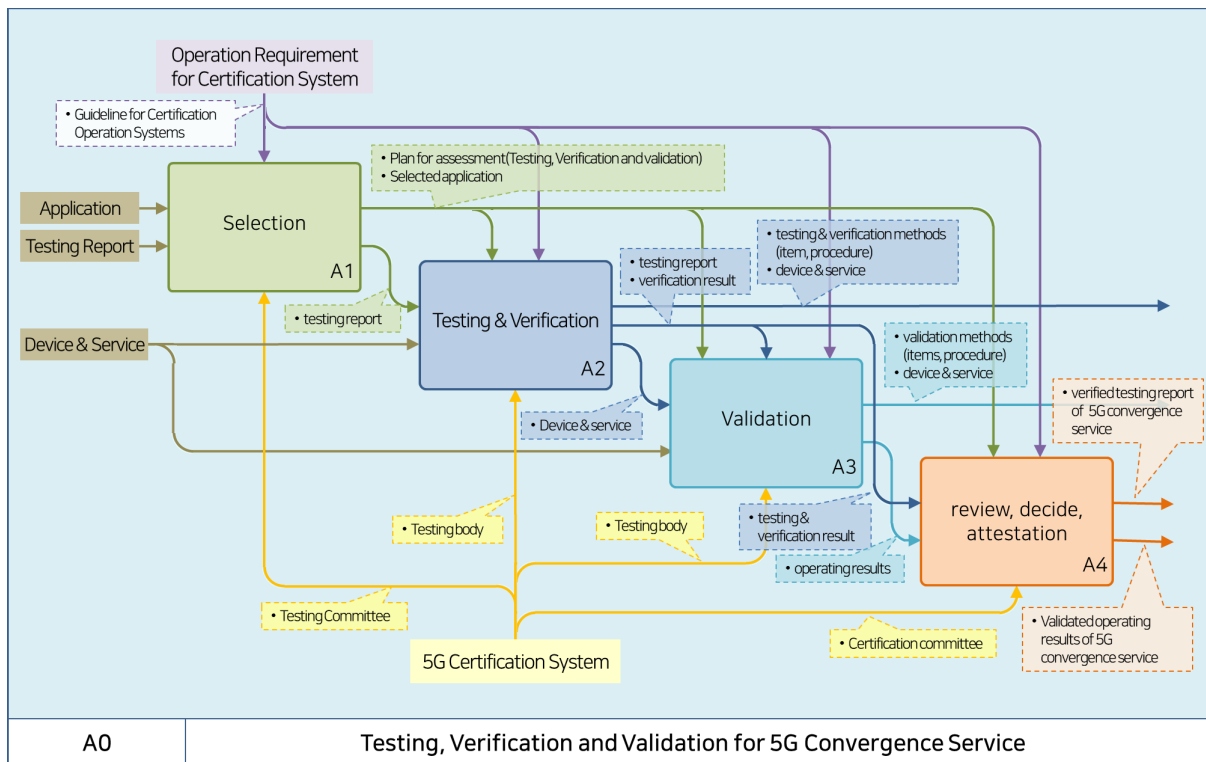


FIGURE 2. IDEF0 level 1 model of testing, verification, and validation

Figure 2 shows the content and detailed functions of conformity assessment activities at one level of detail and describes the relationship between the detailed activities through input, output, control, and mechanisms for each activity. Although omitted in this paper, a framework for implementing the 5G convergence service certification system based on the concept of conformity assessment was designed by specifying the model in Figure 2 in more detail.

3. 5G Convergence Service Certification System. 5G convergence service certification refers to the procedure of verifying whether the certification applicant has an appropriate level of operational quality by evaluating the 5G data communication related device, convergence service management system, and system security using 5G data communication devices. The 5G convergence service certification review refers to the act of measuring the quality level of convergence services using 5G data communication devices operated in the convergence service testbed using a 5G data communication device based on the evaluation criteria for each certification item. According to the conformity assessment system analyzed earlier, a 5G convergence service certification service system in Korea was developed.

3.1. Object of certification.

- Verification or test/verification: Testing and verification results using KOREN/5G convergence service testbed.
- Object of validation: Among products that have received testing reports from accredited testing bodies, application devices and convergence services for which operating result certificates are to be issued.

3.2. Certification operating system. Certification operating system consists of certification body, certification committee, testing evaluation committee and testing body. It is depicted in Figure 3 in which solid arrow line represented main control flow and dotted arrow line represented object flow.

- Certification body: Refer to an organization that performs a series of certification tasks, such as the certification review, attestation, certificate issuance, and management. It documents and manages related review methodology and operating procedures for the establishment and operation of the 5G testbed convergence service certification system.
- Certification committee: Refer to an organization that determines whether or not to be certified by evaluating the testing reports of a testing body conducted according to the certification procedures. It manages verification of certification testing reports, attestation, and certification disputes.
- Testing evaluation committee: Refer to an organization that determines certification testing items, testing procedures, and quantitative targets according to the certification procedures, and manages testing verification of testing bodies. It determines whether certification can be audited and the entry of the certification exam. It also develops certification testing procedures and sets quantitative goals.
- Testing body: Refer to a Korea Laboratory Accreditation Scheme (KOLAS) accredited organization that performs certification tests according to the certification procedures and writes the results.

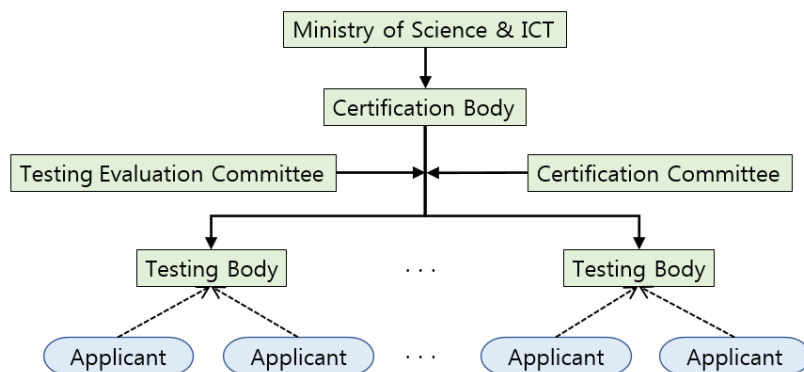


FIGURE 3. 5G convergence service certification operating system

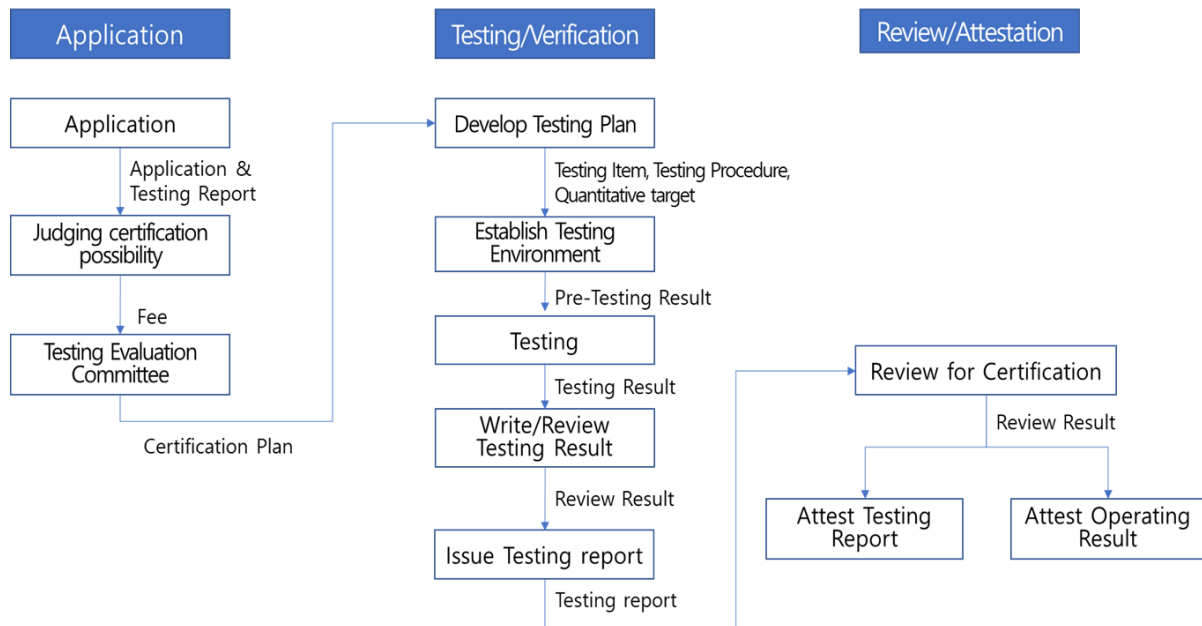


FIGURE 4. 5G convergence service certification procedure

3.3. 5G convergence service certification procedure. Figure 4 shows the overall procedure of 5G convergence service certification.

1) Application for certification

- The applicant must submit the 5G testbed convergence service certification application with a testing report from an accredited testing body to the certification body.
- The testing evaluation committee creates a certification testing plan.

2) Testing and verification

- Development of the testing plan: The testing evaluation committee is formed for determining testing items, testing procedures, and quantitative goals.
- Establishment of the testing environment: A 5G convergence service testbed testing environment is established according to the testing procedure, and a pre-test is conducted.
- Testing: Testing is performed according to the developed testing procedure by an accredited testing body, and a testing report is generated.
- Writing/Revision of the testing report: The testing report is written and reviewed according to the testing plan.
- Delivery of the testing report: The testing report is issued in the name of an accredited testing body and is submitted to the certification committee.

3) Review and attestation

- Review for certification: The certification committee judges whether the testing report is appropriate and attests certification.
- Testing report: The testing report is verified for the result of testing verification using the KOREN/5G convergence service testbed. The 5G convergence service testbed certification is attested in conjunction with the certification from the accredited testing body.
- Operating result: Among the products that have received the testing report from the accredited testing body, an operating result is attested based on the performance testing reports operated for a certain period.

4. Conclusions. This study explores the current state of 5G testbeds being promoted worldwide and sees how they can be applied to 5G convergence services. A conformity assessment framework for 5G convergence services has been designed in accordance with ISO/IEC 17000:2020 standards. Especially, compliance requirements, conformity assessment systems, and certification procedures have been specified and proposed in this study.

The system for providing 5G testing reports, proposed in this paper can be utilized as a way for the KOREN network operation authority to secure the identity of the KOREN network and expand the scope of its application and operation by providing additional testing and certification functions of 5G testbeds while maintaining cooperative relations with existing testing and certification stakeholders.

In addition, the operational guidance laid out in this paper for the 5G testbed convergence service certification scheme in this study provides a framework for the 5G testing report delivery system, but it is necessary to further develop a more detailed operational framework and guidance in the future. In particular, it is deemed necessary to develop a detailed approach toward establishing the recognition organization of the KOREN network operating institutions, post-qualification organization, division of labor among other testing and certification bodies, development of testing and certification procedures for 5G testbed, acceptance of international standards, and proposals for international standards.

By introducing a reliable testing report provision system and certification system for testing verification results using a network-sliding-based 5G convergence service testbed, it is possible to maximize the effectiveness of testbed utilization and to support securing technical skills and market competitiveness through a certification system.

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