Anritsu Solution for Carrier Acceptance Inspection Tests

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[Summary] Ensuring in-service communications quality using either standard conformance tests or NW equipment and UE vendor-owned tests is becoming increasingly difficult due to faster radio access networks, dedicated mobile-carrier services, and the spread of sophisticated smartphones driving a rapid increase in data traffic. To improve UE quality, Anritsu is working with mobile carriers to develop Carrier Acceptance Test (CAT) solutions focused on actual service.

1 Introduction

The explosive increase in network data traffic is driven by rich-content services such as video-on-demand using increasingly popular smartphones on mobile access networks and home PCs on wired networks. An important element in ensuring these types of services is to improve the performance of mobile user equipment (UE) typified by smartphones. The future seems likely to bring the further spread of smartphone-based services using large data volumes, such as video sharing, video streaming, SNS, VoIP, etc., imposing high loads on networks.

To maintain and manage high-quality networks supporting these large volumes of data traffic, mobile carriers are adding their own network functions for supporting their diversifying services based on technical specifications standardized by 3GPP.

As an example, the transition from 3GPP Release 8 to Release 10 has required seamless and smooth introduction of new systems. Moreover, simultaneous UE support for both Release 8 and Release 10 using the same communications technologies requires adoption of backwards-compatible wireless interfaces.

To support these requirements, mobile carriers have combined different communications technologies, such as LTE (Long Term Evolution), W-CDMA (Wideband Code Division Multiple Access), CDMA2000, and TD-SCDMA (Time Division-Code Division Multiple Access) to start offering their own value-added attractive services. At the same time, high-quality, high-performance UEs are needed from the perspective of improving customer satisfaction. As a result, mobile carriers are increasingly using carrier acceptance tests (CAT) as one standard for evaluating UE suitability.

The following provides a simple explanation of the key technologies required to create mobile networks supporting seamless use of different mobile systems.

- Inter RAT (Radio Access Technology) Handover
  This is a technology for switching between cells (base stations) using different wireless technologies, such as LTE systems and UMTS (Universal Mobile Telecommunications System), etc.
- CSFB (Circuit Switched FallBack)
  When using this technology, data communications are performed using LTE but voice calls are made simultaneously for the voice call duration by switching to 2G and 3G methods, such as W-CDMA and CDMA2000.
- SVLTE (Simultaneous Voice and LTE)
  When using this technology, data communications are performed over LTE while voice calls are made simultaneously over W-CDMA and CDMA2000.
- SRVCC (Single Radio Voice Call Continuity)
  When using this technology, voice calls are switched seamlessly between VoIP on data networks such as VoLTE, and circuit switched networks such as CDMA2000.

2 Mobile Carrier Terminal Acceptance Tests (CAT)

2.1 CAT Types

This section classifies the types of CAT from the viewpoint of target test fields and models.

The CAT target test fields can be broadly classified into the following three types:

1) Additional Protocol Tests

These are signalling tests required to maintain the quality of mobile carrier services which are not covered by the earlier Global Certification Forum (GCF) approved protocol conformance tests (PCT). There are two main groups of test items as follows:

[1] Bearer Tests
- Confirmation of bearer connection required by each service
- Bearer switching test

[2] Mobility Tests
- Cell selection and switching
- Roaming connection with other carriers
- Confirmation of UE status during roaming

2) Performance Tests

The following tests evaluate the data communications service and UE performance, such as the communications speed and power consumption due to the radio-wave propagation environment.
- Data throughput test
- Data communications function test
- SMS, IMS
- Power consumption test

3) Mobile Carrier Service Tests
- Call processing test
- USIM test
- Application usability test
- Location service (LCS)
- Audio/Video continuity and quality test
- Emergency call and warning test (ETWS, etc.)

The type of test field to be used for CAT differs according to the mobile carrier. Furthermore, base stations are used for some parts of the test fields.

Table 1 Mobile Carrier UE Acceptance Test Models

Category	Type A	Type B	Type C	Type D	Type E	Type F
CAT Mandatory	Yes	Yes	Yes	Yes	Yes	No
CAT Specification Owner	Operator	Operator	Operator	Operator	Operator	3GPP
Multiple Platforms for CAT	Yes	Yes	No	No	No	Yes
TC Developed By	Test Vendor	Test Vendor	Test Vendor	Operator	Operator	3GPP/ETSI
Test Case Validated/ Evaluated by	Operator	Operator and Test House	Operator	Operator	Operator	Test Vendor
TC Approved by	Operator	Operator	Operator	Operator	Operator	GCF/PTCRB
TC Supplied by	Test Vendor	Test Vendor	Test Vendor	Operator	N/A	Test Vendor
TC Approved List Available to	UE Suppliers only	Everyone	UE Suppliers only	UE Suppliers only	UE Suppliers only	Everyone
Anritsu Supplies	Platform with TCs	Platform with TCs	Platform with TCs	Platform only	Platform only	Platform with TCs
Anritsu Supplies Test Cases to	UE/Chipset Vendor, Test House	UE/Chipset Vendor, Test House	UE/Chipset Vendor, Test House	N/A	N/A	Everyone
PCT Included in CAT	Yes	Yes	No	No	No	PCT only
Anritsu TC Development Platform	RTD	RTD	RTD	C (UMTS/GERAN) Perl (CDMA2000)	RTD	PCT (TTCN2 & TTCN3)

The UE acceptance test methods used by each mobile carrier are classified by model. The typical acceptance test models shown in Table 1 are explained below.

- CAT Model (Type A, B, C)

  In this model, how the test environment is ensured and testing by the UE vendor are important. In most cases, several measuring instrument vendors create the test cases and the advantage for mobile carriers is the competition between measuring instrument vendors for the number of approved test cases and the price of measurement systems. However, this model also has the disadvantage of high costs due to the need to perform quality assurance by the mobile carriers.

- Own Company Model (Type D, E)

  Since the test cases are created by the companies themselves, the test cases can be supplied free-of-charge to UE vendors. When adding tests for new functions, not only are test cases added but also the execution platform and, in particular, the hardware such as the simulator are upgraded, which has the disadvantage of higher costs and longer development time for mobile carriers.

- CT Only (Type F)

  In this model, there are restrictive UE functions which are adopted depending on the UE vendor implementation and not on the mobile carrier. Due to the testing restrictions of the 3GPP standards and the GCF/PTCRB (PCS Type Certification Review Board) approvals, implementation of tests related to unique mobile carrier functions is difficult.

Mobile telephone networks are transitioning to even faster data communications speeds and RAT combinations as well as the complexity of UE functions required by services is not only forcing companies to configure their own test environments but is also greatly increasing the operation and maintenance work loads. Consequently, more carriers are considering adopting the CAT model in future.

2.2 CAT Application Flow

This section explains the operation of the CAT model (Type A, B, C). However, this is only one example because the actual operation methods differ with each mobile carrier.

The UE vendor develops a UE for a specific mobile carrier brand and before this new UE appears on the market, it must be validated as satisfying the delivery conditions decided by the mobile carrier. The CAT system has been used successfully for this purpose as one type of validation method. This test, using CAT system, is done by the UE vendor themselves or by the test house approved by the mobile carrier.

The following diagram shows the relationship among the mobile carrier, UE vendor, measuring instrument vendor, and test house.

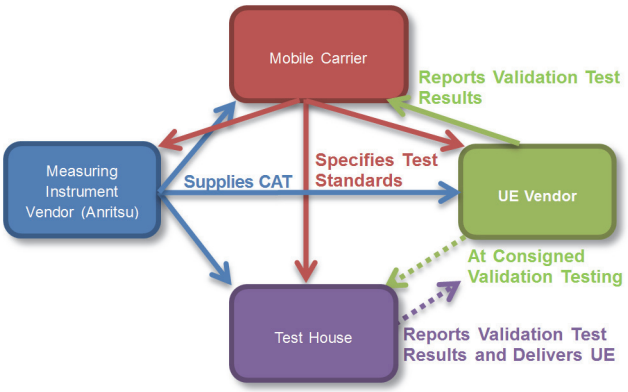

Figure 1 CAT Correlation Diagram

After the measuring instrument vendor develops the CAT system in accordance with the specifications predetermined by the mobile carrier and receives approval from the carrier, the measuring instrument vendor supplies the system to the UE vendor and test house before the UE vendor carries out the testing.

Moreover, the mobile carrier may periodically update the test specifications to request addition of new functions to the UE. As a result of these changes to the test specifications, it is also necessary to update and recertify the CAT system periodically.

Measuring instrument vendors developing CAT systems develop test cases according to test specifications standardized by the mobile carrier and check the test cases by using one or more UE specified by the mobile carrier. Next, the measuring instrument vendor supplies the developed test cases and a log of the execution results for the specified UE to the mobile carrier. The mobile carrier checks both items and if there are no problems, executes the test cases in the presence of the measuring instrument vendor. The carrier checks the details of the log taken at this execution and if there are no problems at all, approves the CAT system. After receiving the approval, the measuring instrument vendor supplies the approved test cases and platform to the UE vendor and test houses. The entire approval process is

called validation. In addition, this validation is performed not only for test cases but is also applied to the entire CAT system, including the platform executing the tests. As a consequence, revalidation is required not just when test cases are updated but also when the execution platform is updated (both hardware and software).

The UE vendors may either execute the CAT by themselves or may ask a test house to execute the CAT. In this case, it may sometimes be permissible to implement tests using revised test cases. However, when a test case is revised, a report of the results accompanied by a description of what was revised and the necessity for the revision must be submitted to the mobile carrier. Then, the mobile carrier checks the results of the CAT system and evaluates the UE acceptance as a pass or fail.

The following figure shows the overall CAT system development flowchart.

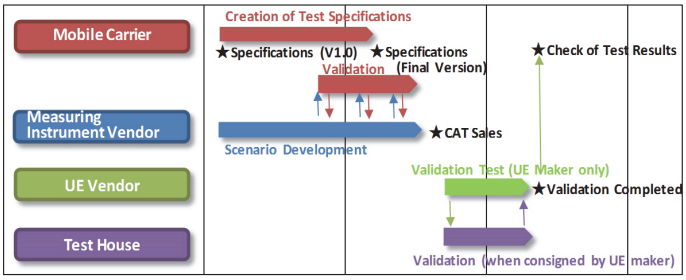

Figure 2 CAT System Development Flowchart

3 CAT-Focused Product Development

Anritsu develops and markets a CAT system test platform (CAT package) as the ME7834 Mobile Terminal Test Platform.

3.1 CAT System Development

Measuring instrument vendors first start developing test cases based on specifications they receive from mobile carriers and then supply them to users (UE vendors and test houses) after passing through the above-described validation and product-packing stages. Moreover, following supply to users, the instrument vendor provides technical support in answering questions from users (user support). Since one objective of CAT is testing new services to be introduced by mobile carriers, the first set of test specifications received from the mobile carrier is not the final version. Consequently, quite commonly test cases based on the test specifications will not run on the UE specified by the mobile carrier. In this instance, the instrument vendor, carrier and UE vendor investigate and cooperate to revise the UE or test specifications or confirm operation using other UEs. The results are then implemented into the CAT. Furthermore, after supplying the CAT system, feedback from the user support is sent to the carrier to improve the quality of the next version of the test specifications.

3.2 Non-Test-Case CAT System Functions

The CAT system also has some important non-test-case functions that are introduced below.

- Report creation function

  Commonly, CAT test cases cover several hundred test items. This report creation function greatly assists with creation of reports on test execution results for mobile carriers after the UE vendor implements CAT.

- Test case editing check function

  CAT package test cases must be edited to help UE vendors with UE debugging. Moreover, any changes and the reasons for making them must be reported to the mobile carrier. This test case editing check function checks whether or not test cases used with the validated CAT system have been edited, helping to prevent testing report mistakes.

- Automation function

  The automation function has two parts—one for running multiple tests consecutively, and another for automating UE operations. The former is provided as a tool for controlling the test software. Additionally, the UE can be operated using its remote control functions, including AT commands.

3.3 Supporting UE Acceptance Test Models

This section explains the types of carrier acceptance models explained in Section 2 in terms of Anritsu products for CAT.

To support the CAT model (Type A, B, C) Anritsu has developed a CAT system for running test cases using a combination of the company's signalling testers, peripheral equipment, and script-editing tools that meets the needs of each mobile carrier and can be supplied to UE vendors and test houses after receiving validation from the mobile carrier. In particular, performance test measurements include the actual throughput of data communications with the PC server. This makes it necessary to provide a test environment supporting authentication of the data communications handshaking procedure without being conscious of the actual procedure.

To support the Own Company Model (Type D, E), Anritsu

has developed and markets signalling testers (MD8480C, MD8430A) for performing protocol evaluations from the first stages of UE development. Moreover, as well as the signalling tester native description language, Anritsu has also developed the Rapid Test Designer (RTD) and Scenario Integrated Development Environment (SIDE) tools for easy creation of test sequences meeting the level of customers' scenario creation technologies.

Lastly, to support the CT Only Model (Type F), Anritsu develops and markets a protocol conformance test set (PCT) using the same signalling tester as the CAT system.

3.4 Delivering System Product

Anritsu has developed its ME7834 Mobile Terminal Test Platform as an integrated CAT system for different mobile carriers. It is composed of measuring instruments (signalling tester and fading simulator) needed for running each CAT package as well as peripherals such as a server PC premounted in a turn-key rack, dispensing with the need for troublesome equipment set-up and connections.

Figure 3 Example of ME7834L Mobile Terminal Test Platform

As explained in Section 2.1, it is not limited to the Type F model and is offered in configurations supporting all CAT models as well as protocol conformance tests (PCT). The ME7834 platform is the ideal test solution for lightening the workload of GCF/PTCRB validation PCT and mobile carrier CAT in a single integrated system package.

4 Summary

Anritsu is currently providing CAT packages as CAT systems for mobile carriers in N. America, Japan, and China. In the future, more mobile carriers outside these areas are expected to introduce the CAT testing model. Even if the same CAT model is introduced, differences between each mobile carrier's test items and services will require timely development of CAT packages and systems meeting each carrier's needs.

In addition, deployment of LTE systems is driving mobile carriers to demand higher-quality UEs supporting faster services, more RAT types, and ensured interoperability at lower costs. Anritsu is continuing work on expanding its CAT systems for UE development testing.

References

1) "Contribution to LTE Technology Verification –Development of MD8430A SignallingTester", ANRITSU TECHNICAL REVIEW No.20 2013

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