To ensure that devices work as desired and seamlessly across different networks, extensive test and trial program are conducted at many stages during a device's lifecycle. Certification programs help to ensure global interoperability between mobile/wireless devices and networks that are based on 3GPP standards.
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Global wireless subscriptions are expected to approach US$ 6 billion by the end of 2011 [1]. These subscriptions are serviced by networks using a wide variety of communications standards including GSM, CDMA, W-CDMA, 1xRTT, 1xEV-DO, and most recently LTE. Along with this wide range of networks, modern wireless devices are taking on a wider range of formats from simple handsets, PDAs and smart phones to wireless broadband data cards, USB dongles and modules that are embedded in laptop PCs, consumer electronic products and M2M devices for metering, automotive, medical and other applications.

Across these large numbers of subscribers, networks, and devices, there is an unstated expectation from consumers that wireless devices they use should function flawlessly at all times in different networks and for different applications. Ensuring it all works reliably and consistently is challenging - but is manageable.

Industry wide forums have been created where-in stake holders like Network operators, device manufacturers, test system suppliers and test houses collaborate to create a certification testing program which addresses the above challenges and certification needs before commercial deployment.
On completion of the development phase, the new device must go through the pre-deployment testing phase.

Pre-Deployment certification testing for wireless devices

For devices using 3rd Generation Partnership Project (3GPP) technologies such as GSM and UMTS, extensive test and trial programs are conducted at many stages during a device’s lifecycle. During the development process, extensive testing is conducted on all parts of the design: protocol stack, RF modules, SIM/USIM modules and multimedia subsystem (audio, video etc.). On completion of the development phase, the new device must go through the pre-deployment testing phase.

T e l e G e o g r a p h y’ s G l o b a l CommsInsight forecast* Network operators, device manufacturers, test system suppliers and test houses. The types of testing required to get a new wireless device into the consumer market are summarized in the figure below.

Prior to the initial deployment of a new wireless device, a network operator typically will require that the device be verified through one of several certification bodies and against other unique Operator-specific tests. The intent of performing tests for both categories is to guarantee that a device will interoperate with a number of networks under a variety of scenarios.

GCF / PTCRB Certification
GCF - Global Certification Forum is an active partnership between network operators, device manufacturers and the test industry. Since its inception in 1999, GCF has created an independent certification program to help ensure global interoperability between mobile/wireless devices and networks that are based on 3GPP standards.

PTCRB - PCS Type Certification Review Board is a body similar to GCF but is led by cellular network operators mostly from North and South America. The main technical difference between the two bodies is mainly due to frequency bands used. PTCRB certifies devices primarily intended for use in the 1,900-MHz and 850-MHz bands and GCF for the 900-MHz and 1,800-MHz bands plus 2,100-MHz FDD I band used for WCDMA based 3G devices.

New Wireless Device

GCF on PTCRB Certification
Operator Specific Acceptance Testing
Regional Compliance Testing
Ok for commercial launch

Operator Specific Acceptance Testing
Operator-specific testing also may be necessary if the operator feels that testing of a certain feature or function is needed and no corresponding tests specifications are provided by standards. Operators may decide to use a specific test plan if there is a need to verify compatibility with a unique Operator network configuration different from the reference configuration used for CT.

If an Operator does decide to write a unique test plan for verification of devices, a procedure must be defined to validate test cases on more than one wireless device. In addition, there must be a method to notify wireless device suppliers when a test case has been validated on a specific manufacturer’s test platform. Lastly, authorized test labs must be enabled to provide test services to the same wireless device suppliers using validated test cases on the same platforms.

Regional Compliance Testing
In addition to GCF/PTCRB certification and Operator-specific testing, a device must receive regulatory approval from a local or regional government authority like the FCC in the United States or EU in Europe (large part of this testing has shifted to GCF and PTCRB since deregulation in the 1990s). Typical regional compliance testing would include but not limited to testing of EMI/EMC, Safety, Acoustic, Thermal, Shock & Vibration, Reliability & HALT.

The focus of this white paper is to bring out the various aspects of GCF and PTCRB certification testing.
GCF & PTCRB Certification Testing

The main guiding force behind the GCF or PTCRB is the conformance test standards and the associated vendor-independent test suite.

The 3GPP organization is responsible for originating standards for wireless technologies such as GSM, W-CDMA, and LTE. The CT standards for a specific technology such as LTE are originated in a subcommittee within 3GPP. Out of many 3GPP technical specifications for CT, the most important ones are TS 51.010 (for 2G GSM/GPRS), TS 34.123 (for 3G) and TS 36.523 (for LTE) which deal with protocol conformance.

Conformance Test Suite Creation:

3GPP provides a software implementation of the test case for protocol CT when CT definitions are written. These test cases are developed in TTCN-2 and TTCN-3. They are also called as ATS. The ATS is created, reviewed, and debugged by a consortium of companies in the test industry, working under the auspices of the ETSI, MCC Task force 160 and supplies a vendor-independent reference for the test cases.

GCF and PTCRB do not automatically adopt all tests defined by 3GPP for a specific technology. Instead, the GCF WIs and PTCRB RFT documents are defined for a particular feature such as HSDPA, Rel-7 or MIMO once agreed by members of the organization.

Subsequent to the definition of a WI, a system manufacturer (T&M) would implement test cases in the WI on its own test platforms, with an individual platform receiving a unique test platform number from GCF and PTCRB. GCF and PTCRB approves test cases in the WI/RFT executed on a specific test platform.

Both the GCF and PTCRB maintain databases of device Certification Criteria (CC) that are updated periodically as WIs and RFTs are added, and other modifications are made. For GCF, this is called the GCF CC Database while for PTCRB it is referred to as NAPRD.

When a wireless device is submitted for certification, the manufacturer must provide a variety of information to either GCF or PTCRB, including PICS and the name of the authorized lab at which the certification will be performed. Applicable WIs will be selected based on the PICS, and certification testing will be performed.

Conformance testing must be carried out in an approved lab. There are a number of specialized labs around the world that offer certification test services using test equipment approved by GCF and PTCRB.

GCF certification also mandates the field trials to provide a balance between lab-based and field-based testing. Whereas conformance tests ensure that a device complies with the relevant core specifications under repeatable laboratory conditions the field trials guarantee that the device will work correctly in real-world conditions. Field trial-qualified operator networks in specific locations are used to execute a predefined test plans to ensure consistency from one device to the next.
Challenges and recommendations

Though the number of authorized test labs has increased over the past years, resulting in more competition and consequently, lower hourly rates, device certification is still an expensive process, requiring hundreds of hours of test time. Some examples to illustrate these facts:

- To test only the signalling protocol of a 3G device, depending on the capability of the device, requires more than 500 test cases to be executed.
- RF test cases must be performed in all supported frequency bands at a range of operating temperatures and battery voltages resulting in multiple test execution cycles running in to hundreds of hours.

Test failures at the certification stage are among the most expensive failures mainly due to

- High cost of test systems
- Ever evolving standards and functionality, triggering continuous revalidation.

Unlike larger manufacturers who can afford to have their own labs, smaller manufacturers have to make use of commercial test labs to achieve test coverage and the required time scale. Either way, there is a significant management overhead involved in the certification process, which impacts time-to-market of a new device.

It is essential that the certification process happens smoothly and predictably to enable the manufacturer to have a timely product launch in an ever decreasing time-to-market window.

The conformance test failure may result in missing a crucial time window and may lead to the new design being scrapped.

To avoid surprises during the certification phase and with an underlying principle that “cost of error correction gets higher the later it happens”, a precertification test phase should be considered. Ideally, precertification testing will use either the same type of test equipment, as in a formal approval lab or equipment capable of executing the same test cases. With the precertification test phase, the manufacturer is able to mature the product incrementally and can do an objective assessment of product quality to decide on the cost intensive certification phase.
Conclusion

The certification process is lengthy and repetitive, but the proven compliance of certified devices brings benefits to all stakeholders including consumers. Consumers gain from the improved interoperability of their devices, especially when roaming onto different networks. Network operators benefit by reducing the amount of approval testing they need to perform themselves, relying instead on the results of the certification process. Device manufacturers need to plan the time and effort they put into the certification process to ensure new-product introductions meet schedule and cost requirements.

By performing a thorough pre-Certification testing in the lab environment, the actual Device Certification Process can be made smooth, cost effective and completed in timely manner. Additionally, the GCF/PTCRB field trials can be executed in a controlled lab environment with commercial grade equipment as a preparatory phase before Field Trials in the GCF approved Operator Networks.

Wipro’s services

Wipro, as a part of its internal initiatives, has set up a Certification / Pre-certification Test Service in Bangalore, India. This facility will address the GCF/PTCRB Device pre-Certification Criteria Testing for 2G, 3G and 4G technologies. It also facilitates Regional Regulatory Compliance Testing like FCC/EU etc. The test house shall certify all end user equipment such as mobile phones, wireless modules, modems, specialty devices and data cards, which need to go through the certification process.

Wipro also hosts a Live Commercial Grade Test Network, consisting of 2G/3G & 4G Network infrastructure. Test Network can be used for performing Interoperability pre-Qualification and field testing. The Test Network provides flexibility to configure different Network settings based on test specific needs.

Wipro Advantage:
- One stop-shop for pre-Certification and Compliance Testing
- Live Test Network for preparatory Field Trial Testing
- Low cost of Testing
- Customized test execution to suit different customer needs
- Flexible service delivery model
- Debug support to development teams
- 24x7 Lab support services
- Highly experienced Wireless Test Consultants

Wipro’s facility will address the GCF/PTCRB Device pre-Certification Criteria Testing for 2G, 3G and 4G technologies.
Glossary

1xRTT : 1x (single carrier) Radio Transmission Technology
3GPP : Third-Generation Partnership Project
4G : Fourth Generations of cellular Test standards
ATS : Abstract test Suite
CC : Certification Criteria
CEC : Certification Entry Criteria
CT : Conformance Test
EMEA : Europe, Middle East, and Africa
ETSI : European Telecommunications Standards Institute
EV-DO : Evolution Data Optimized Standards
FDD : Frequency-Domain Duplex
GCF : Global Certification Forum
GSM : Global System for Mobile communications
HALT : Highly Accelerated Life Test
HSDPA : High-Speed Downlink Packet Access
LTE : Long-Term Evolution
M2M : Machine to Machine
MIMO : Multiple Input, Multiple Output
NAPRD : North American Program Reference Document
PICS : Protocol Implementation Conformance Statement
PTCRB : PCS Type Certification Review Board
RF : Radio Frequency
RFT : Request For Test
RRM : Radio Resource
SIM/USIM : Subscriber Identity Module/Universal Subscriber Identity Module
TDD : Time Division Duplex
T&M : Test and Measurement
TS : Technical Specification
TTCN-2 : Tree and Tabular Combined Notation
TTCN-3 : Testing and Test Control Notation
W-CDMA : Wideband Code Division Multiple Access
WI : Work Items

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About the Author

MANU KRISHNA is a Senior Consultant in Testing Services division of Wipro Technologies. He has over 13 years of experience in the wireless domain, mainly in technology areas like GSM, GPRS, UMTS, HSDPA and LTE. He has vast experience in different functional areas of wireless eco system like mobile protocol stack implementation, BSS deployment, N/W planning and optimization, IOT and Field testing. His area of specialization is Verification and validation of mobile protocol stack, (Unit test, Module test, Integration test, System test,