The UE Test Process
- Ensuring UE Interoperability

PSCR 2010 Winter Conference

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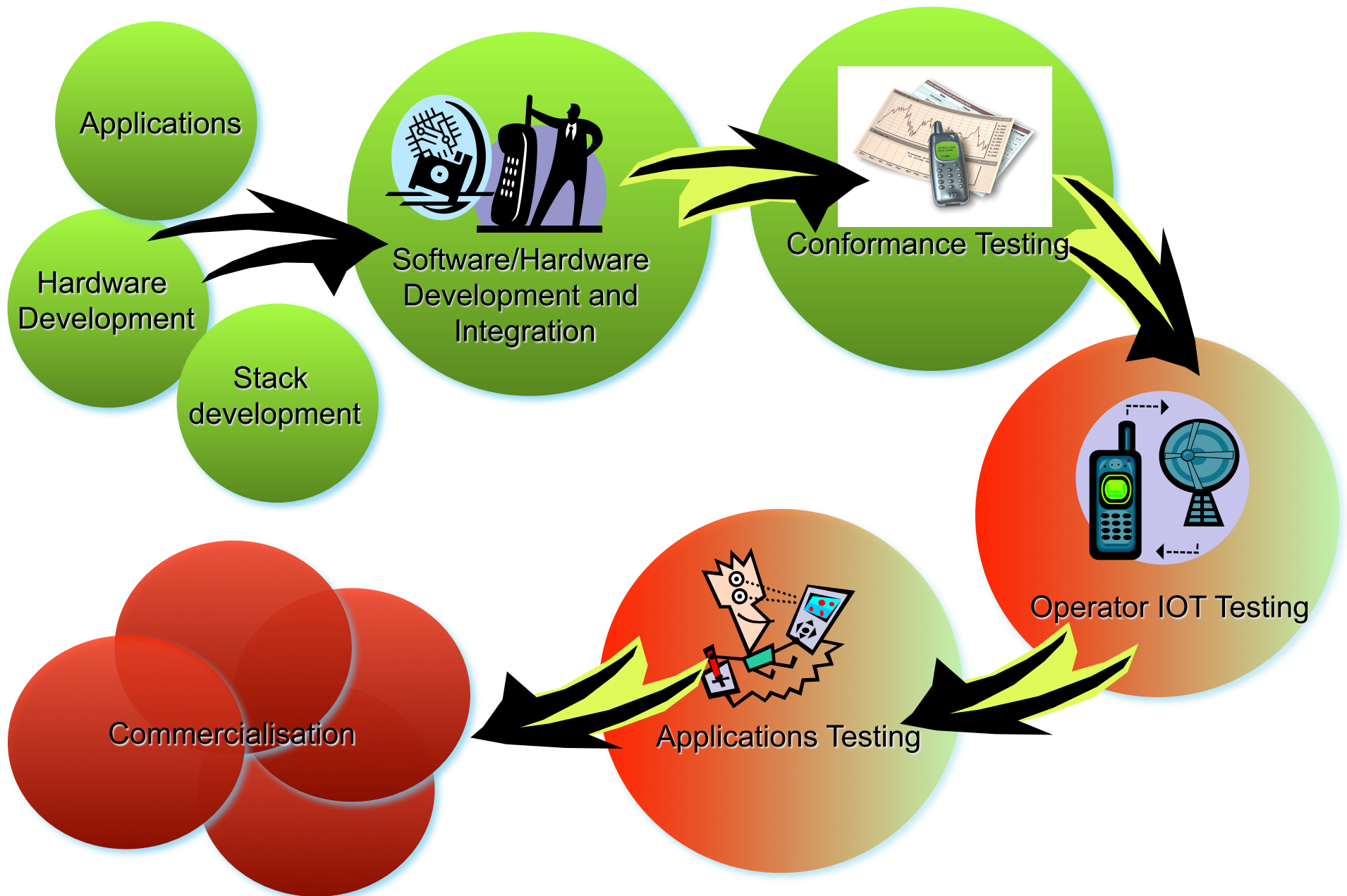
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Conformance Test - Definitions and Processes

The UE Test Process

Applications

Hardware Development

Stack development

Software/Hardware Development and Integration

Conformance Testing

Operator IOT Testing

Applications Testing

Commercialisation

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The Need For Conformance Testing

> Ensure that UEs operate in a broad variety of networks
> Eliminate network problems caused by non-compliant UEs
> Enable 3GPP Standards compliance
> Required for design regression

> Ensures device works when:
- Network equipment upgraded
- New services added
- Network architecture evolves

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Users Of Conformance Test Systems

> UE vendors
  - Proving UE standards compliance to network operators

> Chipset and software component vendors
  - Proving chipset standards compliance to mobile terminal vendors

> Test houses
  - Providing conformance testing and validation to mobile terminal manufacturers

> Network operators
  - Performing acceptance testing and quality assurance

Standards Groups vs. Certification Forums

Standards Groups

3GPP

Specs for GSM, W-CDMA, and LTE
Test Specs for UEs
RF, Protocol, USIM, etc

ETSI

Provides W-CDMA
And LTE TTCN for
Protocol Conformance Test

oma
Open Mobile Alliance

Provides the Test Specs for
Application Enablers

Certification Forums

GCF
Global Certification Forum

Traditionally covers European GSM
Bands & W-CDMA FDD1 & 8

PTCRB
PCS Type Certification Review Board

Traditionally covers N.American
GSM Bands & W-CDMA FDD2, 4 &
5

CDMA
Certification
FORUM

CDMA (cdma2000)

3GPP Charter and Organization

> Collaboration Between ETSI (Europe), ARIB (Japan), CCSA (China), and ATIS (North America), TTA (Korea), and TTC (Japan) – Initiated in 1998

Technical Specification Group Structure

Project Co-ordination Group (PCG)

TSG GERAN
GSM EDGE
Radio Access Network

GERAN WG1
Radio Aspects

GERAN WG2
Protocol Aspects

GERAN WG3
Terminal Testing

TSG RAN
Radio Access Network

RAN WG1
Radio Layer 1 spec

RAN WG2
Radio Layer 2 spec
Radio Layer 3 RR spec

RAN WG3
Iub spec, Iur spec, Iu spec
UTRAN O&M requirements

RAN WG4
Radio Performance
Protocol aspects

RAN WG5
Mobile Terminal
Conformance Testing

TSG SA
Service & Systems Aspects

SA WG1
Services

SA WG2
Architecture

SA WG3
Security

SA WG4
Codec

SA WG5
Telecom Management

TSG CT
Core Network & Terminals

CT WG1
MM/CC/SM (Iu)

CT WG3
Interworking with external networks

CT WG4
MAP/GTP/BCH/SS

CT WG6
Smart Card Application Aspects

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3GPP RAN5 Charter and Organization

> RAN WG5 is Responsible for the Development of UE Conformance Test Specifications Dealing with UTRA (W-CDMA), Evolved UTRA (LTE), and Beyond Including

- RF Conformance Tests for FDD and TDD in Coordination with the Other Relevant RAN Working Groups.
- RRM Conformance Tests for FDD and TDD in Coordination with the Other Relevant RAN Working Groups.
- UTRA, Evolved UTRA and Beyond, IMS and NAS Protocol Tests in Coordination with the Other Relevant RAN and CT Working Groups
- Tests to Cover Inter-RAT Procedures (UTRA, Evolved UTRA and Beyond to GERAN) in Coordination with GERAN WG3
- Formal Description (prose) of Protocol Test Cases Using TTCN in Coordination with ETSI

> Based on Requirements Documents from Other Groups

- RAN WG4 for Radio Test Cases
- RAN WG2 and CT WG1 for Signaling and Protocol Test Cases

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OMA Charter and Organization

> Consortium Created in 2002 to Bring Together Separate Initiatives Focused on Mobile Application Standards
  - Members Include UE and Network Equipment Manufacturers, Operators, and Software Vendors

> Network-Agnostic
  - Applications Compatible with Any RAN

> Maintains a Number of Specifications Including
  - Browser and Content
  - MMS
  - Instant Messaging and Presence
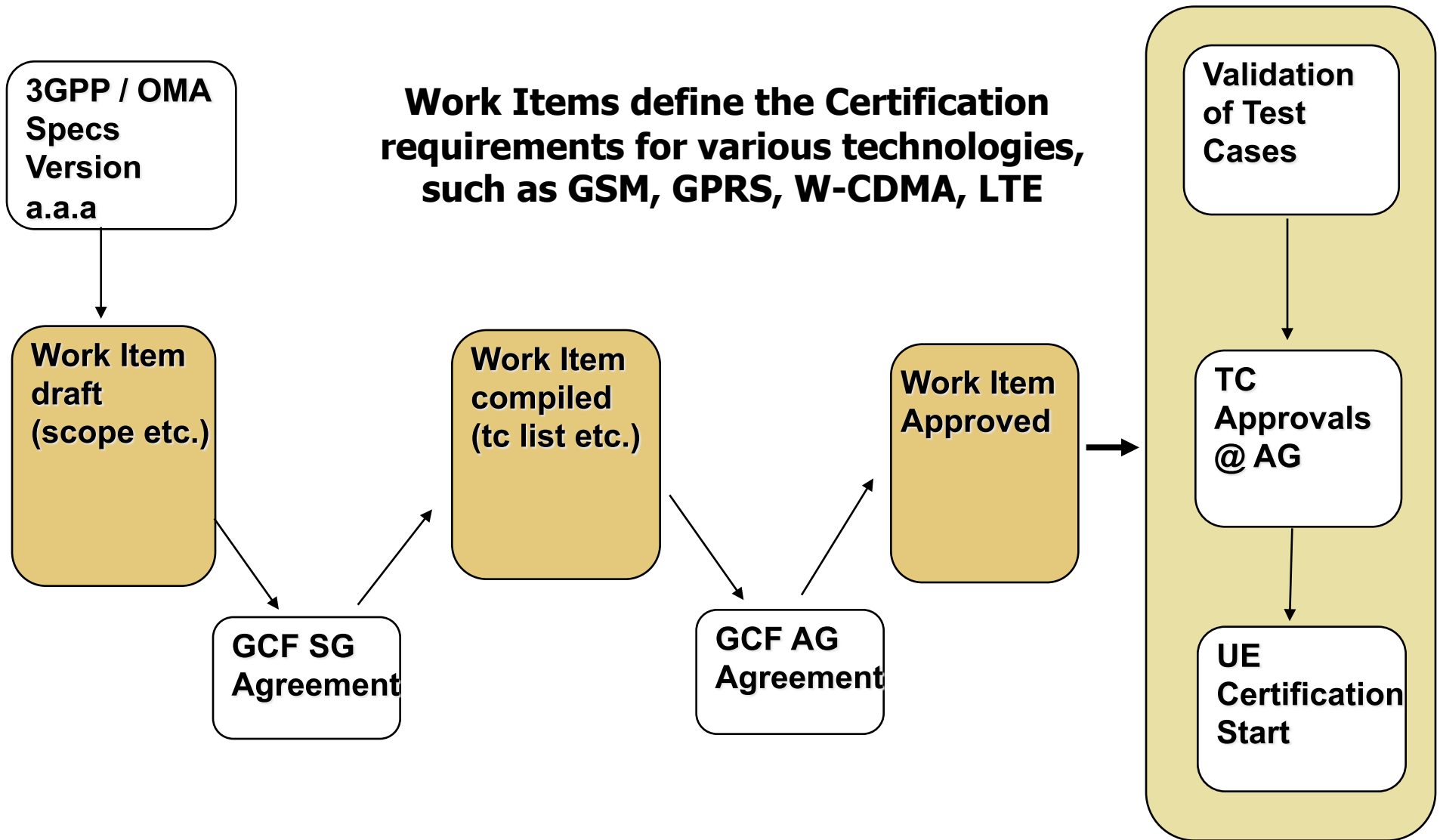 - Data Synchronization
  - Push-to-Talk Over Cellular (PoC)
  - SUPL for A-GPS

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PTCRB Charter and Organization

- Established in 1997 as a Certification Forum by North American Operators
    - Now Includes AT&T, Rogers, T-Mobile/USA, VIVO, Radiomovil, O2, Telefonica/Spain, and MTN
- Provides the Framework for GSM, W-CDMA, and LTE Device Certification for its Members
- North American Program Reference Document (NAPRD) Created as a Composite Reference Standard
- Required Tests Come from a Variety of Standards Groups
    - RF and Protocol Conformance
    - TTY and SIM/USIM/USAT
    - Application Enablers (MMS, PoC, VT, JAVA, DRM, Browsing, SUPL, etc.)
    - OTA Performance
    - Radiated Spurious
    - SAR
    - FCC and IC Testing
    - Acoustic (Head and Torso Simulation
- 3rd-Party Labs are Authorized to Conduct PTCRB Testing

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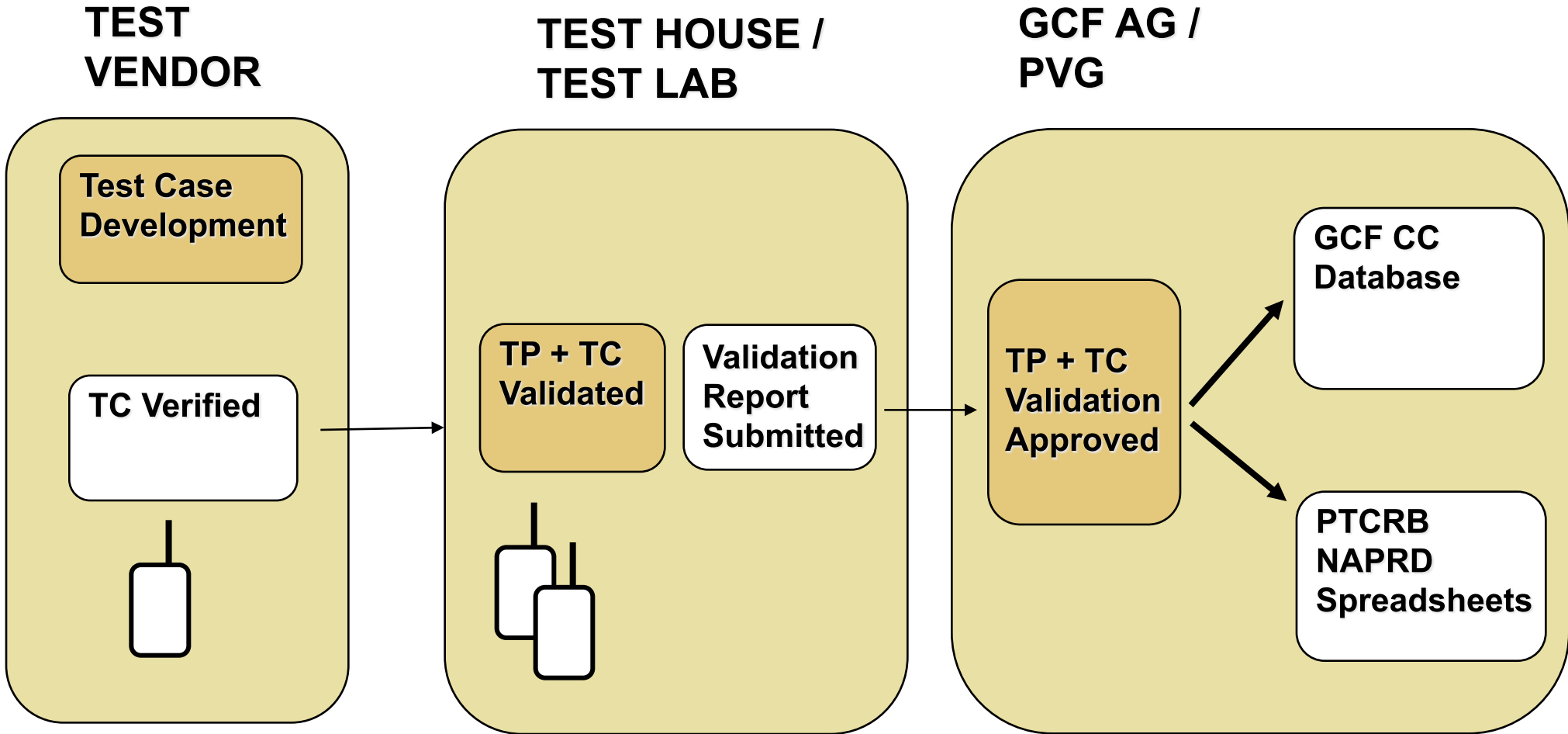# Work Item Definitions (GCF Definitions)

- In General, a Work Item Includes an Inter-Related Assortment of TRX, Performance, RRM, and Protocol CT Tests from 3GPP Standards
- For LTE, Work Items are Sorted by RF vs. Protocol vs. Priority

- **- WI-080 E-UTRA RF Rel. 8 FDD**
- **- WI-081 E-UTRA Protocol Rel. 8 FDD (P1 & P2)**
- **- WI-082 EPC Protocols Rel. 8 FDD (P1 & P2)**
- **- WI-083 E-UTRA Protocol Rel. 8 FDD (P3 & P4)**
- **- WI-084 EPC Protocols Rel. 8 FDD (P3 & P4)**

- **- WI-090 E-UTRA RF Rel. 8 TDD**
- **- WI-091 E-UTRA Protocol Rel. 8 TDD (P1 & P2)**
- **- WI-092 EPC Protocols Rel. 8 TDD (P1 & P2)**
- **- WI-093 E-UTRA Protocol Rel. 8 TDD (P3 & P4)**
- **- WI-094 EPC Protocols Rel. 8 TDD (P3 & P4)**

Work Item Flow Overview

3GPP / OMA Specs Version a.a.a

Work Items define the Certification requirements for various technologies, such as GSM, GPRS, W-CDMA, LTE

Validation of Test Cases

Work Item draft (scope etc.)

Work Item compiled (tc list etc.)

Work Item Approved

TC Approvals @ AG

GCF SG Agreement

GCF AG Agreement

UE Certification Start

Test Case Validation Flow Overview

TEST VENDOR

TEST HOUSE / TEST LAB

GCF AG / PVG

Test Case Development

TC Verified

TP + TC Validated

Validation Report Submitted

TP + TC Validation Approved

GCF CC Database

PTCRB NAPRD Spreadsheets
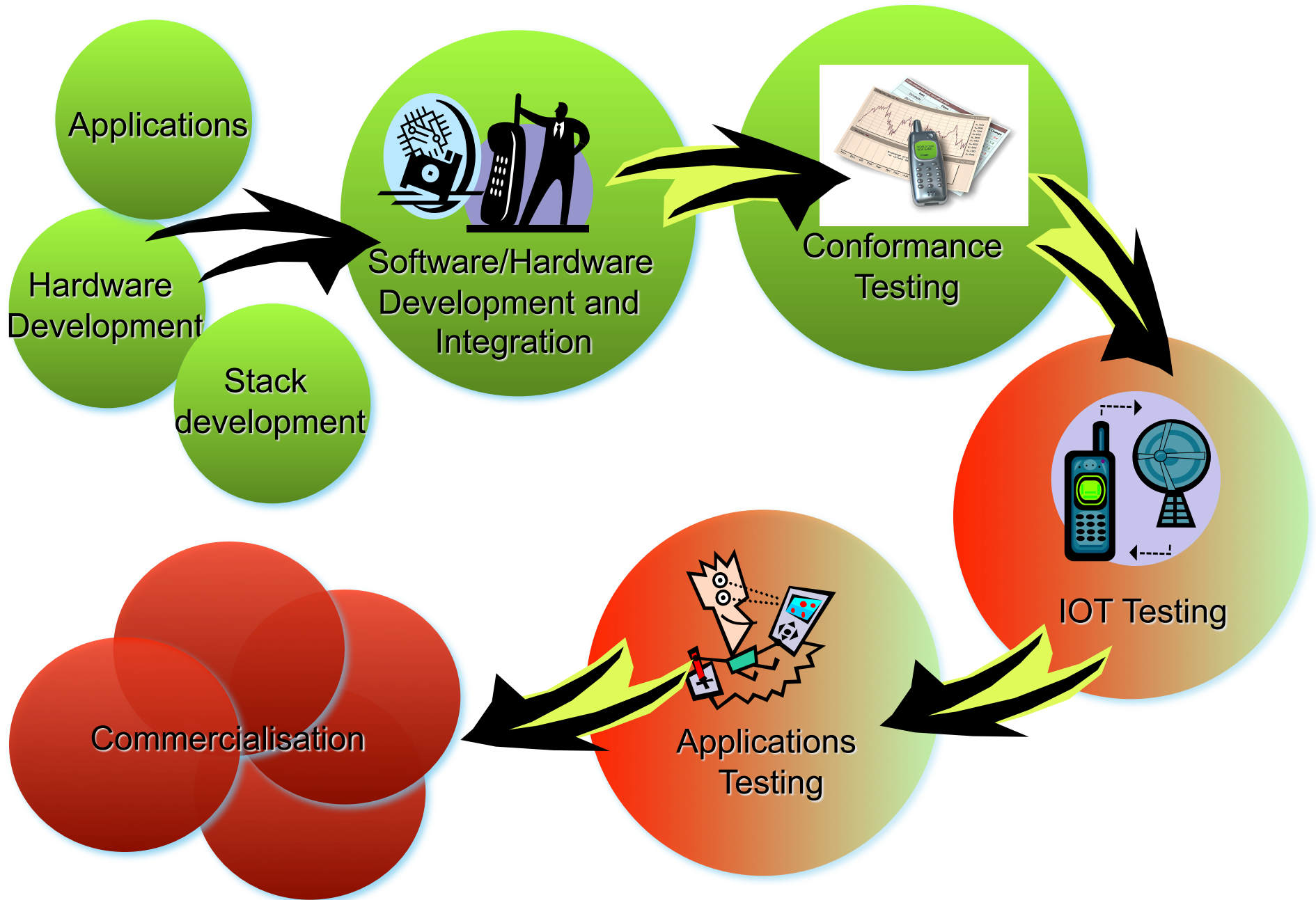
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LTE Band 14 Status and Next Steps for CT

> PTCRB has Included Band 14 Included in the Certification Program for LTE Devices
> - Additional Bands Include 4, 12, 13, 14, and 17

> Test Cases Must Now be Agreed, Developed, Validated, and Approved by PTCRB for Band 14
> - Test Cases to be Developed by Test Equipment Companies
>   - Leveraging Verified or Validated Test Cases in Other Bands
> - Test Cases Validated Using 2 UEs with Different LTE Chipsets
>   - Band 14 Prototypes are Needed to Accomplish this Task
> - Test Cases Approved by PTCRB

> Test Houses Will Purchase Test Platforms and Offer UE Certification Services to the Industry

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Operator IOT Requirements and Test Case Processes

UE Development Process

Applications

Hardware Development

Stack development

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Test Requirements – 2 Perspectives

> ## UE Suppliers
> - Building block approach then integration
> - Designed to a specification (e.g. 3GPP)
> - Conformance testing (GCF / PTCRB)
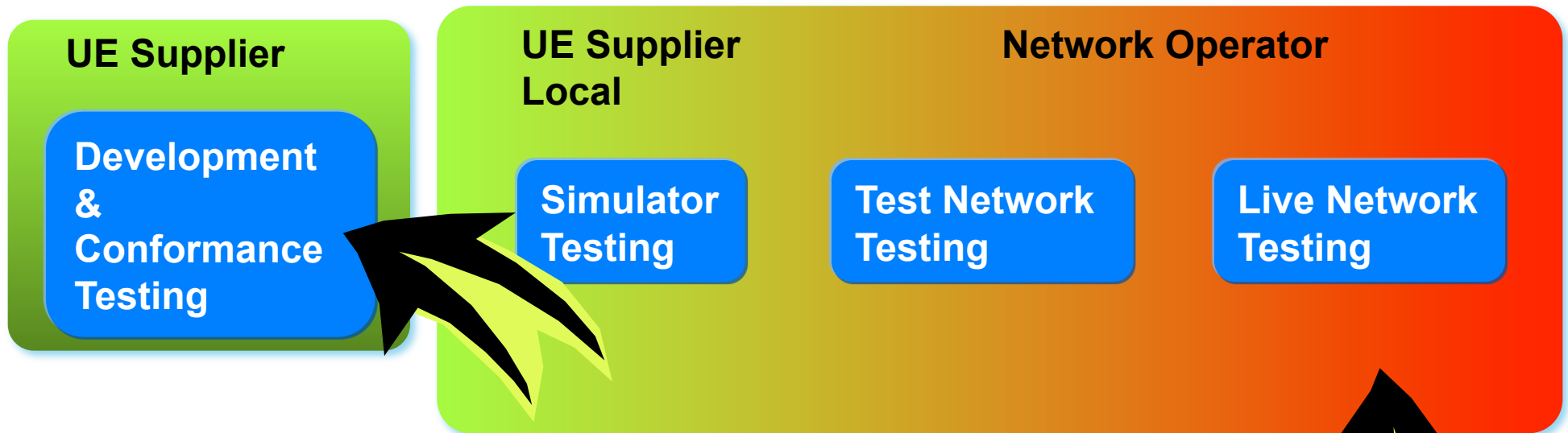> - Defined by marketing for competitive advantage (features)

> ## Network Operators
> - Overall performance and behaviour on their network
> - Application oriented
> - Beyond CT
> - Defined by marketing for competitive advantage (applications)

Meeting a defined specification

Meeting customer needs

Anritsu's Understanding of the Goal

UE Supplier

Development & Conformance Testing

UE Supplier Local

Simulator Testing

Network Operator

Test Network Testing

Live Network Testing

Consumer

Key Objectives:

> Push more testing back into Simulator domain, where turn-around time is much shorter and UE Supplier can handle at their own development site

> Reduce the number of problems that end up going into the field
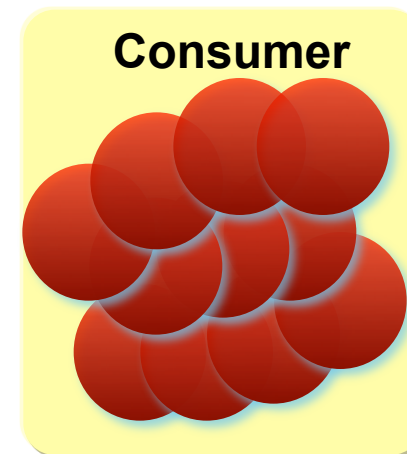
Why Use a Lab Simulation?

> Although final proving will always be done in the field, laboratory simulation of a network can be close enough to prove many functions

> Benefits to using a laboratory
>   - Repeatable results
>   - Parameters defined accurately
>   - Easily adaptable for variants to check performance
>   - Functions may be tested before network availability
>   - Less need for logistical support
>   - Reduces travel cost and time
>   - Interference can be isolated

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What Tests are Typically Required?

- Radio Bearer tests
    - Bearer combinations
    - Reconfigurations during speech calls
- Data performance
    - Throughput and session re-establishment
    - Data functionality
- Network mobility
    - Cell selection and reselection
    - Roaming scenarios and device behaviour
    - Determining timing for rescans etc
- Call processing
    - Barred SIM / USIM access control
    - Emergency call procedures
    - Supplementary services
- RF Tests Beyond GCF or PTCRB
- Protocol Tests Beyond GCF or PTCRB

LTE Operator IOT Recommendations for PSCR

> ### Data Performance
>> - Throughput Under a Variety of Typical Network Conditions
>> - Packet Session Setup and Teardown under Typical Conditions

> ### Roaming Scenarios
>> - Intra-Network Roaming from One PS Network to Another
>> - Roaming from PS Network to Public 700 MHz LTE Network
>> - Roaming from PS Network to Out-of-Band 3GPP or non-3GPP Network

> ### eMBMS

> ### RF Tests with Band 14 Interference
>> - Adjacent Verizon Bands
>> - PS Narrowband Operation

> ### Call Prioritization

> ### Security

> ### Others?

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LTE RF CT, Protocol CT, and Operator IOT

Anritsu LTE UE Solutions Portfolio

ME7833L

LTE Protocol CT/IOT Test System

LTE Device Integration/Operator Acceptance

Inter-RAT LTE⇔UTRAN/GERAN, LTE ⇔CDMA2000

ME7873L

TRX/Performance Test System

RRM Test System

Device Certification/Pre-Certification

Functional Verification

3GPP TS36.521-1/3 (GCF)

Operator RF Supplementary Tests

MD8430A/RTD

Signalling Tester

with Rapid Test Designer

LTE Device Integration

Operator Acceptance

4x2 MIMO

>100Mbps throughput

Multiple eNB Simulation

ME7832L

Dedicated Protocol Conformance Test System

Device Certification/Pre-Certification

Functional Verification

3GPP TS36.523 (GCF)

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