World Class Standards

LTE test suites for UE conformance

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Session 1: June 4th 11:15

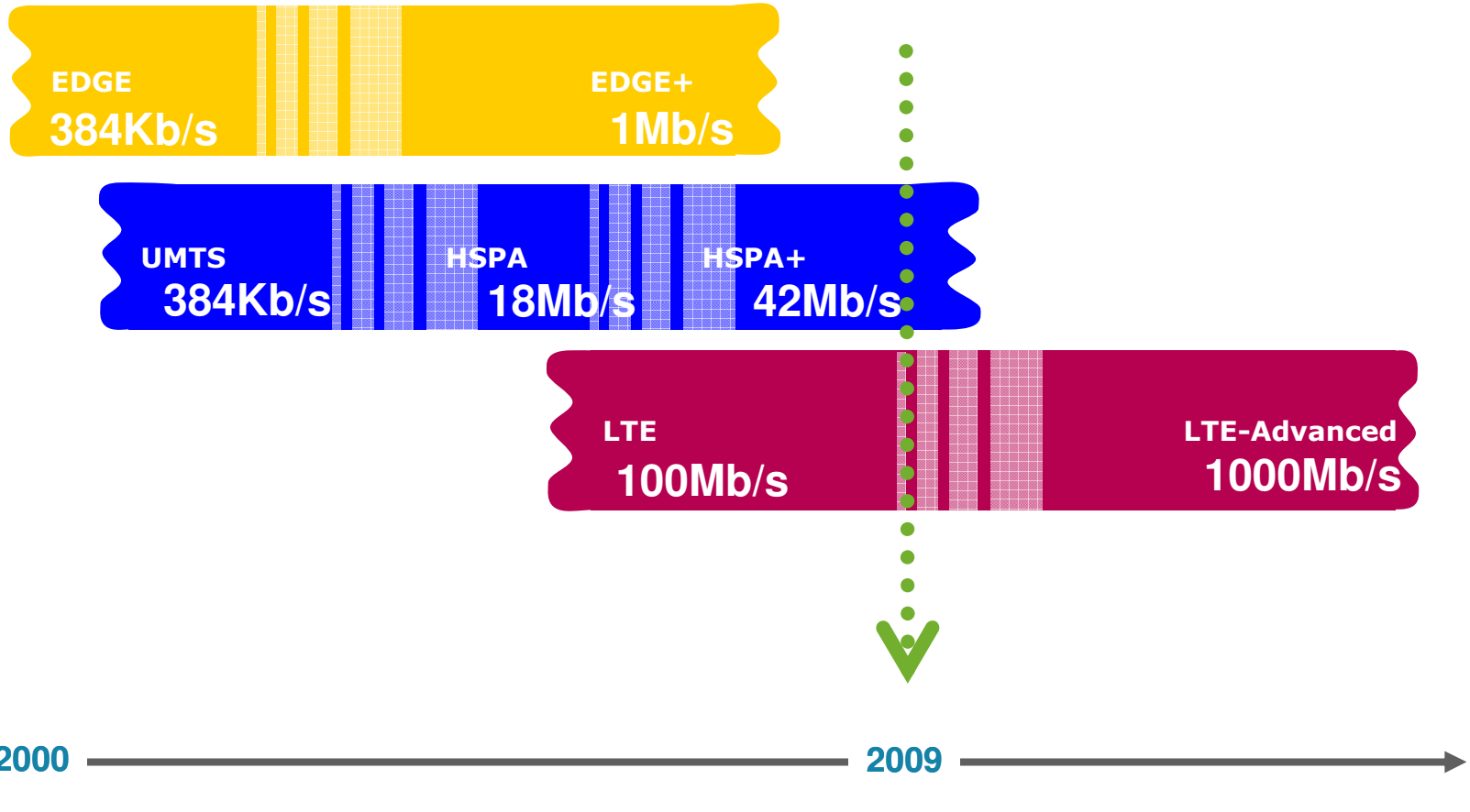
- MCC TF160 – 3GPP LTE/SAE UE Conformance Test
- UE Conformance Testing: Test Suite Design
- Coding Style and Template Restrictions
- Conclusions

What is 3GPP?

- A collaborative standardization activity between:
  - ARIB (Japan-radio)
  - ATIS (North America)
  - CCSA (Peoples Republic of China)
  - ETSI (Europe)
  - TTA (Republic of Korea)
  - TTC (Japan- core network)
- Founded in December 1998
- Prepares complete sets of specifications for mobile radio systems; GSM, GPRS, EDGE, W-CDMA, HSPA, LTE and LTE-Advanced

3GPP Family Evolution

Standards availability



MCC TF160 - General

- **Task Force – Mobile Competence Centre: Project Group at ETSI**
  - Pool of TTCN expertise used by 3GPP

- **3GPP: 3rd Generation Partnership Project (http://www.3gpp.org)**
  → Telecommunication Standardisation Bodies
  → TSG RAN: Radio Access Network
  → WG RAN5: Mobile terminal conformance testing

- **Conformance Tests**
  - Specification (Prose): RAN5
  - Implementation (TTCN): MCC TF160
  - Validation: Test Industry

- **MCC TF160: Signalling Conformance Tests for 3GPP (RAN5: Testing)**
  - Task: Develop Conformance Test Suites for UE world-wide certification
  - since 2000 Conformance Tests for UMTS Signalling (TTCN-2)
    since 2006 Conformance Tests for IMS (TTCN-3)
    2007..2008 Pre-evaluation of TTCN-3 for LTE Signalling
    2008..now 3GPP LTE/SAE UE Conformance Test

MCC TF160 – LTE/SAE Project (1)

- Size: 18 experts all over the world
- Duration: more than 5 years
- Test cases: ~ 100 implemented; 450 planned
- Code size:
  - Modules: more than 90 (more than 120 expected)
    - > 60 000 lines of code (TTCN-3)
    - > 250 000 words
    - > 2 800 000 bytes
  - Type Definitions: 15 TTCN-3 modules, 3 ASN.1 modules
    - > 12 000 lines of code (TTCN-3)
    - > 26 000 lines of code (ASN.1)
- Tools:
  - 6 different compilers (all available at ETSI)
  - quality checks (naming conventions, template restrictions etc.)
  - code generation (top-level test case definitions, parameters, etc.)

MCC TF160 – LTE/SAE Project (2)

- General Requirements and Challenges
  - Ensuring all test equipment has similar behaviour at any time
  - Different data types: TTCN-3, ASN.1, XML …
  - Test suite life cycle > 8 years
  - Backward compatibility and extendibility towards LTE- Advanced
  - Continuous maintenance and deliveries (every 3 – 4 weeks)
  - Verification and Validation of the test suite

- Technical Requirements
  - Real-time behaviour
  - Test Model
    - Control and Configuration of Test Equipment
    - Agreed by 3GPP (TS 36.523-3)

MCC TF160 – LTE/SAE Project (3)

- Quality Requirements
  - Tool-independent implementation
  - Delivered TTCN-3 test cases can only be verified by 3GPP test industry
    ⇒ Runtime Errors very costly
    ⇒ Change Request Process
  - Readability
    ⇒ Code needs to be readable by 3GPP test industry, not only test case writers
  - Impact on Implementation
    ⇒ Tools for Quality Assurance (e.g. to avoid runtime errors)
    ⇒ Change Request necessary for Changes in approved Objects (even on Name Changes)

MCC TF160 – Cooperation with other ETSI Projects

- STF343 – TTCN-3 Tool Assurance
  - Test Suite for Tool Compatibility based on MCC TF160‘s Pre-evaluation Result
- STF349/380 - TTCN-3 extension and maintenance (→ Release 3.4.1 Features)
  - Input for clarifications on TCCN-3 core spec.
  - Handling of local timers ("any timer.timeout", "all timer.stop")
  - Template restrictions
  - encvalue/decvalue functions
  - Pre-processing macros
  - etc.
- Quality Assurance for TTCN-3 Test Specifications (ETSI, University of Göttingen)
  - Usage of the Tool
    → Feedback
    → Additional Requirements
- Knowledge Exchange and Support with other ETSI Projects and Groups
  - WiMax Test Project
  - MTS (ETSI Body: Methods for Testing & Specification)

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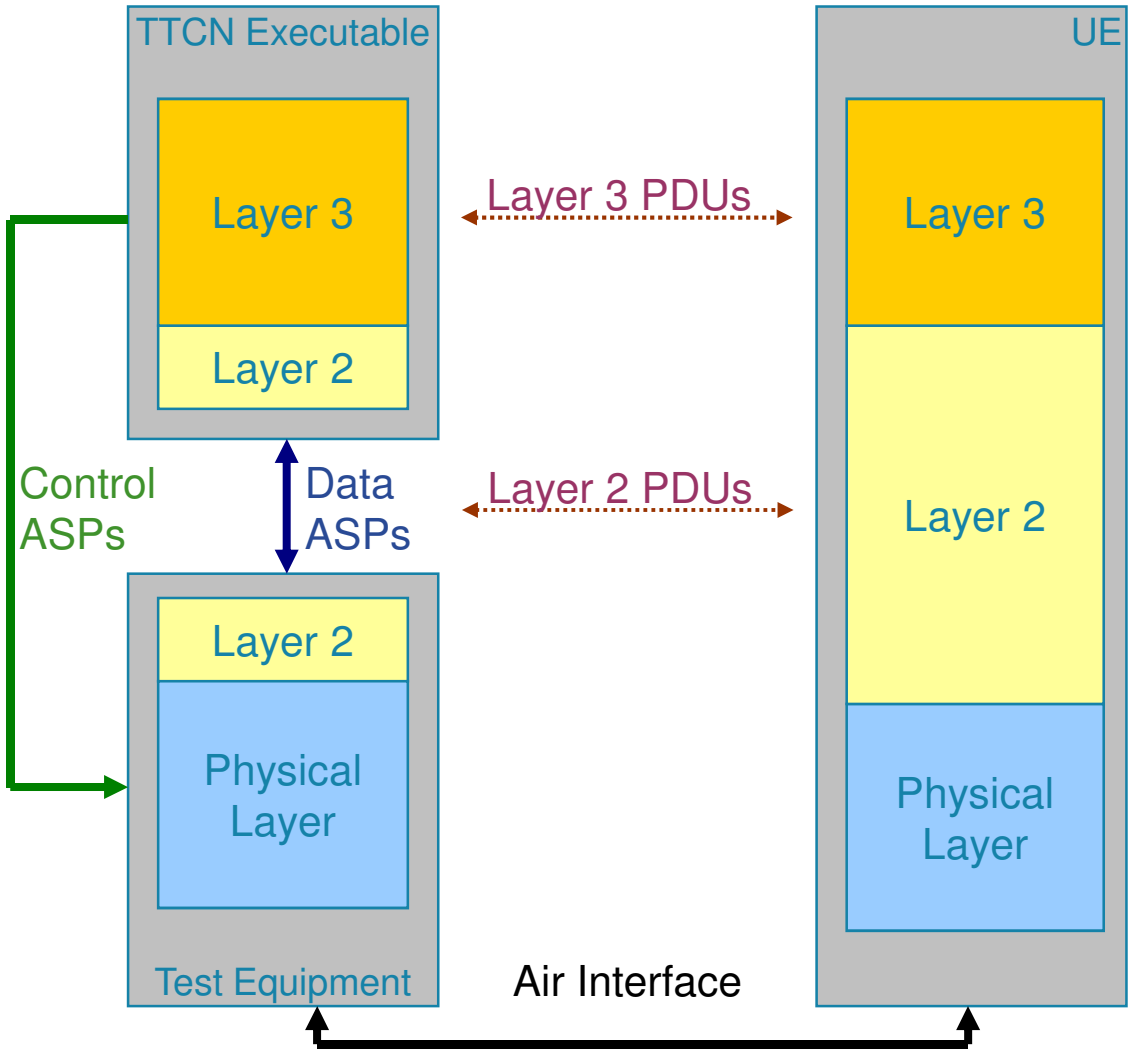
Test Suite Design: UE Conformance Testing

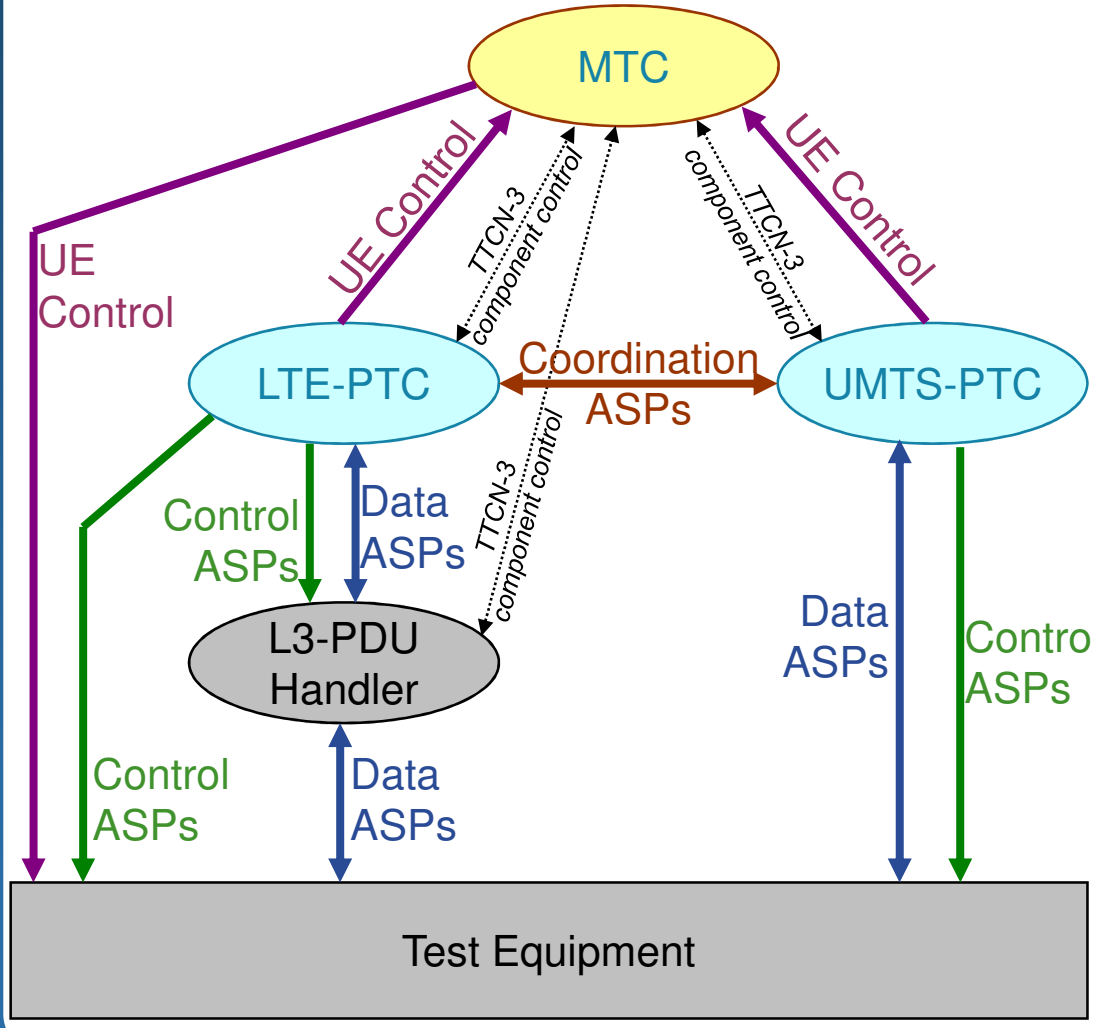


- ASPs: Layer-to-Layer (acc. to the test model)
  - Control ASPs: Configuration and Control of the Test Equipment
  - Data ASPs: Carrying PDUs and Control Information (Timing, Routing, ...)
- PDUs: Peer-to-Peer (acc. to the protocol standards)

Test Suite Design: Design Considerations

- Timers
  - only local timers are used
- Global Variables
  - grouped into component specific structures
  - Accessed by wrapper functions ("set", "get")
- Verdict Assignment
  - Immediate test case termination after FAIL or INCONC
- Test Cases
  - Top-level test case definition generated by Tools
- Modular Structure
  - Separation of components into different Radio Access Technologies (these use different type definitions)
  - Common Modules + Test case specific modules

PTC Model



- MTC
  - Control of PTCs
  - Upper Tester (AT/MMI interface to UE)
- PTCs: per Radio Access Technology
  - LTE-only
  - LTE + UMTS
  - LTE + GSM/GPRS
  - etc.
- L3-PDU Handler
  - coding and encryption
  - no verdict assignment etc.
- UE Control: AT/MMI Commands
  - Routed through MTC
    ⇒ Only one System Port
- Coordination ASPs
  - PTC to PTC
    → InterRAT Handover
- **TTCN-3 Component Control**
  - TTCN-3 Build-in Mechanism
    (Create, Start, Kill, Done, Killed, etc.)

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Coding Style

- **Project specific Naming Conventions**
  - ETSI Generic Naming Conventions
  - \+ Project Specific Requirements
  - ⇒ 3GPP LTE/SAE UE Conformance Test Suite Specific Naming Conventions

- **Different Approaches for Templates**
  1. Classification into Templates with and without Matching Pattern
     - Templates with matching pattern shall be used in receive statements only
     - Templates without matching pattern may be used in receive or send statements
  2. Classification into Templates for Sending and for Receiving
     - Templates for sending are exclusively used in send statements
     - Templates for receiving are exclusively used in receive statements

  → MCC TF160 applies 2nd Approach

- **Project Specific Conventions for LTE/SAE Conformance Tests**
  - Same prefixes as for templates in TTCN-2
    - same people are working on/with TTCN-2 and TTCN-3 test cases
  - Templates distinguished for Sending and Receiving
    - Simple checks for template parameters (see next slides)
    - Improved quality check capabilities for template restrictions

→ http://www.ttcn-3.org/NamingConventions.htm

Naming Conventions: Example "Baseline Moving"

- **Old Type Definition**

```
cr_Message := {
  field1 := value1,
  field2 := value2
}
```

⇒ the template does not contain matching pattern

- **Extended Type Definition**

```
cr_Message := {
  field1 := value1,
  field2 := value2,
  newField := *   // any-or-omit for backward compatibility }
```

⇒ now the template contains matching pattern

⇒ **Classification into send and receive templates does not cause problems with baseline moving**

Template Restrictions (Release 3.4.1)

- **Motivation**
  - Runtime errors may be caused by matching pattern used
    - in send statements
    - as parameters of "valueof"
  - Due to parameterisation of templates compiler cannot find all of these errors
- **Rules**
  - Send Templates
    - Prefix: cs_, cas_, cds_, etc. (acc. to naming conventions)
    - Template itself: "template (value)"
      Template Parameters: "template (omit)" (optional field)
      "template (value)" (mandatory field)
  - Receive Templates
    - Prefix: cr_, car_, cdr_, etc. (acc. to naming conventions)
    - Template itself (no restriction)
      Template parameters "template" (optional field)
      "template (present)" (mandatory field)
- **Checks**
  - Rules can be checked by appropriate tool ("restrictions fitting to prefix")
  - Correct parameterisation can be checked by compilers
    (parameter handed over shall follow restriction of formal parameter)

⇒ **Template Restrictions + Naming Conventions = Better Quality**

Template Restrictions: Examples

Correct Implementation

```
template (value) PDU_Type cs_SendTemplate(
                                    integer    p_Value,
                                    template (value) IE1_Type p_Mandatory,
                                    template (omit)  IE1_Type p_Optional)
    := { ... }
```

Wrong Implementation

```
template PDU_Type cs_SendTemplate(
                                    integer    p_Value,
                                    template (value) IE1_Type p_Mandatory,
                                    template (omit)  IE1_Type p_Optional)
    := { ... } // missing restriction for template

template (value) PDU_Type cs_SendTemplate(
                                    integer    p_Value,
                                    template (present) IE1_Type p_Mandatory,
                                    template           IE1_Type p_Optional)
    := { ... } // missing or wrong restrictions for parameters
```

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Conclusions

- 3GPP conformance testing moved from TTCN-2 to TTCN-3 for LTE
- The LTE test suite
  - Aims to be tool independent
  - Is visible to the whole of 3GPP
  - Has a long project lifespan
  - Is extendable (LTE ⇒ LTE-Advanced ⇒ ???)
- MCC TF160 gives feedback to and receives support from
  - TTCN-3 Standardisation Group
  - TTCN-3 Quality Check Projects
  - TTCN-3 Tool Vendors
- MCC TF160 wants to encourage the close co-operation with the above parties to continue to improve the quality of TTCN-3.

World Class Standards