IMS voice conformance test over LTE

ETSI STF160 2012 TTCN-3 用户大会文档

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- The Project
- Support of Voice in LTE
  - Voice options in LTE
  - SRVCC Architecture
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- The Experience
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议题

- The Project

  --3GPP UE conformance test
  - Mobile terminal conformance is one of the key issues in the mobile industry, impacting interoperability.
  - 3GPP RAN5 and GERAN3 are responsible for UE conformance test specifications
  - A task force STF160 under TSG RAN/RAN5 develops, maintains, delivers the 3GPP UE test suites in TTCN
  - Only these TTCN test cases produced at ETSI are valid for the UE certifications
    - Applied by certification bodies like GCF, PTCRB
  - ETSI CTI provides to 3GPP the STF leadership and management of all 3GPP TTCN-related matters
  - The STF has 18 experts from ETSI, CCSA and ATIS
    - The largest testing project supported by ETSI
  - Funding 90 mm / year
    - 3GPP funding 58 mm (754k Euro)
    - Voluntary contributions 32 mm as man power, free-of-charge from TDIA and other 3GPP companies
  - UE conformance test covers seven technologies: LTE, W-CDMA, TD-SCDMA, GSM/GPRS, IMS, CDMA2000 and inter-technology mobility and roaming
    - For all mobile devices and modules
    - For all 3GPP/3GPP2 frequency Bands
    - For 7 3GPP Releases (Rel-9 - backwards to R99)
  - The team maintains 2200 test cases,
  - Develops 200 new test cases / year

- Provides 12 deliveries / year
- Baseline upgrade once per year
- MCC TF160: Signalling Conformance Tests for 3GPP (RAN5: Testing)
  - Task: Develop Conformance Test Suites for UE world-wide certification
  - 2000..now Conformance Tests for UMTS Signalling FDD/TDD (TTCN-2++) (Rel-99 ... Rel9)
  - 2006..now Conformance Tests for IMS (TTCN-3, bearer agnostic)
  - 2007..2008 Pre-evaluation of TTCN-3 for LTE Signalling
  - 2008..now 3GPP LTE/SAE UE Conformance Test[Rel8 & Rel9]
  - 2011..now IMS Emergency Call/ SRVCC calls in LTE/SAE-> UTRAN/GERAN/CDMA 1XRTT

The Project
--LTE/SAE Project

- Test cases: 393 Verified
  + 75 LTE/SAE + 39 Positioning fully implemented
  613 test cases planned [Rel 8 & Rel 9]
  120+ planned for IMS
- Code size:
  - 263 Modules
  - App. 240 K Lines of code (TTCN-3)
- Type Definitions
  - TTCN-3: > 31 modules, App. 30K lines of code
  - ASN.1: > 8 modules , App. 50K lines of code
  - XML: < Not yet used
- Tools:
  - 6 different compilers (all available at ETSI)
  - Quality checks (naming conventions, template restrictions etc.)
  - Code generation (top-level test case definitions, parameters, etc.)
  - Code analysis (structure, approved objects)
- TTCN-3 code is freely available for 3GPP members and widely used http://www.3gpp.org/ftp/tsg_ran/WG5_Test_ex-T1/TTCN/Deliveries/LTE_SAE/

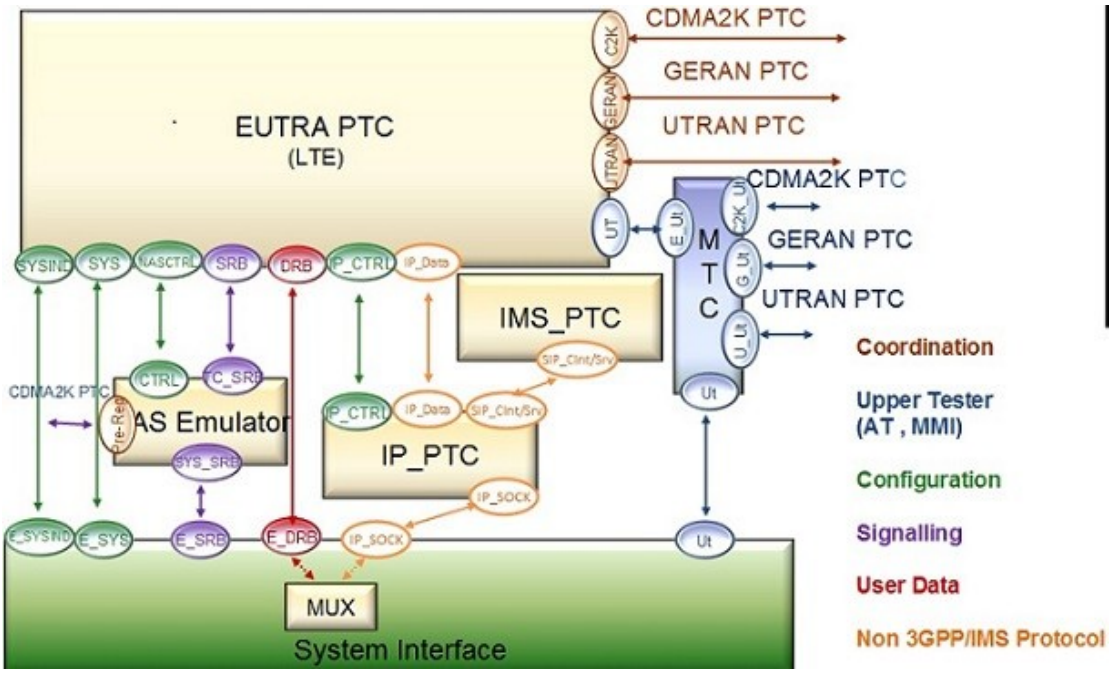
The Project
--Component Structure

- MTC
  - Start of PTCs, monitoring of “done” and “killed”
  - RAT independent interfaces (e.g. AT-/MMI-commands to control the UE)
  - In general no pass/fail verdicts
- PTCs for each RAT (radio access technology)

- LTE, UMTS, GSM/GPRS, CDMA2000
- May be connected to any other RAT PTC
- Only RAT specific interfaces
- Assignment of pass/fail verdicts

- Ports and interfaces
  - Connections: only one-to-one
    (⇒ no “send to”, “receive from”; no use of address data type)
  - No duplicated interfaces: e.g. only one interface for AT-/MMI-commands hosted by the MTC
  - Message based communication only

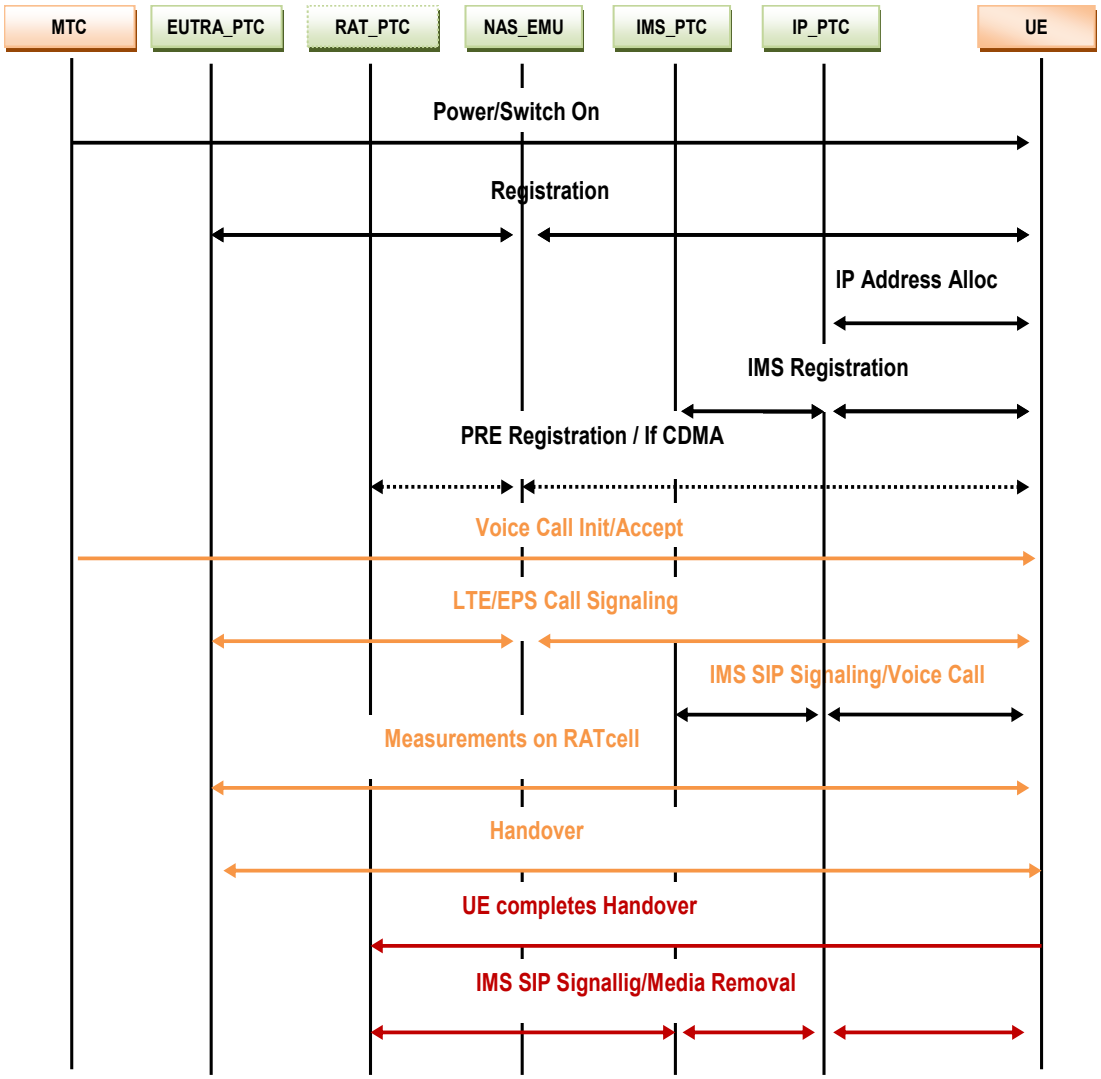
- PTCs for other protocols
  - IP PTC
    - IP data (e.g. DHCP, ICMPv6) handling
    - To keep system interface simple and deal with “parallel behaviour”
    - In general no test characteristic (⇒ no pass/fail verdicts)
    - Possibility to provide non standard test specific behaviour by routing the IP messages to EUTRA PTC. Test characterisitic (⇒ pass/fail verdict allocations)
    - More than one instances possible. One instance per PDN
  - IMS PTC
    - By default provides generic IMS SIP Registration and deregistration
    - Provides UDP/TCP transport of IMS SIP signalling messages
    - In general no test characteristic (⇒ no pass/fail verdicts)
    - Possibility to provide non default, test specific behaviour
    - More than one instances possible: one instance per PDN
  - NAS Emulator
    - “protocol layer” underneath LTE PTC
    - Performs NAS security (Ciphering/Integrity) with the help of external functions



SUPPORT OF VOICE IN LTE
--Voice options in LTE

- **LTE is an all packet technology supporting Packet switched domain only**
- **Support for Voice is still a necessity**
  - **Regulatory requirements present for support of voice call [emergency calls]**
  - **In the age of smart phones, voice still accounts for 15% of mobile traffic.**
- **CSFB is 3GPP endorsed initial voice support, commercially launched in 2011.**
  - **LTE networks are deployed alongside legacy voice networks [UTRAN/GERAN/CDMA 1xRTT]**
  - **UE will be handed over or redirected to the legacy voice RAT when Voice service is needed**
  - **Increases call establishment time by 5 to 8 seconds.**
- **SRVCC is next logical step after CSFB in LTE road map**
  - **UE while camping in LTE uses IMS [VoLTE] for voice**
  - **Core network on both sides will be connected and synchronised.**
  - **Allows single Radio in UE to be handed over from VoLTE to legacy CS domain UTRAN/GERAN/1XRTT; Handover in opposite direction is still not standardised.**
  - **Provides a seamless voice experience to customers using LTE multi mode handsets**
- **Some operators going for non 3GPP endorsed technologies, for example SVLTE**
  - **UE will be simultaneously camping on LTE network for data and some voice technology [e.g. 1xRTT] for voice.**
  - **No need for core networks to be connected and synchronised**
  - **2 UE’s put in one plastic case**

SUPPORT OF VOICE IN LTE
--SRVCC call Message flow



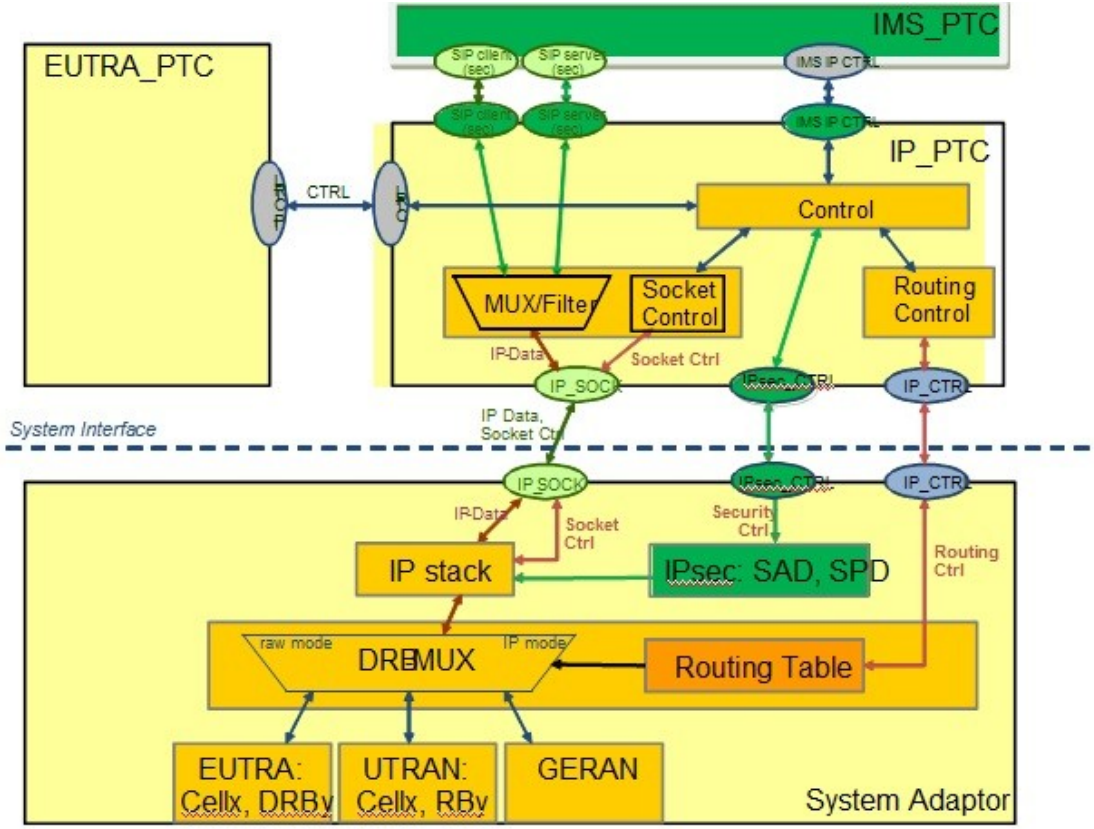
SUPPORT OF VOICE IN LTE
--SRVCC call Complexity

- **Requires MTC and at-least 5 PTCS [EUTRA, NAS Emu, IP, IMS and one of target RAT PTC's]**
  - **Co-ordination between 6 components. [Does not considers multiple instances of IP and IMS components for multi PDN network simulations]**
  - **Signalling handled by these components will be partially independent with start and stop points, synchronised with signalling in other components.**
  - **Simple and robust inter component co-ordination message protocol desired. Hand shake signals are mostly sufficient; configurable RAT specific information also needs to be shared occasionally.**
  - **Requires test case specific behaviour for IMS_PTC, Verdict assignment in IMS_PTC.**

SUPPORT OF VOICE IN LTE
--Future IMS extensions

- **Tests for Video calls over LTE**
  - **requires additional bearer for video.**
  - **requires additional IMS profiles.**
- **Tests for IMS Voice call over HSPA (PS domain) and its handover to CS domain in UTRAN or GERAN**
  - **Similar complexity as SRVCC LTE**
  - **IMS over HSPA[UTRAN bearer] required**
- **Tests for support of IMS VoLTE call handover to VoHSPA and vice versa.**
  - **More IMS SIP signalling over HSPA after handover for call release/de-registration**
  - **IMS bearers for voice to be supported both in LTE and HSPA**
- **IMS Emergency call over LTE and HSPA**
  - **Needs multiple PDN connections, hence multiple instances of IMS PTC.**
- **Test model needs to be ready for these test requirements**

SUPPORT OF VOICE IN LTE
--Test Model Enhancements for IMS



- ❖ **Functionality in dark green added new; Other functionality also enhanced**
- ❖ **SigComp is not required for VoLTE, but may be used for IMS over UTRAN**
- ❖ **It may be required in future to add SigComp**

- **Test case specific IMS PTC**
  - **Provides test case specific IMS behavior.**
    - **Handles default IMS registration &**
    - **Customized SIP signaling for IMS voice call.**
  - **Assigns verdicts**
  - **SIP codec achieved by TTCN 3 built in functions encvalue/decvalue**
  - **Sigcomp not handled yet.**
- **Enhancements to IP PTC**
  - **Added functionality for DHCP/DNS and other IETF protocols during IMS registration**
  - **Enhance IP control for configuring Ipsec in SS IP stack emulation**
  - **Routing/receiving of SIP PDU’s to/from IMS PTC by Mux/Filter**
  - **Enhanced routing.**
- **Enhancements in SS adaptor**
  - **Ipsec handling, configuration of security policy database (SPD) and security association database (SAD) security parameters**
  - **Possibility to map IMS bearers on UTRAN bearers (VoHSPA)**
- **Additional inter component co-ordination ports and messages**

THE EXPERIENCE
--MCC160 Experience

- **ETSI MCC TF160 is one among few teams simultaneously using TTCN2 and TTCN3 for ATS development.**
  - **The only ETSI team still using TTCN2 for historical reasons**
- **Language evolution & Tool support**
  - **TTCN2++ frozen in May 1999, with negligible tool enhancements, seems to have exceeded its ‘use by’ period.**
  - **TTCN 3 enjoys enviable language/tool enhancements and maintenance**
- **Grey areas in spec**
  - **Grey areas (too late to clarify the standards) with different understanding across tool vendors, preventing such features usage.**
    - **IS_PRESENT, behavior with omitted contents , pointing to a list of elements etc.**
  - **No such issues with TTCN 3 due to active language and tool support;**
    - **MCC 160 actively provides such feed back, resulting in clarification in standards and enhancements of tools.**
- **Fixed Mobile convergence:**
  - **Industry is buzz with fixed mobile convergence, requiring many IP based IETF protocols [DHCP/DNS/ICMP/SigComp/IPSec…] support in wireless networks**
    - **TTCN 2 IP based code getting unreadable with too many octet**

strings and local trees.
    - Similar code is very simple in TTCN 3.
    - Absence of built-in functions like encvalue/decvalue in TTCN 2, proving costly; requires many TSO’s to be defined
- Increased code Sizes
    - Tests from 7 releases [Rel99, Rel4, Rel5,…Rel9], proving too much for decade old TTCN 2 compilers to handle.
        - Import tables overhead becoming more than the actual code size.
        - Higher the release, severe the problem due to modular structure for development.
        - Resulting in huge, un manageable modules
        - Compilation and code generation is very time consuming
    - TTCN 3 tools seem to enjoy immunity against such code expansion
        - Integration of IMS with LTE was smooth.
        - Import of a module in TTCN3 is one line with ‘import all’ option.
        - 60k[2009] -> 240k [2012] TTCN 3 lines of code.
        - 90[2009]-> 263[2012] modules
        - 3 [2009]->6+[2012] active components in a test case
        - No known compiler complains
- Proposal to move UTRAN Rel10 and later test development from TTCN 2 to TTCN 3; possibly to also port existing TTCN2 Rel7 and later tests to TTCN 3.
    - Discussion & decision to be made in RAN5 #55 meeting in May 2012

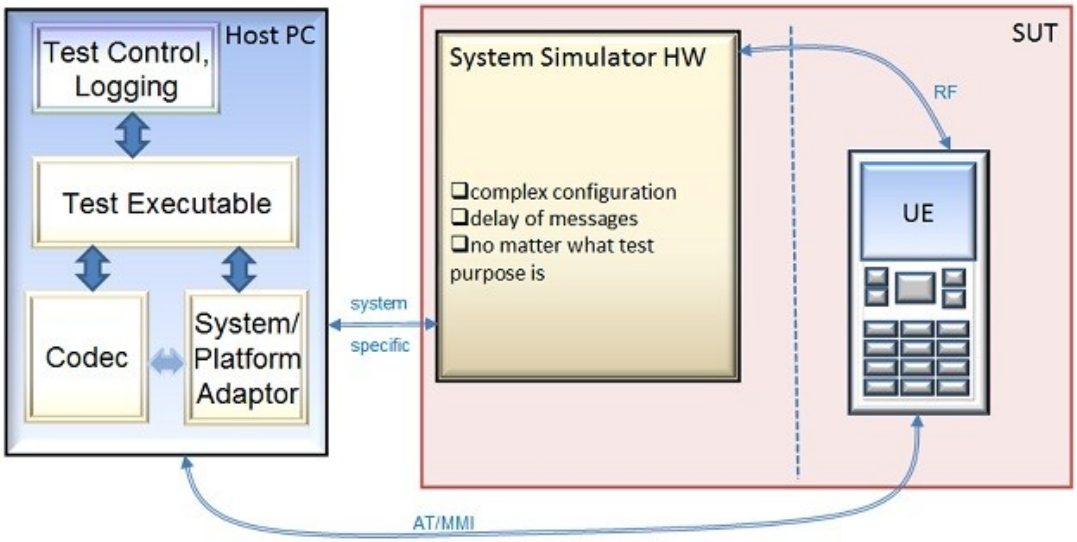
CONCLUSIONS

- Regulatory requirements for support of voice & commercial need for interoperability with legacy CS voice service, contributed in most challenging enhancements in test model and coding MCC TF160 worked on till date.
- Integration of IMS in LTE, brought along with its challenges of handling many flavors of IMS implementations.
- TTCN 3 Rocks
    - Once again TTCN 3 proved to be a good choice by providing competent language frame work, to overcome all challenges in integrating IMS with LTE.
        - Even though there is still no formal verification of IMS in LTE, we do have informal claims of good progress being made; Initial IMS registration performed successfully.
    - Successfully demonstrated co-habitation of seven technologies: LTE[FDD/TDD], W-CDMA, TD-SCDMA, GSM/GPRS, IMS, CDMA HRPD/1XRTT
    - Active TTCN3 language and tool support is enviable.
    - Quality check tools, marking approved objects from rest are ‘icing on the cake’
- The successful integration of IMS with LTE, further motivates to harmonize the IMS code and test model existing in 2 MCC 160 projects:

- the IMS conformance testing (34.229-3) and
- the IMS required for VoLTE (36.523-3).

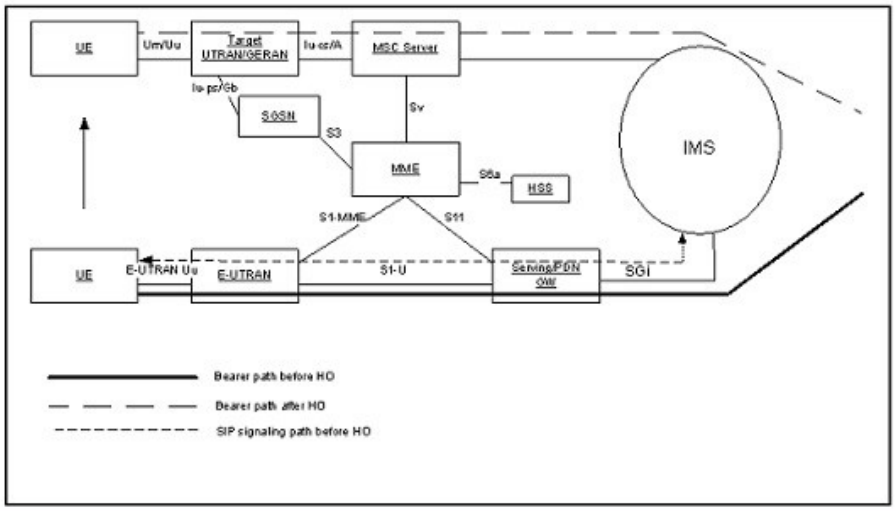
- Challenge for second half of 2012.
- Maximize code reuse in terms of shared modules, hence code synergy.
- Speeds new test case development due to code synergy.
- Boon for maintenance and enhanced quality.
- Targets harmonization of Test Model
- Requires new proxy TTCN 3 modules for primitive mapping
- Requires further enhancements for Sigcomp, XCAP.

Test System



⇒ e.g. requirements regarding real-time behaviour for System Simulator and TTCN-3 code

SRVCC Reference Architecture



- Architecture for EUTRA to UTRAN/GERAN considered. Similar for EUTRAN to CDMA 1XRTT.
- MSC server is enhanced for SRVCC