

Nomor 3GPP Newsletter – February 2008

Latest progress in System Architecture Evolution (SAE)

LTE/SAE

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General Background on SAE

SA WG2 started its own Study for the System Architecture Evolution (SAE) whose objective is "to develop a framework for an evolution or migration of the 3GPP system to a higher-data-rate, lower-latency, packet-optimized system that supports, multiple RATs (Radio Access Technologies). The focus of this work [is] on the PS domain with the assumption that voice services are supported in this domain". SA2's SAE work is conducted under Work Item "3GPP system architectural evolution", approved in December 2004. It was initiated when it became clear that the future was clearly IP with everything (the "all-IP" network, AIPN - see TS 22.978), and that access to the 3GPP network would ultimately be not only via UTRAN or GERAN but by WiFi, WiMAX, or even wired technologies. Thus SEA has consider following objectives:

- Impact on overall architecture resulting from RAN's LTE (Long Term Evolution) work
- Impact on overall architecture resulting from SA1's AIPN (All IP Network) work
- Overall architectural aspects resulting from the need to support mobility between heterogeneous access networks

SAE Architecture

Figure 1 in the annex illustrates the SAE architecture of non-roaming case. The functions and meaning of each component and interface have already been explained in the newsletter April 2007 and can also be found in 3GPP TS23.401 and 3GPP TS23.402.

SAE Current Status

On SA#37, the following decisions were made on the work plan of LTE/SAE:

- Target for LTE/SAE freezing is Dec 2008.
- Rel-8 schedule will be determined by LTE/SAE completion.
- Explicit tracking of LTE/SAE progress at each SA plenary.
- Early stabilization of stage 2 building blocks to expedite stage 3 work is encouraged.
- At this point in time no LTE/SAE BBs (Building Blocks) are excluded from LTE/SAE.
- At least the following BBs are essential for LTE/SAE:
Functions and procedures for SAE to support LTE access with GTP;
Functions and procedures for SAE to support LTE access with PMIP;
Functions and procedures for SAE to support interoperation between LTE and legacy cellular PS accesses (LTE <-> 2G/3G/CDMA).

Table 1 illustrates the current status of SAE Work Items.

SAE Open Issue List

High level functions (common high level functions for all accesses):

- QoS general aspects (label, QCI, etc...) Introduce 'Priority' as a QCI characteristic; Normative table of standardized QCIs is

defined;
Normative mapping between standardized QCI and pre-Rel-8 QoS parameter values is defined.

- Roaming aspects (including local breakout) S8a roaming to non-3GPP access:

The subscriber's QoS profile to create the default bearer on S8a may be transmitted to the S-GW (Serving Gateway) through S6d from the AAA (Authentication Authorization Accounting) proxy that gets the profile from AAA Server;

The signalling procedure for default Bearer establishment over S8a for chained S2a/b – S8a case has been decided.

- Information Storage

The information stored in HSS (Home Subscriber Server), MME (Mobility Management Entity) and Serving GW has been temporarily defined, but some elements are still FFS.

- PCC (policy and charging control) Updates to 23.203 (from both 23.401 and 23.402 functions)

Documentation strategy for incorporating items from 23.401/23.402 into 23.203 is added to 23.203.

IP CAN (IP-Connectivity Access Network) Session to include multiple IP addresses assigned to the same UE is modified. This entails a second change to the section considering input to PCC decisions.

The architecture is augmented with the S7x reference point, represents the S7a and S7c reference points as defined in the TS 23.402.

The functional entity BBERF (Bearer Binding and Event Reporting Function) is introduced.

The architecture is augmented with roaming scenarios with home routed access and visited access.

The reference point S9 between the H-PCRF (Home Policy Charging Rule Function) and V-PCRF (Visited Policy Charging Rule Function) introduced.

PCRF scope extended according to TS 23.402.

A new chapter defines the role of the V-PCRF in 23.203.

The principle of dividing a PLMN (Public Land Mobile Network) into multiple diameter realms and the relevant information used to assist the PCC message routing is approved.

It is clarified that there is a single VPCRF in the roaming case and the DRA (Dynamic Resource Allocation) based solution shall be utilized to do the VPCRF selection.

Two new procedures for relocating gateways in the trusted non-3GPP IP access are introduced.

DRA maintain the information for IP-CAN Session

- Common aspects on Attach/Detach: Attach Type, IP address allocation, etc MME provides the parameter 'RAT/Frequency Selection Priority' (RFSP) to an eNB across S1. The MME receives the RFSP from the HSS (e.g., during the Attach procedure);

Configure into MME/SGSN whether PMIP (Proxy Mobile IP) or GTP (GPRS Tunnelling Protocol) is to be used in the roaming case;

When an external DHCP (Dynamic Host Configuration Protocol) server is used, the P-GW must act as DHCP server towards the UE and DHCP client towards the external DHCP server.

- Functions and procedures for SAE to support LTE access - common and GTP-specific aspects:

Attach/detach procedures (incl. IP address allocation, multiple PDN (Packet Data Network) support, etc.)

The functions and responsibilities during IP address allocation are clarified to to enable stage 3 work on IP address allocation.

IP address allocation mechanism for PMIP base S2a and S2b is approved.

The parameter APN is introduced to the EUTRAN initial attach procedure to support

multiple PDN configurations stored in the HSS for a subscriber.

How to handle dual-stack bearers carrying native IPv4 and IPv6 packets during mobility between 3GPP accesses is proposed.

Service request, including overload issue, etc

A solution to reduce the MME load during service request procedure is approved.

Inter eNodeB handover with CN node relocation (LTE <-> LTE), clean-up

An approach using a simple extension of the X2 based handover for Serving GW only relocation is proposed.

Functions and procedures for SAE to support interoperation between LTE and legacy PS accesses (LTE <-> 2G/3G/CDMA2000):

- Interworking between LTE and CDMA2000 PS

A definition solution for HRPD (High Rate Packet Data) session maintenance, including maintaining QoS state in CDMA HRPD access between pre-registration and HO phase.

Several the U-Plane handling alternatives in the EUTRAN – HRPD handover are proposed.

- Functions and procedures for SAE to support non-3GPP accesses:

Attach/detach (including IP address allocation, mobility mode selection, etc.)

It is clarified when S2a is supported with a Trusted Non-3GPP Access then a 3GPP based access authentication is required. When S2a is not supported with a Trusted Non-3GPP Access then a 3GPP based access authentication may be performed. In case of Untrusted non-3GPP access network a 3GPP based access authentication may be performed;

It is clarified when 3GPP access is used the UE is at the home link and therefore S2c is only used for signalling

EPS use PMIP Proxy Binding Update and Proxy Binding Ack messages to exchange

unique PDN identifiers for GRE Keys on S5 / S8.

A procedure for UE-requested activation of additional PDN connection for PMIP-based S5/S8 is added to TS23.402.

- Handover (non3GPP ↔ 3GPP)

A PDN GW reallocation procedure for the S2c reference point is proposed. With the proposed solution PDN GW reallocation is triggered by the AAA/HSS and is executed at the first BU/BA exchange following DSMIPv6 bootstrapping. The procedure re-uses the Mobile IPv6 extensions that the IETF MEXT WG is specifying for Home Agent reliability (Internet-Draft on "Mobility Header Home Agent Switch Message", already submitted to IESG for publication as a Proposed Standard), which ensures compatibility with any integrated or split UE implementing IETF standards.

The S-GW selection for handover between 3GPP and non-3GPP in case of chained S-GW is clarified.

General principles describing the foundation of network controlled mobility between Mobile WiMax and 3GPP access in EPS (Evolved Packet System) is proposed.

- PCC aspects specific to support of PMIP-based S5/S8

Clarified that SGW needs to pass DL TFT (Traffic Flow Template) to MME during Dedicated Bearer Activation and Dedicated Bearer Modification without Bearer QoS Update

- PCC aspects specific to support of non-3GPP accesses (S2 interfaces)

The existing procedures and add further procedures to enable interworking between non-3GPP access system connecting to EPC using MIPv4 FA CoA based procedures is updated.

When a Trusted or Untrusted Non-3GPP IP Access to 3GPP Access handover occurs and a PMIP-based S5/S8 Interface is used, the Serving GW sends a Gateway Control Session Establishment (IP CAN Type, MN NAI, APN, RAT Type) message to the

PCRF. The IP Address(es) of UE need not to be known by the Serving GW and need not to be sent to the PCRF. It also needs to be changed in 3GPP Access to Trusted Non-3GPP IP Access Handover with PMIPv6 on S2a.

- Mobility Mode Selection

Clarified that IP MM protocol selection is based on network operator's policy.

Clarified that IP address preservation when NBM (PMIPv6) is used is as per PMIPv6 spec in IETF.

The stage 2 description of the solution for IPMS is approved.

- Functions and procedures for SAE to support LTE LCS (Location Service)

Single Radio Voice Call (SR-VCC) Continuity:

Some clarifications to the description of SR-VCC Alternative E in TR23.822 are approved.

A consolidated presentation of the Alternative F-1 and Alternative D2-VDN+ to allow both ICS (Implementation Conformance Statement) and non-ICS approach in TS23.822 is approved.

Evaluation of remaining SRVCC options - update of section 7.19.1.10 in TR23.822 is approved.

The scope of SRVCC for 1xRTT was agreed and moved from TR 23.882 for 1xRTT to TS 23.216.

Study on IMS (IP Multimedia Subsystem) services in local breakout and optimal routing of media:

A new Work Item on system enhancements for the use of IMS services in local breakout to be completed within the Rel-8 timeframe is introduced

The Study Item "System enhancements for the use of IMS services in local breakout and optimal routing of media" (FSIMS_LBO) to update the dates of presentation to SA for information and for approval of TR 23.894 is revised.

CS Fallback:

A new Work Item for CS Fallback is proposed.

The 'Overall Description', 'Scope', 'Reference Architecture', 'General Description for Location Management', 'Attach Procedure' and 'Detach Procedure' parts of the Work Item were approved.

Operators view on SAE work planning

SA2 analysed that, it is feasible to complete stage-2 work for the SAE items that were found essential at SA#37 by June 2008. The establishment of an agreed subset of Items which should get priority in SA WG2 for SAE Rel-8 was decided.

In December 2008, delegates representing sixteen network operators met in order to examine the level of support amongst the operators represented for each of the 3GPP Release 8 LTE/SAE items. Each operator was given three votes to cast for each of their three top priority items.

The results were as follows:

- Single Radio Voice Call Continuity 13 votes
- SAE Generic Support for non-3GPP accesses 12 votes
- SAE impacts on IMS (Local Breakout) 8 votes
- NTT DoCoMo CS fallback 6 votes
- SAE aspects of Emergency calls (GPRS and LTE) 4 votes
- LTE MBMS 3 votes SAE Control Plane LCS 3 votes CS over EPS 3 vote
- WiMAX interworking 3 votes

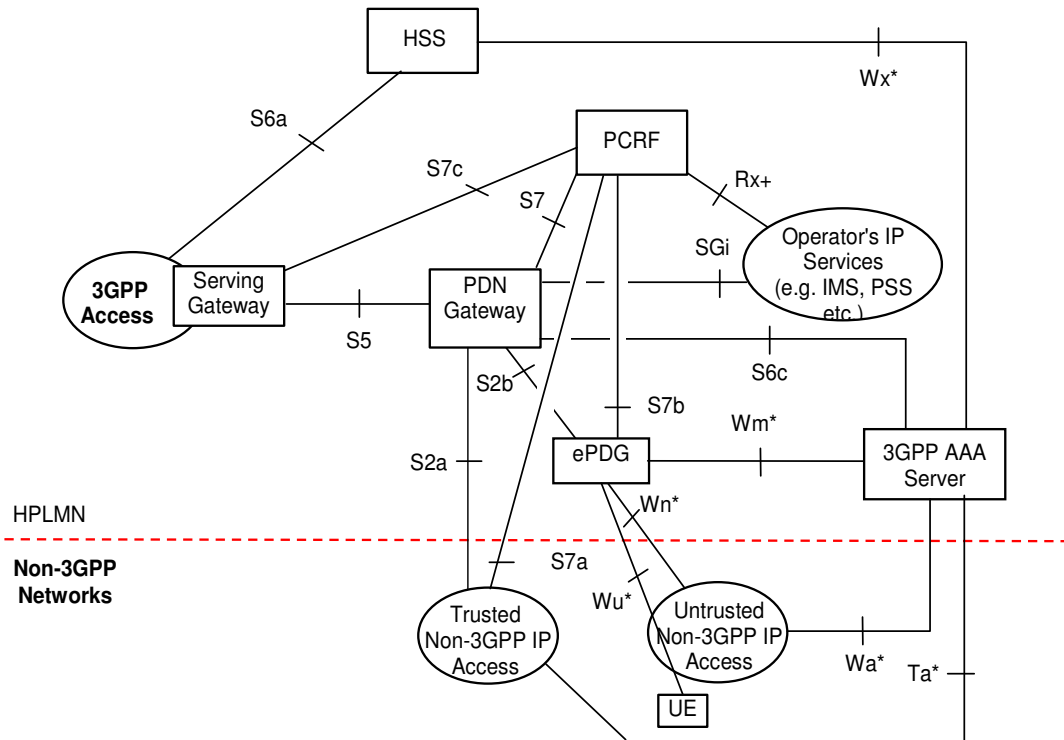
Telefonica and BT indicated that their preferred option would be to have a full SAE(LTE), including all (essential plus not essential) features, even if that could represent a small delay in closing the final full Release 8. Sprint was present in the meeting and voted. SA WG2 is asked to use this list as a de facto priority list.

Vodafone suggests having a Release 9 in around 09-12/2008 and a Release 10 following on 9 to 15 months later.

Table 1: SAE Work Item Status

Work Item Name	Start Date	Finish Date	Completion Percent
3GPP System Architecture Evolution Specification	03.01.2000	20.06.2008	15%
Requirements for evolution of the 3GPP system architecture	08.06.2006	12.01.2007	95%
High level and common (for all accesses) functions	02.01.2007	14.03.2008	11%
Stage 2 of High level functions	02.01.2007	07.09.2007	90%
Stage 3 (CT1) for SAE impact on services, network functions and capabilities	05.02.2007	14.03.2008	4%
Stage 3 (CT3) for SAE impact on existing capabilities	05.02.2007	14.03.2008	5%
Stage 3(CT4) of SAE impact on existing capabilities	05.02.2007	14.03.2008	7%
Stage 3 for Network selection procedures	05.02.2007	14.03.2008	0%
Stage 3 PCC aspects of SAE	05.02.2007	14.03.2008	5%
Stage 3 of Interworking between EPC and external PDNs (SGi)	05.02.2007	14.03.2008	0%
Stage 3 of SAE / LTE identities	05.02.2007	30.11.2007	10%
SAE for LTE access	02.01.2007	14.03.2008	18%
SAES-SA-FP_LTE with GTP variant	02.01.2007	03.12.2007	40%
Stage 2 for SAES-SA-FP_LTE with GTP variant	02.01.2007	03.12.2007	66%
Stage 3 for GTP protocol	05.02.2007	30.11.2007	10%
SAES-SA-FP_LTE with PMIP variant	02.01.2007	03.12.2007	26%
Stage 2 for SAES-SA-FP_LTE with PMIP variant	02.01.2007	03.12.2007	55%
Stage 3 for PMIP protocol within EPC	05.02.2007	30.11.2007	10%
Stage 3 for PMIP protocol between EPCs	05.02.2007	30.11.2007	10%
Stage 3 for UE NAS mobility procedures in idle and active mode	05.02.2007	14.03.2008	8%
Stage 3 for Session management, bearer control and QoS aspects	05.02.2007	14.03.2008	8%
Stage 3 for security aspects for LTE Access	05.02.2007	14.03.2008	8%
Stage 3 for QoS mechanisms	05.02.2007	14.03.2008	0%
Stage 3 for EPC - HSS interface	05.02.2007	30.11.2007	10%
SAE for Interoperation between LTE and legacy cellular PS accesses	05.02.2007	20.03.2008	20%
Stage 2 for Interoperation between LTE and 2G/3G	05.02.2007	31.12.2007	50%
Stage 3 of EPC - GPRS	05.02.2007	30.11.2007	10%
Stage 2 for Interoperation between LTE and CDMA2000	18.06.2007	20.03.2008	35%
Stage 3 for Inter-system mobility between E-UTRAN and other access networks	05.02.2007	14.03.2008	0%
Stage 3 for MME - SGSN "signalling free" protocol	05.02.2007	30.11.2007	10%
SAE for support of non-3GPP accesses	02.01.2007	14.03.2008	21%
Stage 2 for Host-based Mobility aspects	02.01.2007	03.12.2007	60%
Stage 2 for Network-based Mobility aspects	02.01.2007	03.12.2007	60%
Stage 2 for Optimised Handover with WiMAX	25.06.2007	07.03.2008	15%
Stage 3 for Access to the EPC via non-3GPP access networks	05.02.2007	14.03.2008	4%
Stage 3 for Mobility management based on mobile IP	05.02.2007	14.03.2008	8%
Stage 3 security aspects for non3GPP Access	05.02.2007	14.03.2008	8%
Stage 3 for interfaces within EPC	19.09.2007	20.12.2007	0%
Stage 3 for Interfaces EPC - non-3GPP IP access	05.02.2007	30.11.2007	10%
Stage 3 for AAA/HSS related	05.02.2007	30.11.2007	10%
Stage 3 for EPC - AAA interface	05.02.2007	30.11.2007	10%
Functions and procedures for SAE to support LTE MBMS	25.06.2007	13.06.2008	15%
Functions and procedures for SAE to support LCS	13.08.2007	13.06.2008	5%
Single Radio Voice Call Continuity for 3GPP	02.01.2007	07.03.2008	25%
Voice Call Continuity for CDMA2000 1X	25.06.2007	07.03.2008	15%
SAE impacts on IMS	02.01.2007	07.03.2008	25%
SAE aspects of Emergency Calls	08.10.2007	20.06.2008	0%

Figure 1: SAE Architecture (non-roaming case)



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