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EMM Scenario and Eleven EMM Cases

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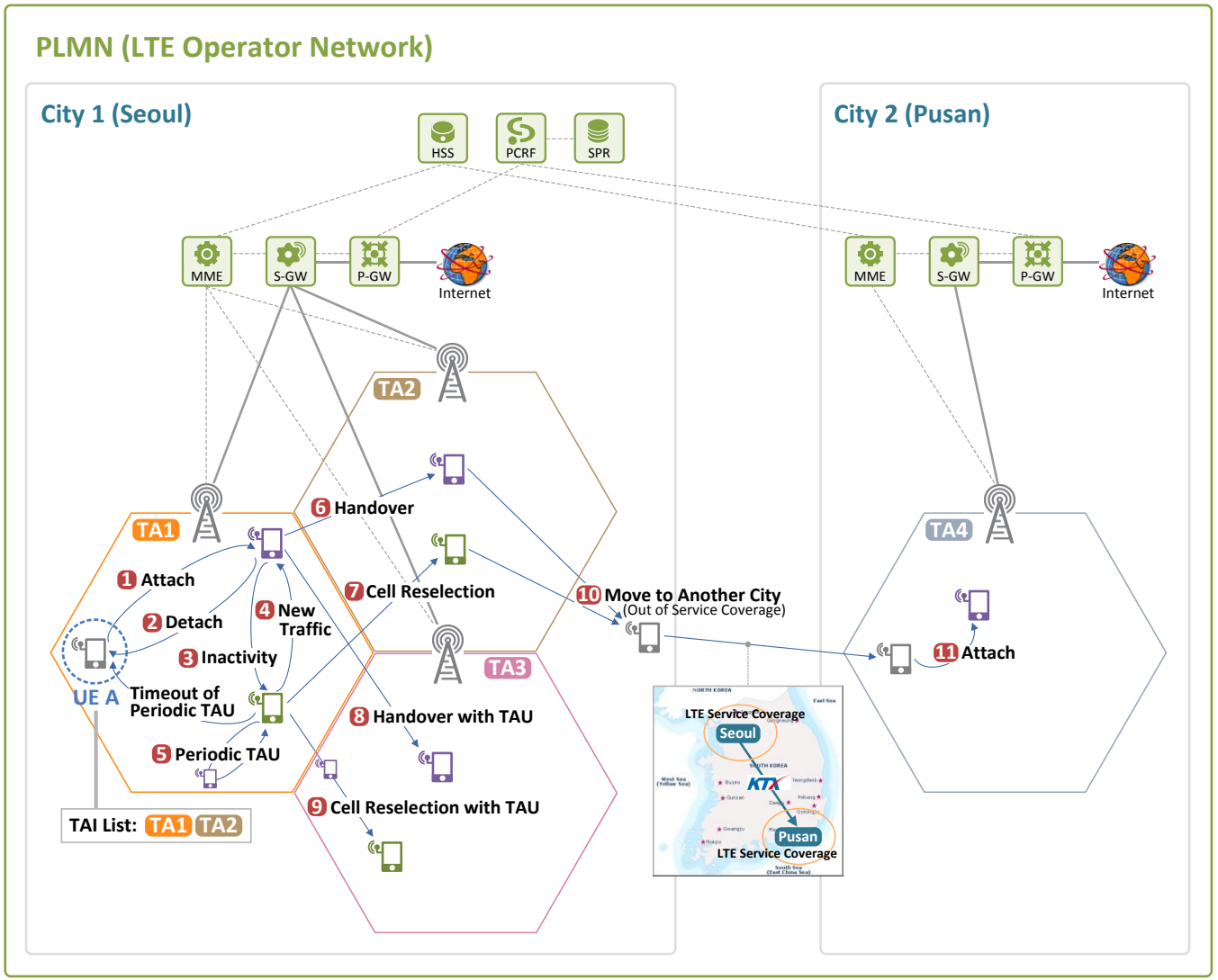
NMC Consulting Group was founded on year 2002 and is advanced, professional network consulting company which is specialized for IP Network area like FTTH, Metro Ethernet and IP/MPLS, Service area like IPTV, IMS and CDN lastly, Wireless network area like Mobile WiMAX, LTE and Wi-Fi.

EMM Scenario

- Target UE: UE A in City 1
- Initial State:
  UE A is switched off, and there exists no UE context for the UE A in the network.
  (EMM-Deregistered + ECM-Idle + RRC-Idle)



EMM Scenario Environments

EMM-Deregistered + ECM-Idle + RRC-Idle

EMM-Registered + ECM-Connected + RRC-Connected

EMM-Registered + ECM-Idle + RRC-Idle

User Plane Path

Control Plane Path

Brief Description of Eleven EMM Cases (1/4)

EMM Case 1. Initial Attach

- **UE State: "EMM-Deregistered, ECM/RRC-Idle" → "EMM-Registered , ECM/RRC-Connected"**
  - UE A is switched on. UE A enters the state "**EMM-Deregistered, ECM-Idle, RRC-Idle**" and tries to connect to the network.
  - There is no UE Context of UE A in UE A and MME.
  - After synchronizing to a cell, UE A initiates the **Initial Attach** procedure by sending an "***Attach Request***" message to the MME with IMSI as UE ID.
  - After successful completion of the **Initial Attach** procedure, UE A enters the state "**EMM-Registered, ECM-Connected, RRC-Connected**" and can use services that require registration.

EMM Case 2. Detach

- **UE State: "EMM-Registered , ECM/RRC-Connected" → "EMM-Deregistered , ECM/RRC-Idle"**
  - UE A is detached from the network in the state "**EMM-Registered, ECM-Connected, RRC-Connected**".
  - According to the detach triggering factors, there are three types of **Detach** procedures: UE-Initiated, MME-Initiated and HSS-Initiated
  - Upon successful completion of the **Detach** procedure, UE A enters the state "**EMM-Deregistered, ECM-Idle, RRC-Idle**".

EMM Case 3. S1 Release due to User Inactivity

- **UE State: "EMM-Registered , ECM/RRC-Connected" → "EMM-Registered , ECM/RRC-Idle"**
  - UE A is not using the service for a certain period of time in the state "**EMM-Registered, ECM-Connected, RRC-Connected**".
  - User inactivity is detected by eNB, and the S1 bearer and S1 signaling connection are released.
  - After successful completion of the **S1 Release** procedure, the state of UE A transits to "**EMM-Registered, ECM-Idle, RRC-Idle**".

Brief Description of Eleven EMM Cases (2/4)

EMM Case 4. Service Request due to New Traffic

- UE State: "EMM-Registered , ECM/RRC-Idle" → "EMM-Registered , ECM/RRC-Connected"
  - New traffic is generated when UE A is in the state "**EMM-Registered, ECM-Idle, RRC-Idle**".
  - The new traffic can be generated by UE A or the network, and the **Service Request** procedure is initiated.
  - After successful completion of the **Service Request** procedure, UE A transits to the state "**EMM-Registered, ECM-Connected, RRC-Connected**".

EMM Case 5. Periodic Tracking Area Update (TAU)

- UE State: : "EMM-Registered , ECM/RRC-Idle" → "EMM-Registered , ECM/RRC-Connected" → "EMM-Registered , ECM/RRC-Idle"
  - UE A is in the state "**EMM-Registered, ECM-Idle, RRC-Idle**", and the periodic TAU timer (T3412) is expired.
  - UE A performs the **Periodic TAU** procedure: UE A transits to the state "**EMM-Registered, ECM-Connected, RRC-Connected**" by establishing an ECM connection to the MME by sending a "***TAU Request***" message.
  - After successful completion of the **Periodic TAU** procedure, the ECM connection is released and UE A returns to the state "**EMM-Registered, ECM-Idle, RRC-Idle**".

EMM Case 6. Handover without TAU

- UE State: "EMM-Registered , ECM/RRC-Connected" → "EMM-Registered , ECM/RRC-Connected"
  - UE A in the state "**EMM-Registered, ECM-Connected, RRC-Connected**" moves a new cell and detects it enters a new TA included in the TAI list.
  - **Handover** is performed to the new cell, but the **TAU** procedure does not need to occur.
  - After successful completion of the **Handover without TAU** procedure, UE A remains in the state "**EMM-Registered, ECM-Connected, RRC-Connected**".

Brief Description of Eleven EMM Cases (3/4)

EMM Case 7. Cell Reselection without TAU

- UE State: "EMM-Registered , ECM/RRC-Idle" → "EMM-Registered , ECM/RRC-Idle"
  - UE A is in the state "**EMM-Registered, ECM-Idle, RRC-Idle**". UE A moves a new cell and detects it enters a new TA in the TAI list.
  - **Cell Reselection** is occurred to the new cell, but **TAU** procedure is not performed.
  - After the **Cell Reselection without TAU** procedure, UE A remains in the state "**EMM-Registered, ECM-Idle, RRC-Idle**".

EMM Case 8. Handover with TAU

- UE State: "EMM-Registered , ECM/RRC-Connected" → "EMM-Registered , ECM/RRC-Connected"
  - UE A in the state "**EMM-Registered, ECM-Connected, RRC-Connected**" moves a new cell and detects it enters a new TA not included in the TAI list.
  - **Handover** is performed to the new cell, then UE A performs the **TAU** procedure.
  - After successful completion of the **Handover with TAU** procedure, UE A remains in the state "**EMM-Registered, ECM-Connected, RRC-Connected**".

EMM Case 9. Cell Reselection with TAU

- UE State: "EMM-Registered , ECM/RRC-Idle" → "EMM-Registered , ECM/RRC-Connected" → "EMM-Registered , ECM/RRC-Idle"
  - UE A in the state "**EMM-Registered, ECM-Idle, RRC-Idle**" moves a new cell and detects it enters a new TA not included in the TAI list.
  - **Cell Reselection** is performed to the new cell, the UE A performs the **TAU** procedure: UE A transits to the state "**EMM-Registered, ECM-Connected, RRC-Connected**" by establishing an ECM connection to the MME by sending a "***TAU Request***" message.
  - After the **TAU Update** procedure, the ECM connection is released and UE A returns to the state "**EMM-Registered, ECM-Idle, RRC-Idle**".

Brief Description of Eleven EMM Cases (4/4)

EMM Case 10. Move to Another City

- **UE State: "EMM-Registered , ECM/RRC-Connected"** or **"EMM-Registered , ECM/RRC-Idle"** → **"EMM-Deregistered , ECM/RRC-Idle"**
  - UE A (being served or in Idle state) in the City 1 moves to the City 2. UE A moves out the LTE coverage and detached from the network.
  - After the **Detach** procedure, UE A enters the state "**EMM-Deregistered, ECM-Idle, RRC-Idle**".

EMM Case 11. Initial Attach in Another City

- **UE State: "EMM-Deregistered , ECM/RRC-Idle"** → **"EMM-Registered , ECM/RRC-Connected"**
  - UE A in the state "**EMM-Deregistered, ECM Idle, RRC-Idle**" enters to the City 2 and detects a new LTE cell.
  - UE A initiates the **Initial Attach** procedure by sending an "***Attach Request***" message to the new MME with GUTI as UE ID.
  - After successful completion of the **Initial Attach** procedure, UE A enters the state "**EMM-Registered, ECM-Connected, RRC-Connected**".

Summary of Eleven EMM Cases

Summary of Eleven EMM Cases

EMM Case		Activity	Related LTE Technical Document
EMM Case 1	Initial Attach	• Attach of Unknown UE	EMM Procedure : 1. Initial Attach for Unknown UE
EMM Case 2	Detach	• UE-initiated Detach • MME-initiated Detach • HSS-initiated Detach	EMM Procedure: 2. Detach
EMM Case 3	S1 Release due to User Inactivity	• eNB-initiated S1 Release • MME-initiated S1 Release	EMM Procedure: 3. S1 Release due to User Inactivity
EMM Case 4	Service Request due to New Traffic	• UE triggered Service Request • Network triggered Service Request	EMM Procedure: 4. Service Request due to New Traffic
EMM Case 5	Periodic TAU (Tracking Area Update)	• Periodic TAU (Tracking Area Update)	EMM Procedure: 5. Periodic TAU
EMM Case 6	Handover without TAU	• X2 based Handover • S1 based Handover	EMM Procedure: 6. Handover without TAU
EMM Case 7	Cell Reselection without TAU	• Cell Reselection without TAU	EMM Procedure: 7. Cell Reselection without TAU
EMM Case 8	Handover with TAU	• X2 based Handover • S1 based Handover	EMM Procedure: 8. Handover with TAU
EMM Case 9	Cell Reselection with TAU	• Cell Reselection with TAU	EMM Procedure: 9. Cell Reselection with TAU
EMM Case 10	Move to Another City	• Move to Another City	EMM Procedure: 10. Move to Another City
EMM Case 11	Initial Attach in Another City	• Attach in Another City	EMM Procedure: 11. Initial Attach for Known UE via Old MME

References and Abbreviations

[1] Netmanias Technical Document, "LTE EMM and ECM State", February 2013, http://www.netmanias.com/bbs/zboard.php?id=1x_TechdocsForum_4G

[2] 3GPP TS 24.301, "Non-Access-Stratum (NAS) Protocol for Evolved Packet System (EPS); Stage 3".

[3] 3GPP TS 23.401, "General Packet Radio Service (GPRS) Enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Access".

[4] NMC Consulting Group Report, "E2E LTE Network Design", August 2010.

Abbreviations

ECM	:	EPS Connection Management
EMM	:	EPS Mobility Management
eNB	:	Evolved Node B
EPS	:	Evolved Packet System
E-RAB	:	E-UTRAN Radio Access Bearer
E-UTRAN	:	Evolved Universal Terrestrial Radio Access Network
GPRS	:	General Packet Radio Service
GUTI	:	Globally Unique Temporary Identifier
HSS	:	Home Subscriber Server
LTE	:	Long Term Evolution
MME	:	Mobility Management Entity
NAS	:	Non-Access Stratum
PCRF	:	Policy and Charging Rule Function
P-GW	:	Packet Data Network Gateway
PLMN	:	Public Land Mobile Network
RRC	:	Radio Resource Control
S-GW	:	Serving Gateway
SPR	:	Subscriber Profile Repository
TA	:	Tracking Area
TAI	:	Tracking Area Identity
TAU	:	Tracking Area Update
UE	:	User Equipment