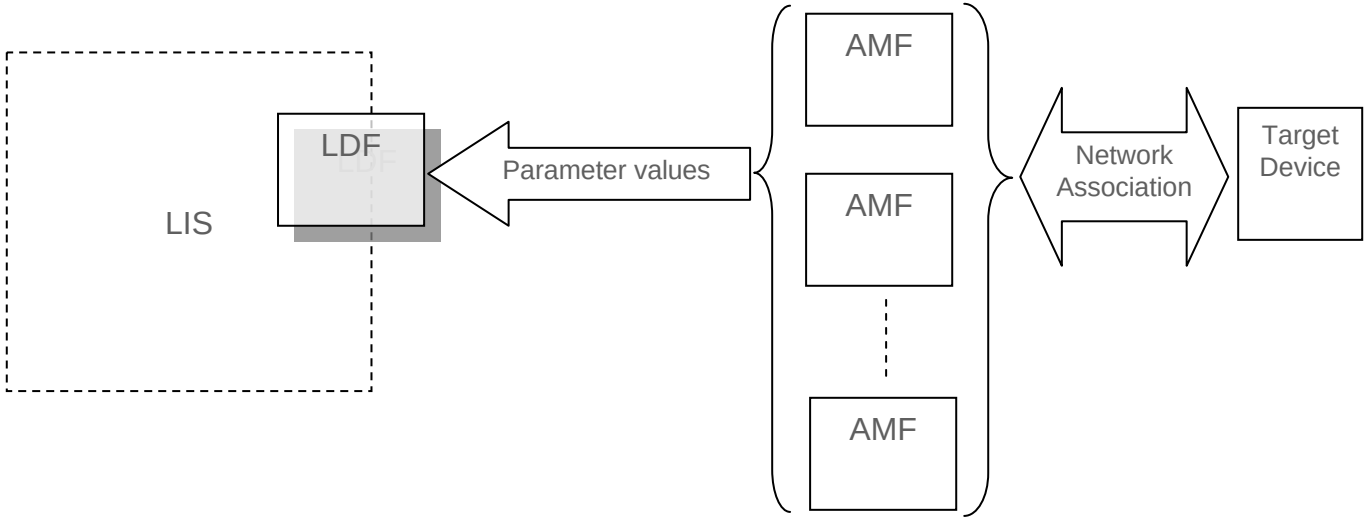
ATIS – ESIF – NGES
Issue 58

Parameter Conveyance for Location Determination of Devices Attached To Access Networks

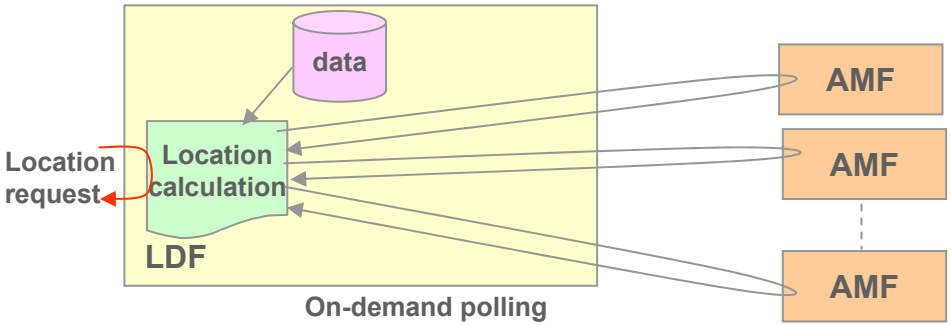
Overview of material including introductory Stage 3 details

Requirements Model



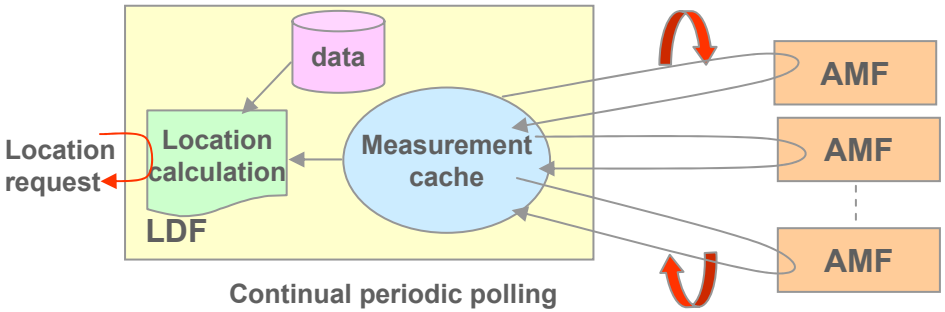
- The Location Determination Function (LDF) is responsible for determining/calculating location
- The LDF is a logical entity associated with a LIS which provides the location determination capability for the LIS
- Goal is to define requirements for an architecture and protocols allowing an LDF to acquire the value of network parameters (referred to as measurements) that apply to a specific target device within an access network
- For the purpose of requirements terminology, an Access Measurement Function (AMF) is defined which is responsible for providing the access network parameter values to the LDF as they apply to a particular target device
- For the purpose of expressing requirements, it is assumed that an LDF may communicate with one or more AMF instances associated with a particular access network in order to acquire the values of all relevant network parameters to be able to determine the location of the target device.

Measurement collection models



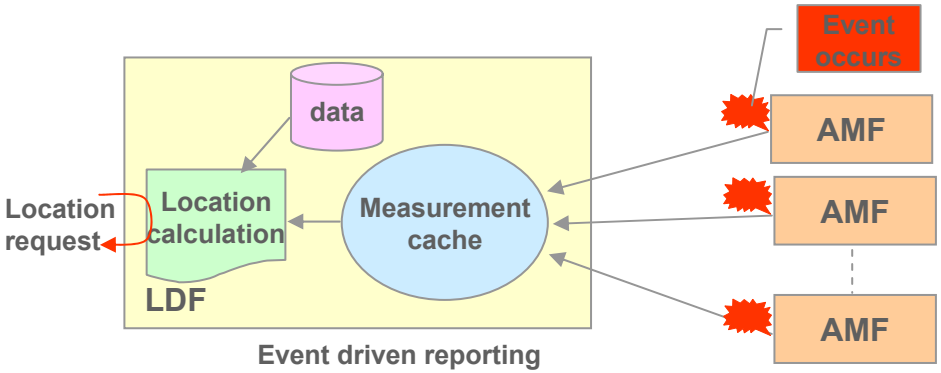
On-demand polling

A. On-demand polling. The LDF requests relevant parameter values for the target device when a location calculation is requested/required.



Continual periodic polling

B. LDF cache with polling. The LDF periodically requests the parameter values for all devices which the AMF instance(s) are aware of on a periodic and ongoing basis. These measurements are cached and the cache is used when a location calculation is requested/required.



Event driven reporting

C. LDF cache with reporting. When an AMF instance detects an “event” indicating that new parameter values for corresponding target devices occurs, it reports the new measurement information to the LDF. These measurements are cached by the LDF and the cache is used when a location calculation is requested/required.

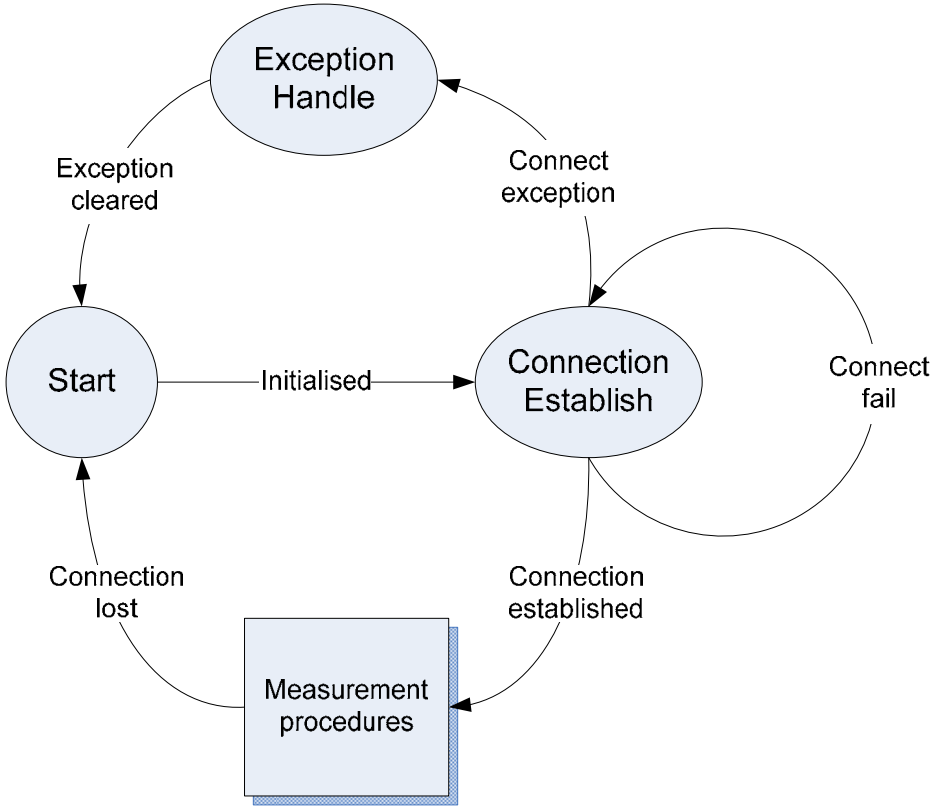
Messaging, session management, procedures, and data

- To meet the architectural requirements, the following messaging facilities are required
  - Polling request/response
  - Reporting and synchronization
- LDF to be able to establish communication sessions with one or more AMF instance(s)
  - AMF provides a measurement service to which LDF is the client
  - Session management under control of LDF
  - Authentication/authorization option to be supported
  - Secure/encrypted communication option to be supported
- Procedures required to support the different measurement delivery models
  - Minimum requirements for response to messaging
- Extensibility and general applicability to be supported
  - Any kind of access network parameters
  - Any kind of target device identifier – against which measurements are reported
  - The ability to aggregate a set of parameter data types and associated target device identifier data types as a class
    - And consequently, the ability to extend a class with additional data

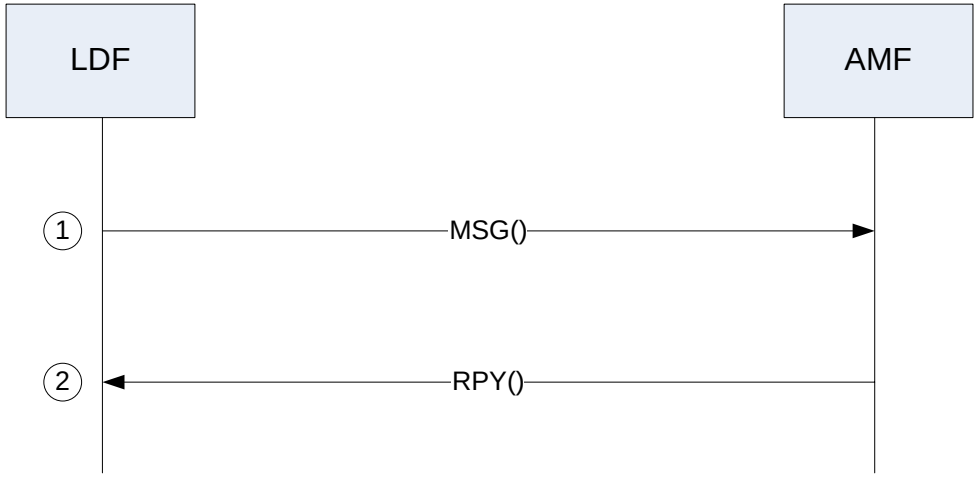
Stage 2 Specification

- Connection management
  - Connection state machine
  - Heartbeat signalling
- Message sequences
  - Query
  - Notification
  - Resynchronization

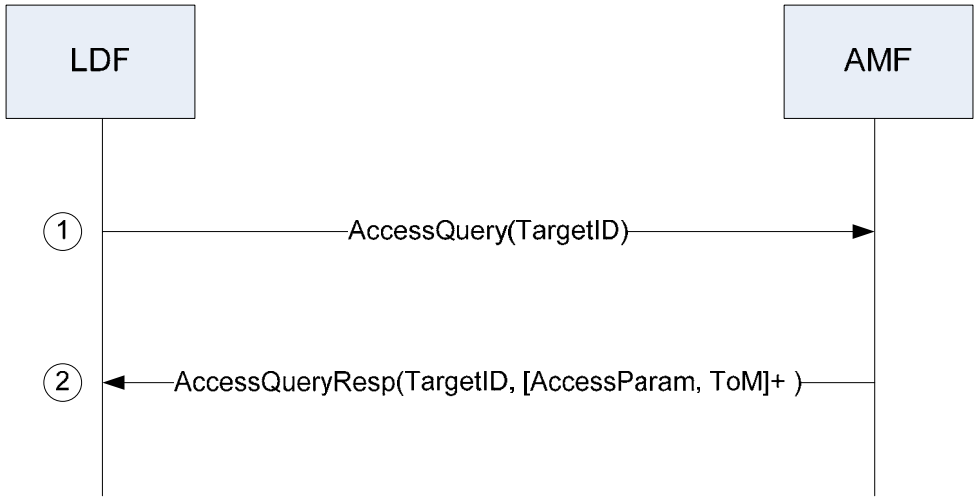
LDF-AMF Connection management



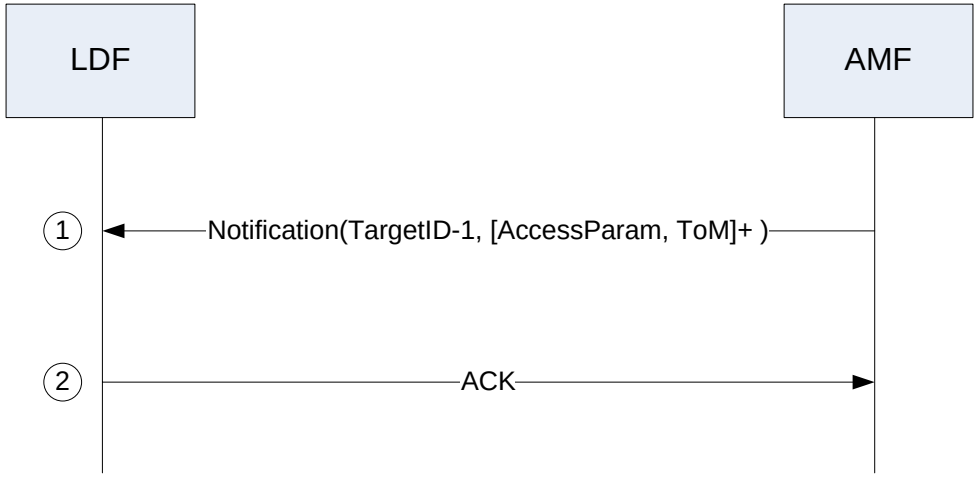
Heartbeat sequence



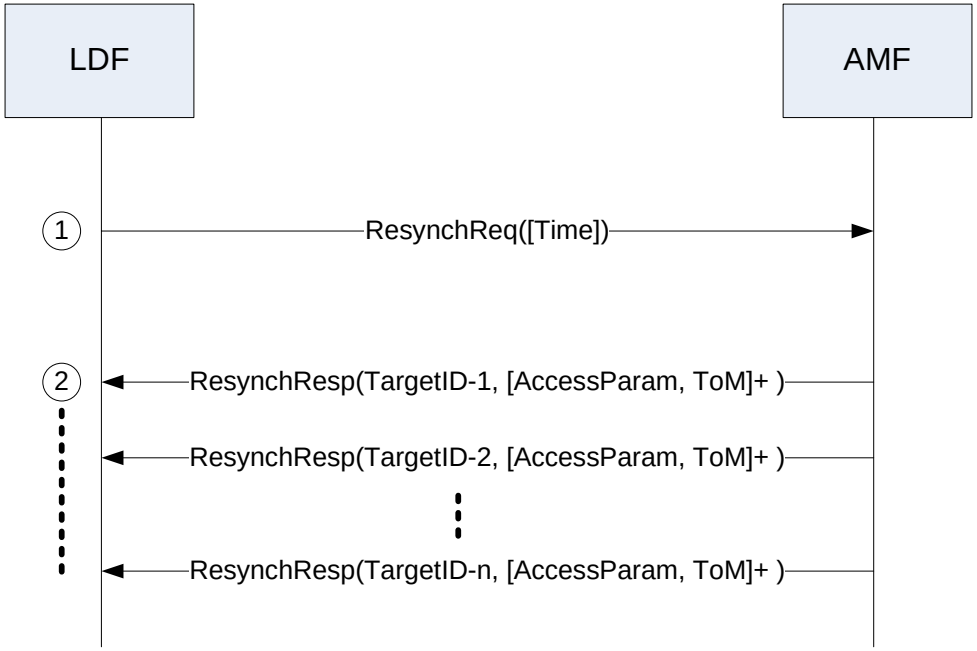
Polling sequence



Notification sequence



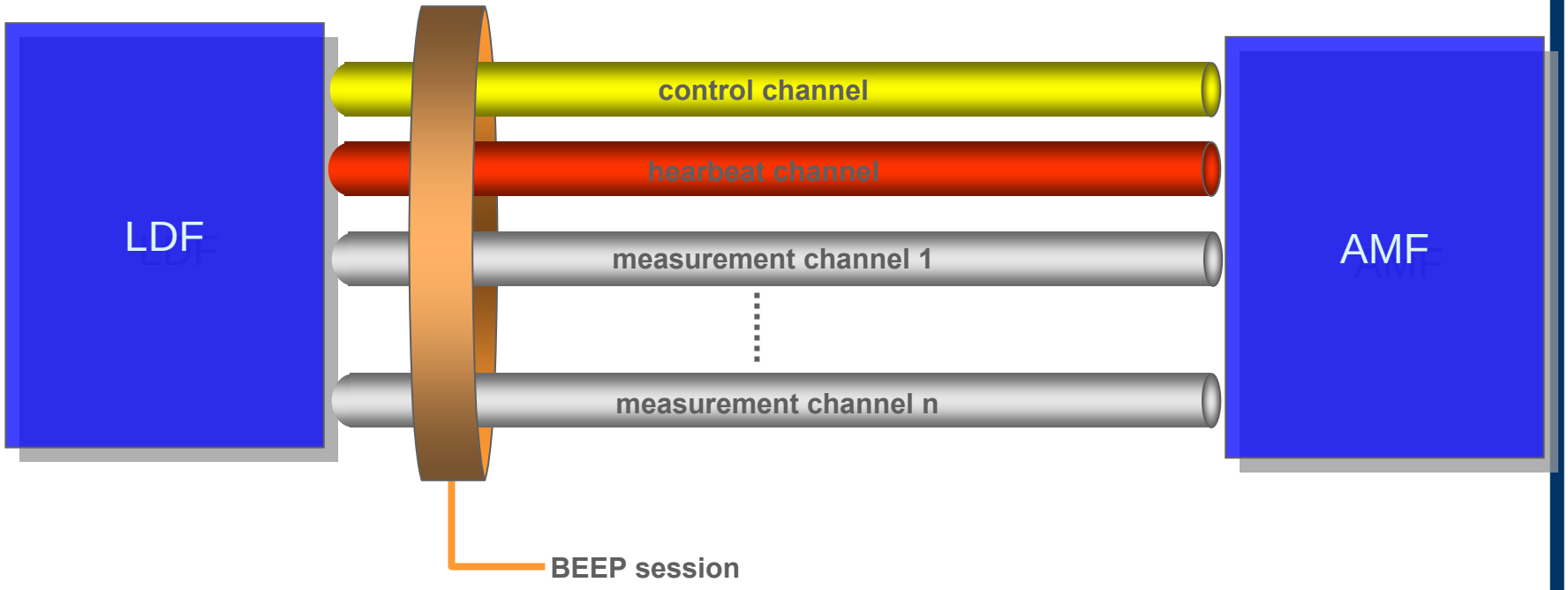
Resynchronization sequence



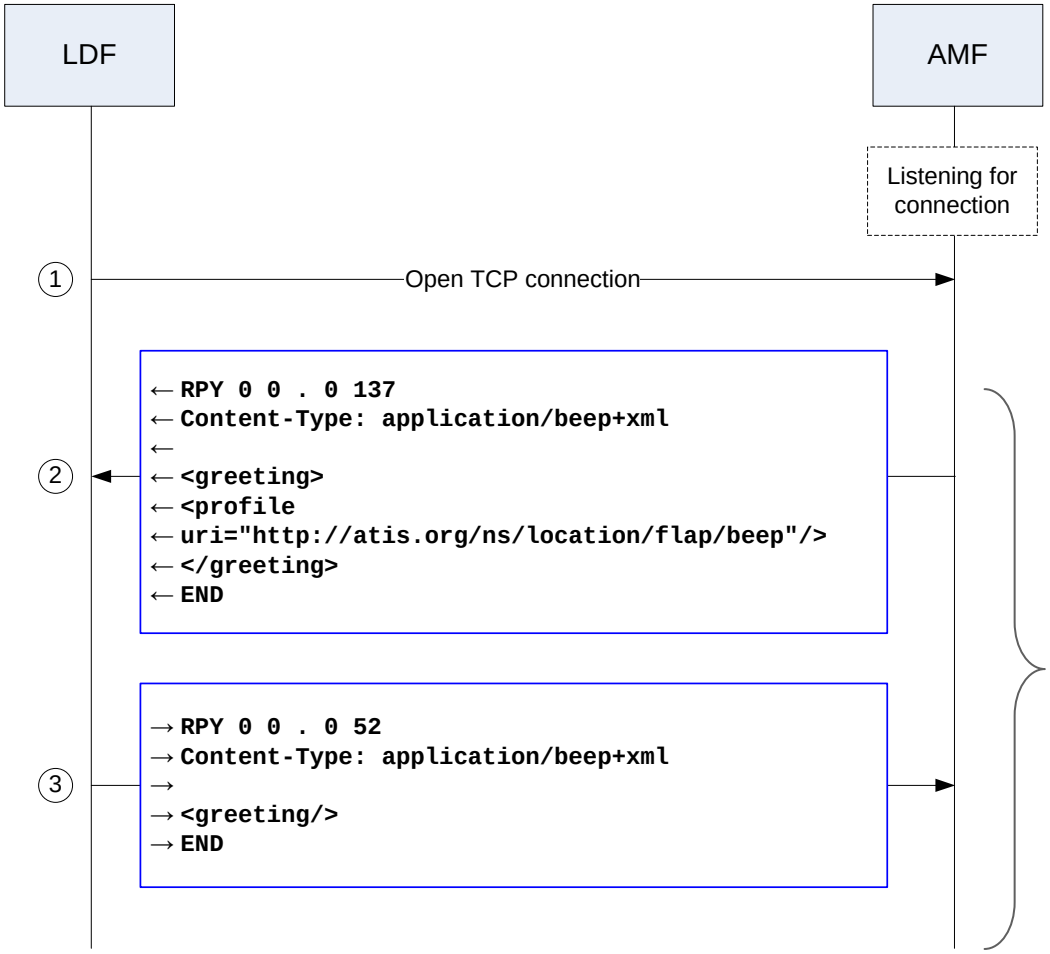
Stage 3 Specification

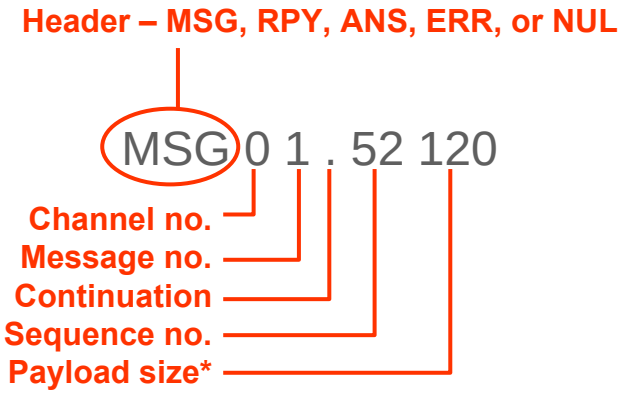
- Transport and connection management
  - BEEP session establishment
  - Security options
  - Heartbeat channel profile
- FLAP BEEP profile
  - Messages and attributes
- BEEP XML (TBD)
- Recommendations (TBD)
  - Timers, authentication methods, etc…

BEEP session and channels



LDF-AMF Session Establishment



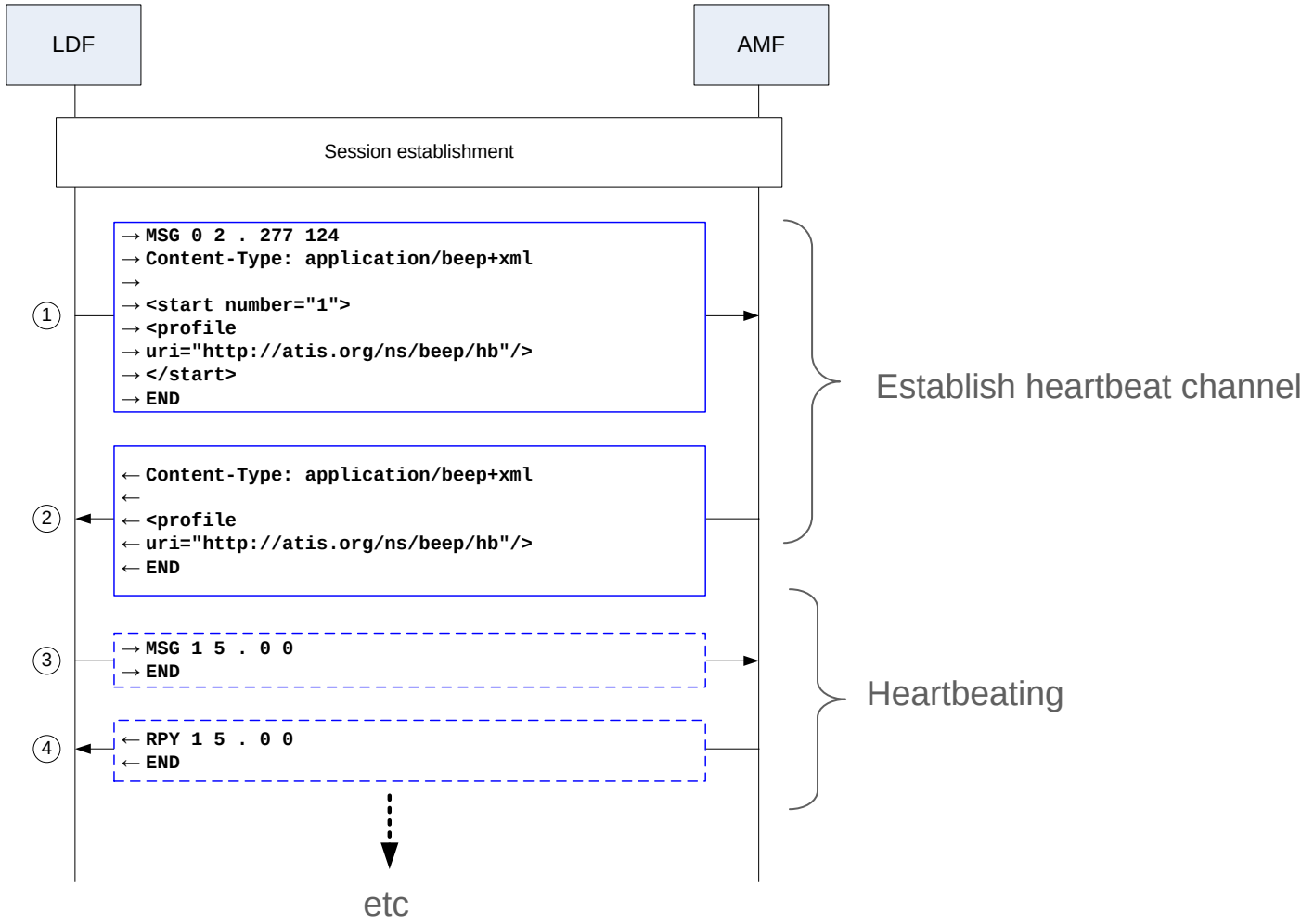


Ref: IETF RFC3080

- BEEP session establishment.
- The profile confirms that the AMF supports FLAP
- For secure connections, the AMF can also indicate support for the TLS profile (Ref: IETF RFC3080)

*** Payload size not guaranteed to be correct in examples ☺**

Heartbeat channel



FLAP Channel Establishment

LDF

AMF

Session and heartbeat establishment

1

```
→MSG 0 1 . 137 239
→Content-Type: application/beep+xml
→
→<start number="2">
→<profile
→uri="http://atis.org/ns/location/flap/beep">
→<![CDATA[
→<ns-prefix xmlns="http://atis.org/ns/location/
flap"
→xmlns:802.11="http://ieee.org/ns/location/flap/
802.11"/>
→]]>
→</profile>
→</start>
→END
```

Request channel for 802.11 measurements

2

```
→RPY 0 0 . 52 220
→Content-Type: application/beep+xml
→
→<profile uri="http://atis.org/ns/location/flap/
beep">
→<![CDATA[
→<ns-prefix xmlns="http://atis.org/ns/location/
flap"
→xmlns:802.11="http://ieee.org/ns/location/flap/
802.11"/>
→]]>
→</profile>
→END
```

Confirm channel for 802.11 measurements

FLAP query example

LDF | AMF

Session and heartbeat and FLAP channel establishment

1

```
→ MSG 2 1 . 63 176
→ Content-Type: application/xml
→
→ <aq xsi:type="802.11:aq">
→ <802.11:terminal>
→ <802.11:mac>01020304050a</802.11:mac>
→ </802.11:terminal>
→ </aq>
→ END
```

Polling mode request for terminal with MAC address

2

```
← RPY 2 1 . 801 294
← Content-Type: application/xml
←
← <aqr result="200" xsi:type="802.11:aqr">
← <802.11:access time="2008-04-
15T14:02:25.160+10:00"
← expires="2008-04-15T16:02:25.160+10:00">
← <802.11:wapname>”voltaire”</802.11:wapname>
← <802.11:ssid>”voltaire”</802.11:ssid>
← <802.11:wapmac>010e2345ab94</802.11:wapmac>
← </dhcp:access>
← </aqr>
← END
```

Provide wireless access point information serving terminal

BEEP heartbeat profile

Registration item	Value
Profile identification	http://atis.org/ns/beep/hb (for example)
Messages exchanged during channel creation	none
Messages starting one-to-one exchanges	Empty BEEP message
Messages in positive replies	Empty BEEP message
Messages in negative replies	none
Messages in one-to-many exchanges	none

FLAP BEEP profile

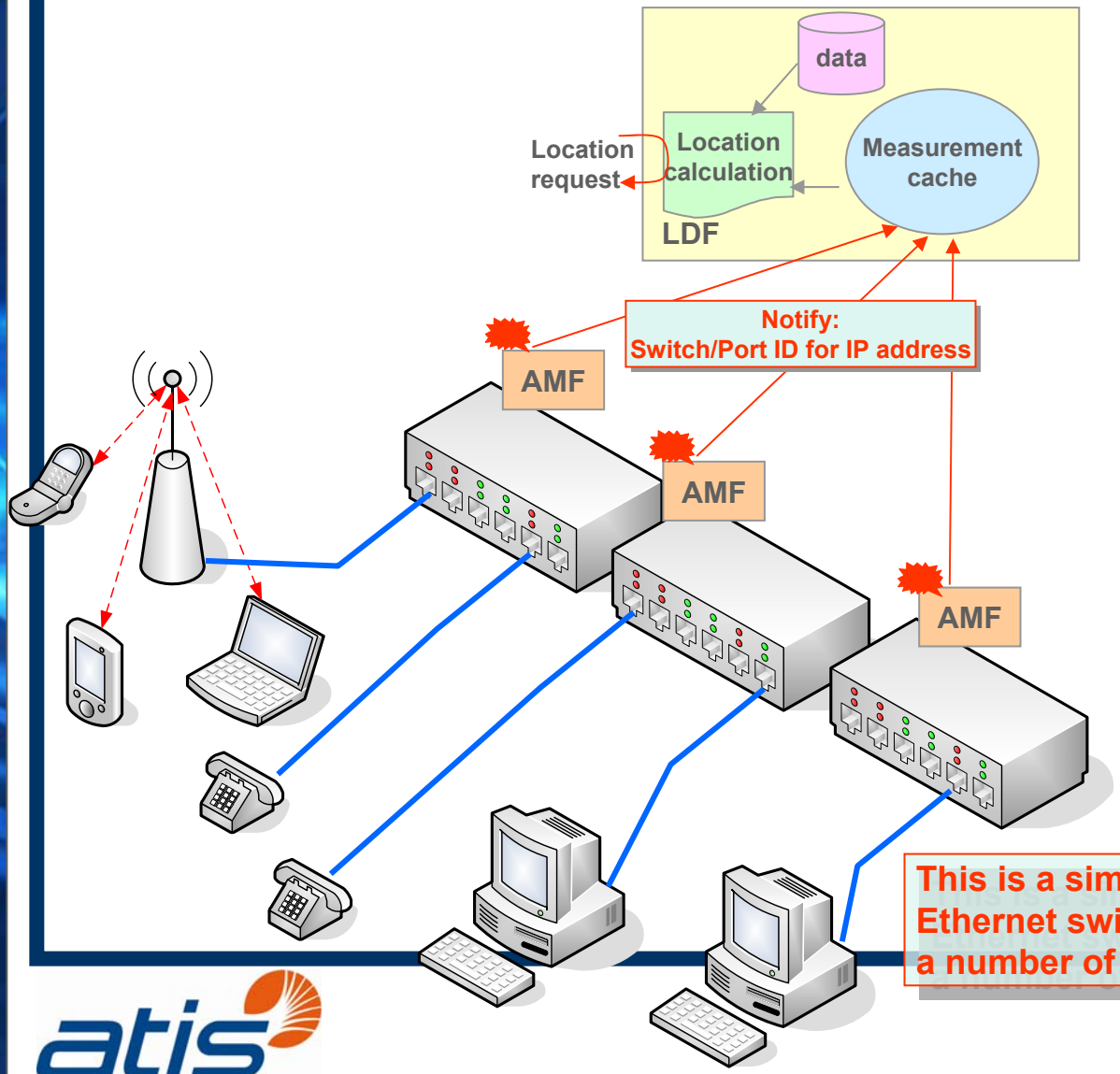
Registration item	Value
Profile identification	http://atis.org/ns/location/flap/beep (for example)
Messages exchanged during channel creation	MeasurementClass
Messages starting one-to-one exchanges	ntfy (Notify)
	aq (Access Query)
Messages in positive replies	syncr (Synchronize Response)
	aqr (Access Query Response)
Messages in negative replies	error
Messages in one-to-many exchanges	sync (Synchronize Request)

Examples

- Ethernet network
  - With example FLAP schema definition
- WiMAX network
- DSL network
- LTE network

Note that these are all examples and are not intended to be prescriptive in terms of how FLAP should be used for these technologies. It is ATIS' intention that the SDOs responsible for these technologies will be able to define their own XML specification under their own namespace.

Example – Ethernet switch network



- Cache with reporting approach.
- AMF associated with managed Ethernet switch reports a measurement each time it sees a new IP address present on each port.
  - Terminal identifier is IP address and measured parameter switch/port ID
- When location calculation is required for a specific IP address, the LDF obtains the corresponding switch/port information from cache.
- The LDF determines the location by reference to wiremap data which associates a switch port with a nominal location
  - Workstation location of a fixed port
  - Nominal floor or area of coverage of a wireless access point

This is a simple hypothetical example Ethernet switch location could be done in a number of ways!!

Example Ethernet Schema

This is an abbreviated example of the schema that a standards body would define in order to have their specific access technology supported under this framework.

The components in red are those that are specific to the technology. The rest of the schema specification is boilerplate or simply the definition for the introduced data types.

It allows the standards body to focus on what is important to its technology – i.e. what defines a target device (terminal) and what network measurements (access) are important in determining location.

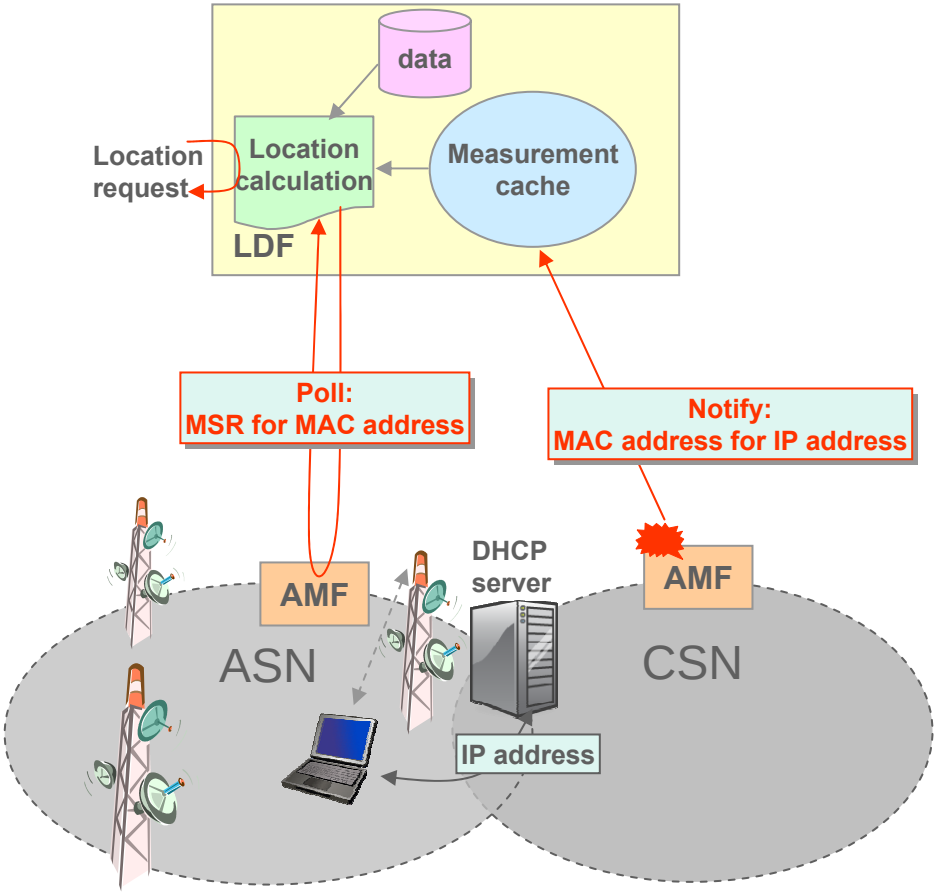
All of the connection management, query semantics, and procedures are defined in the common specification and can be used for all technologies.

```
<?xml version="1.0"?>
<xs:schema
   xmlns:flap="http://atis.org/ns/location/flap"
   xmlns:ethernet = "http://ieee.org/ns/location/flap/802.11"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
     :
  <xs:annotation>
   <xs:documentation>
    FLAP Schema for Ethernet measurements, based on the LLDP definitions
   </xs:documentation>
  </xs:annotation>
     :
  <!-- Terminal definition -->
  <xs:element name="terminal" type="ethernet:ethernetTerminalType"
          substitutionGroup="flap:terminal"/>

  <xs:complexType name="ethernetTerminalType">
            :
        <xs:element name="mac" type="ethernet:macAddressType"/>
            :
  </xs:complexType>

  <!-- Access definition -->
  <xs:element name="access" type="ethernet:ethernetAccessType"
          substitutionGroup="flap:access"/>
  <xs:complexType name="ethernetAccessType">
        :
        <xs:element name="chassis" type="ethernet:ethernetDataType"/>
        <xs:element name="port" type="ethernet:ethernetDataType"/>
        :
  </xs:complexType>
        :
</xs:schema>
```

Example - WiMAX

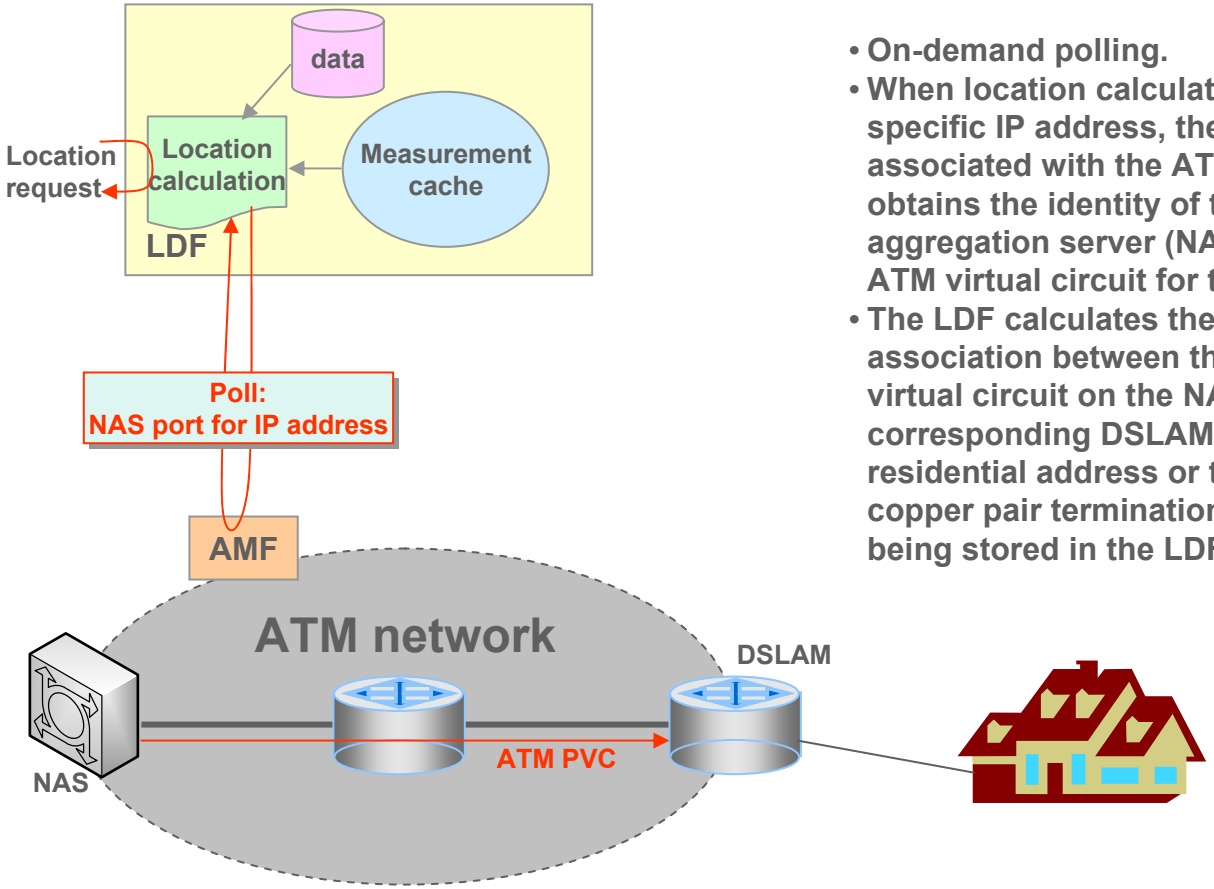


- Combination of cache with reporting and on-demand polling.
- AMF associated with DHCP server reports mobile station IP address to MAC address association as soon as it is allocated to a device. LDF caches the MAC-IP address association.
  - Terminal identifier is IP address and measured parameter is MAC address
- When location calculation is required for a specific IP address, the LDF obtains the corresponding MAC address from cache
- The LDF polls the AMF associated with the WiMAX access network to obtain the "Mobile Scanning Report" (MSR)* parameters associated with the MAC address
- The LDF calculates the location based on the received timing values and signal strengths in conjunction with data that specifies the locations of the base stations

** Mobile Scanning Report (MSR) parameters can be found in the IEEE specifications for WiMAX. They include the timing and signal strength measurements of multiple base stations as seen by the MS.*

This is a simple hypothetical example – WiMAX could be done in a number of ways!!

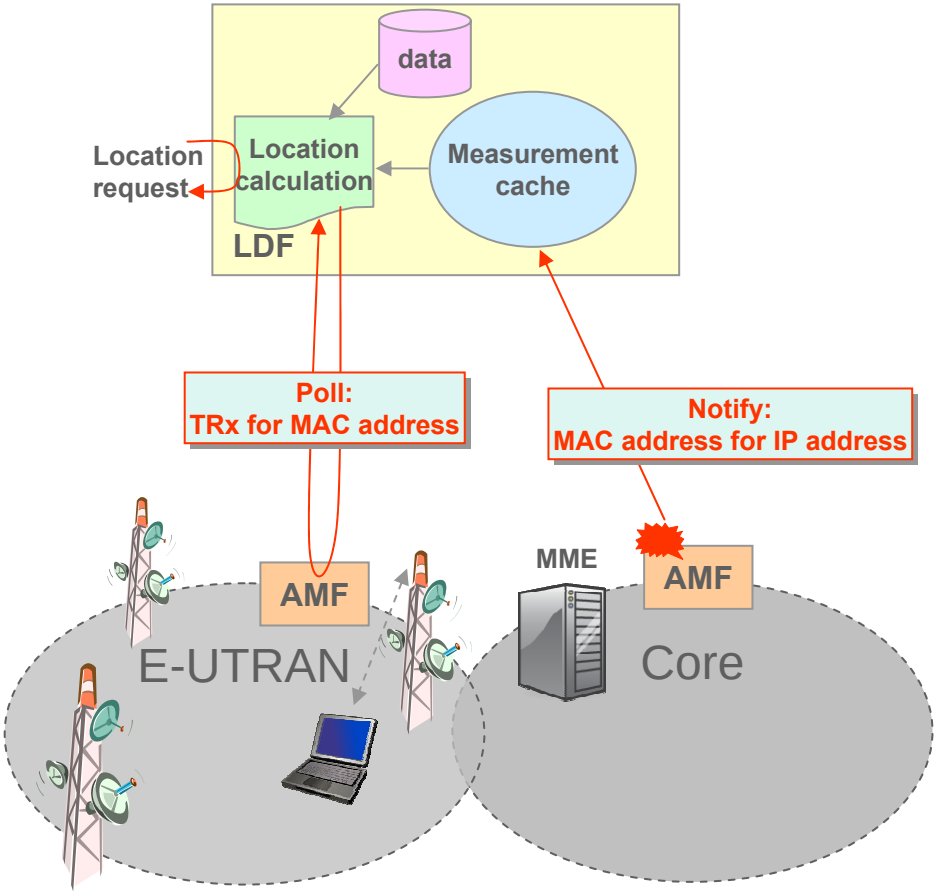
Example – DSL (PPoA)



- On-demand polling.
- When location calculation is required for a specific IP address, the LDF polls the AMF associated with the ATM access network and obtains the identity of the terminating network aggregation server (NAS) port hosting the ATM virtual circuit for that subscriber.
- The LDF calculates the location based on the association between the ATM permanent virtual circuit on the NAS port, the corresponding DSLAM termination, and the residential address or the corresponding copper pair termination. These associations being stored in the LDF database function.

This is a simple hypothetical example – there are numerous DSL scenarios!!

Example - LTE



- Combination of cache with reporting and on-demand polling.
- AMF associated with the core network reports mobile station IP address to MAC address association as soon as it is allocated to a UE. LDF caches the MAC-IP address association.
  - Terminal identifier is IP address and measured parameter is MAC address
- When location calculation is required for a specific IP address, the LDF obtains the corresponding MAC address from cache
- The LDF polls the AMF associated with the E-UTRAN to obtain the network timing and receive signal strengths (TRx) associated with the UE.
- The LDF calculates the location based on the received timing values and signal strengths in conjunction with data that specifies the locations of the e-nodeB base stations.

This is a simple hypothetical example – LTE is still under definition!!