WiMAX Networking Paradigms – Base for heterogeneous networking in IEEE802?

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Re:

Call for contributions for IEEE802.16 HET SG for session #79

Base Contribution:

n/a

Purpose:

Introduction of WiMAX networking paradigms to provide information for evaluating applicability to heterogeneous networking in IEEE802

WiMAX Networking Paradigms

Base for heterogeneous networking in IEEE802?

2012-05-09

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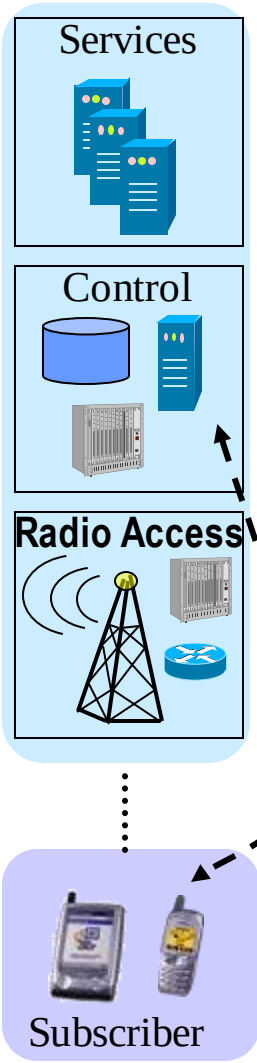
NSN

ToC

- Where is the value in the networks
- Mobile Network Architectures
- WiMAX Network Reference Model
  - Building blocks
  - Reference points
  - Data path
- Control plane functions
- Interworking with 3GPP
- Mobile WiMAX Specification Framework
- Leveraging WiMAX Network Specifications

The Mobile Network Operator Value Chain



← **Profit Center**

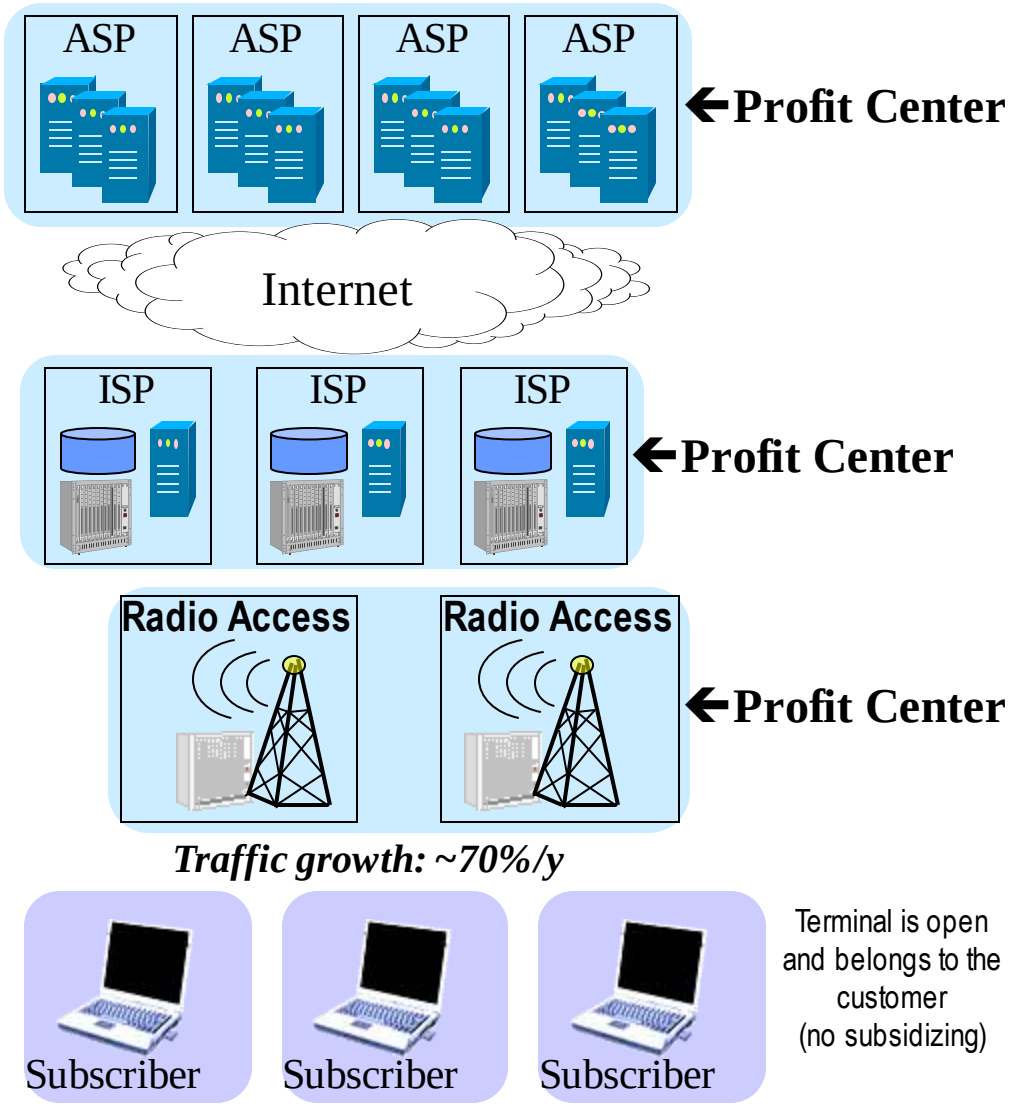
← **Profit Enabler**

← **Cost Center**

Tight coupling (and subsidizing) of terminals is key to profits

- Commercial operations tend to focus onto increasing their profits
- Increasing the customer base is one dimension of increasing profits, introduction of new services is the other dimension.
- The profits acchievable by new services depend on the relation between customer value (price) and the cost for realizing the service
- Management will allways focus on high value while keeping the expenses for the realization small
  - Best example: SMS
- The radio access network is adding most to the cost, hardly anything to the profits.
  - Bandwidth is considered as a scarce resource
  - Results in traffic growth of ~7%/year

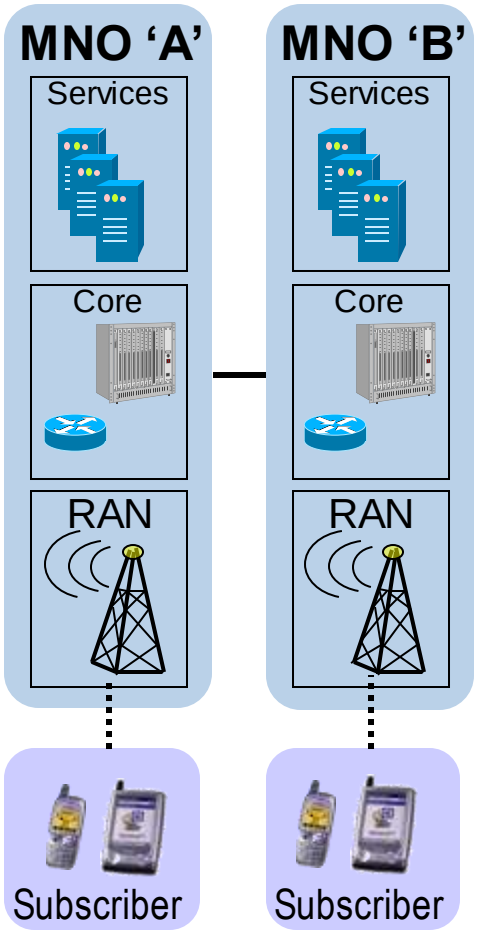
The Broadband Operator Value Pattern



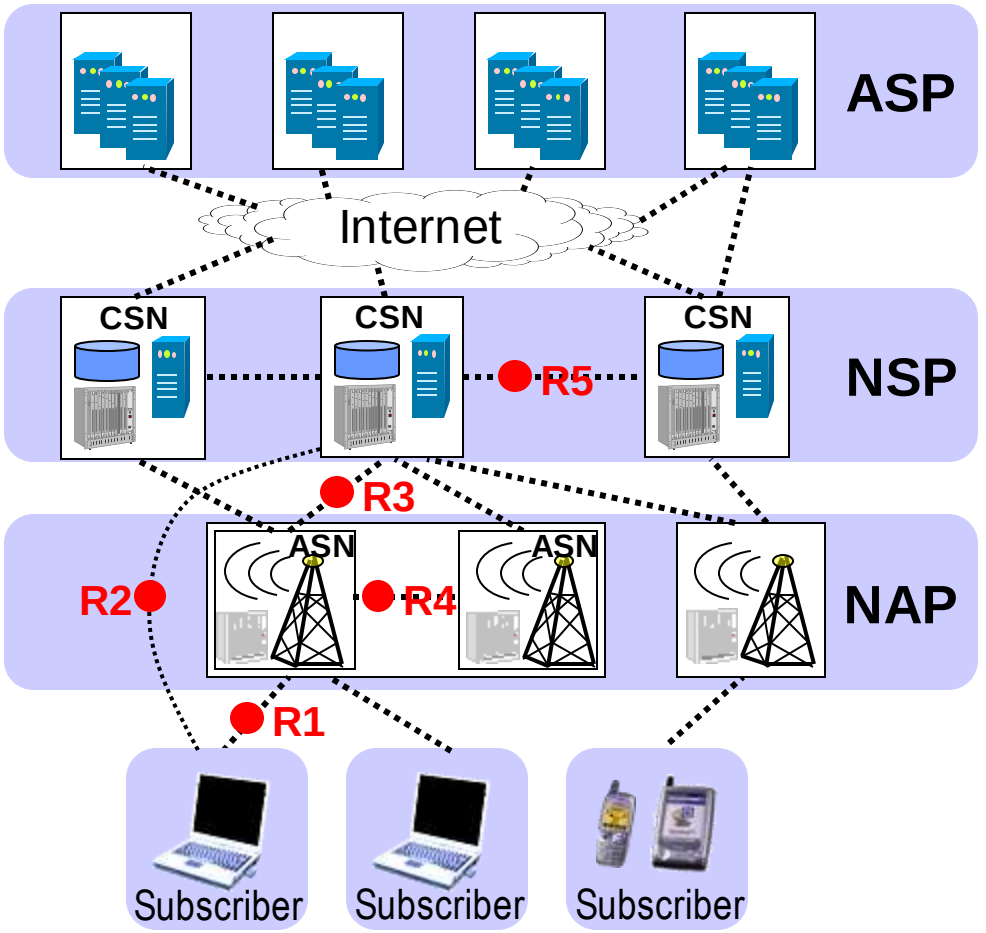
- The Internet introduced a major change in the value creation of network operators by allowing everybody to provide services to end costomers.
- Application service provision, connectivity service provision and access service provision have become independent businesses in competitive markets.
- This led to the pervasive proliferation of services over broadband pipes.
- There is a new kind of mobile service provider coming up, with services tied to the device (iOS & Android environment)

Mobile Network Architectures

Legacy Architecture



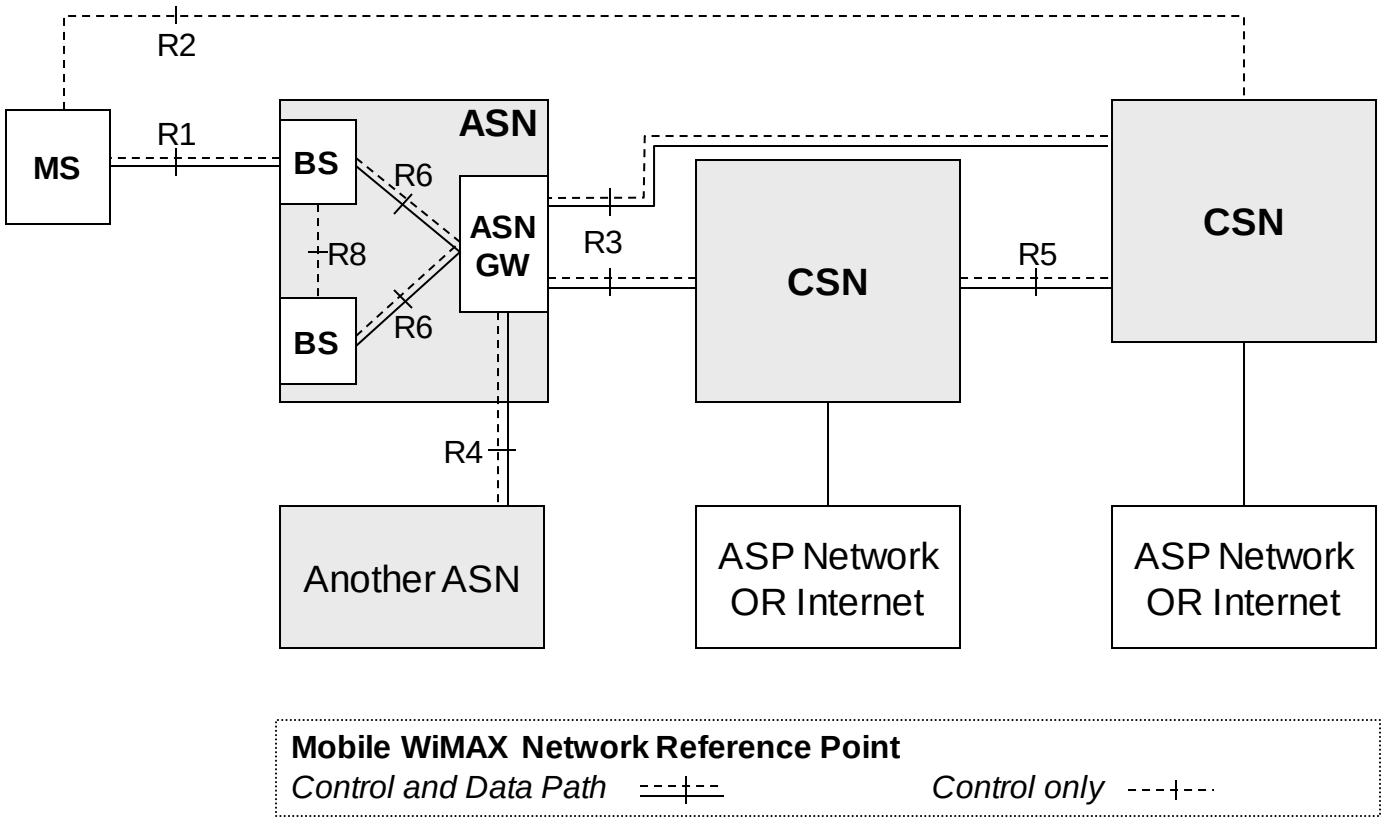
Mobile WiMAX Network Architecture



Entities of the WiMAX Network Reference Model

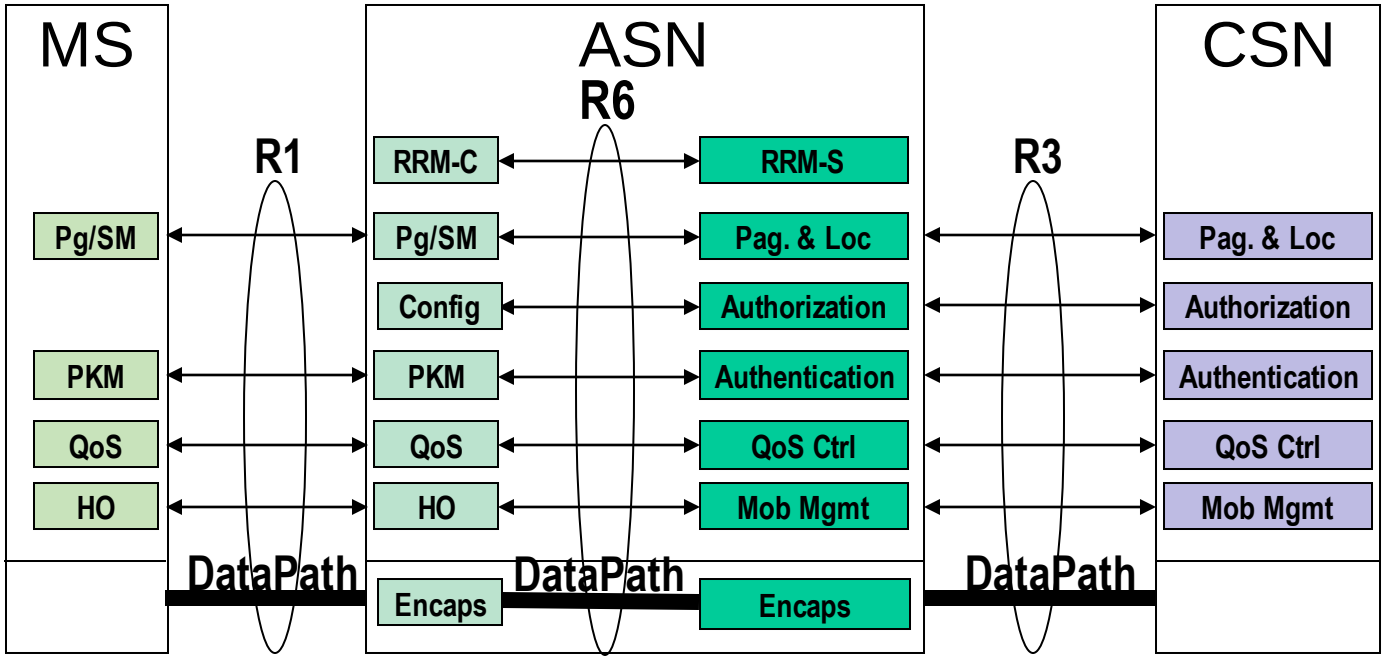
- CSN: Connectivity Serving Network
  Logical representation of the functions of a NSP, e.g.
  - Connectivity to the Internet, ASPs
  - Authentication, authorization and accounting
  - IP address management
  - Mobility and roaming between ASNs
  - Policy & QoS management based on a SLA
- ASN: Access Serving Network
  Logical representation of the functions of a NAP, e.g.
  - 802.16 interface w/ network entry and handover
  - Radio Resource Management & Admission ctrl.
  - L2 Session/mobility management
  - QoS and Policy Enforcement
  - Mobile Access Gateway (MAG)
  - Forwarding to selected CSN

Mobile WiMAX Network Reference Model



MS: **Mobile subscriber station**
ASN: **Access Serving Network**
CSN: **Connectivity Serving Network**

WiMAX Reference Points

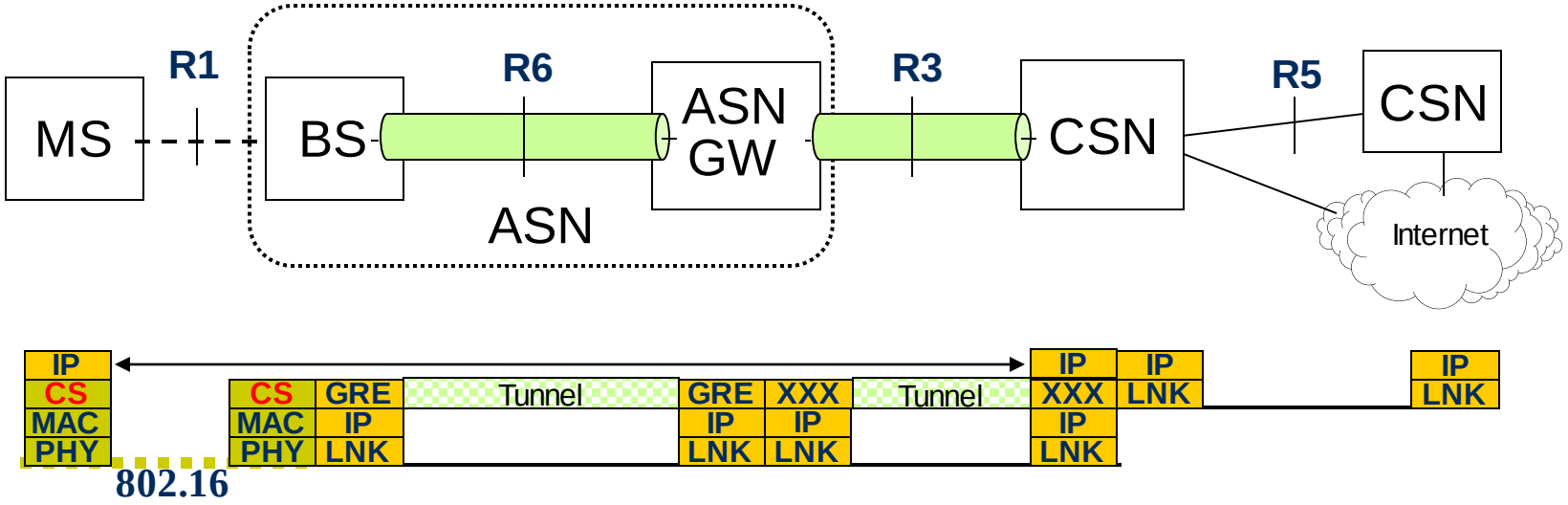


- NRM Reference Points represent a bundle of protocols between peer entities
  - Similar to a real IP network interface
- The implementation of a particular protocols over a reference point is optional
  - If a particular protocol is present, it must conform to the WiMAX specification

WiMAX Networking Considerations

- Interoperability enforced via reference points without dictating how vendors implement edges of reference points
- Introduces the notion of functional entities – which can be combined or decomposed by vendor and/or operator
- No single physical ASN or CSN topology is mandated – allowing room for vendor / operator differentiation
  - Standardized decomposition of ASN into BS and ASN-GW
  - CSN is fully kept opaque; no aim for standardized implementations
- Mobility is mainly achieved by ASN anchored MM (R6, R4)
  - R3 mobility (MIP) is used for path optimization, network sharing and wide-area nomadicity, but not for seamless handover.
- AAA and Roaming is based on IETF EAP supporting any kind of ‘credentials’ (Password, Certificate, SIM & U-SIM)

Anchoring of the Customer/Terminal in the CSN



- All user traffic is tunneled between MS and CSN
  - The 802.16 Convergence Sublayer (CS) provides tunneling over the air.
  - GRE tunneling is applied in the ASN when R6 is exposed
  - Either MIP tunneling or other generic tunnels in the case of Simple IP networks are used on R3

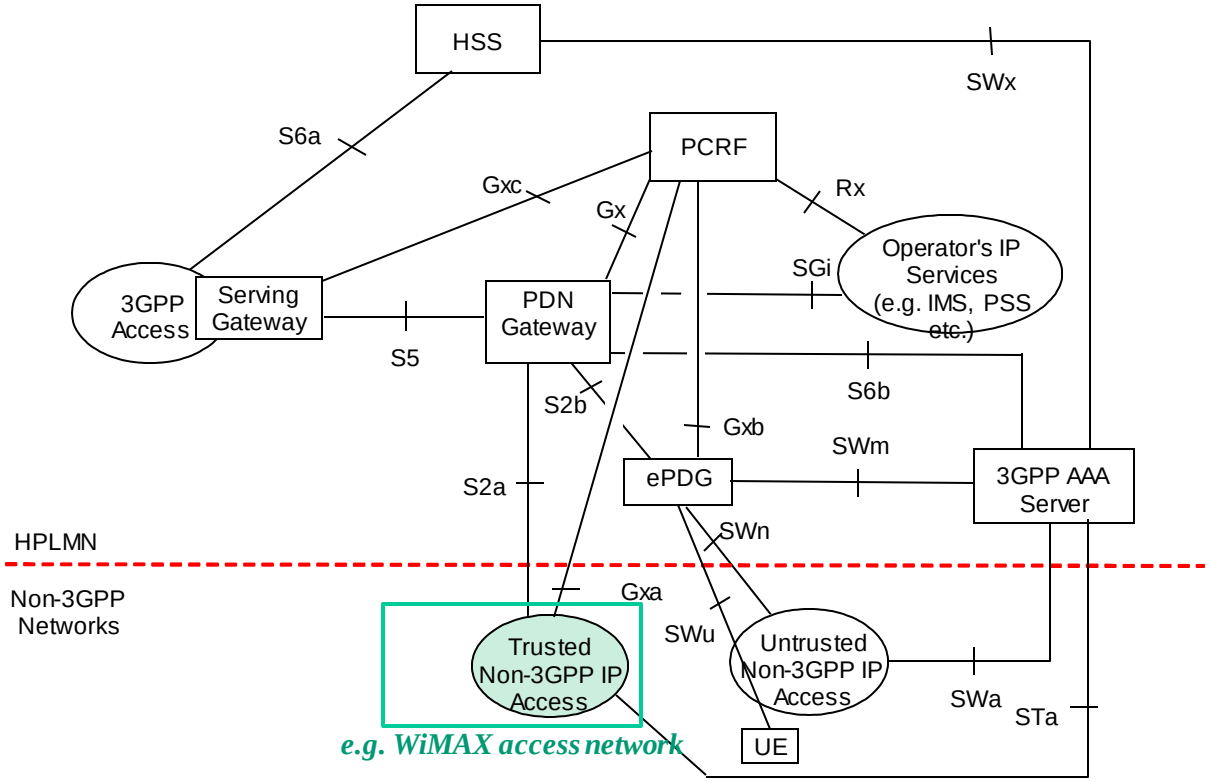
Main Control Plane Functions

- Network entry discovery and selection
  - MS scans and detects available WiMAX access; NAP selection
- Authentication, Authorization and Accounting (AAA)
  - Network access authentication and authorization based on the home CSN's subscriber profile; accounting procedures
- Network entry and exit
  - Procedures for establishing initial connectivity with a WiMAX network and leaving the network gracefully.
- IP addressing
  - Assignment of IP address to MS via DHCP, MIP/AAA or stateless autoconfiguration for IPv6.
- Security
  - Distribution of keying material within the ASN and CSN; reference point protection; control of air interface security

Control Plane Functions (2)

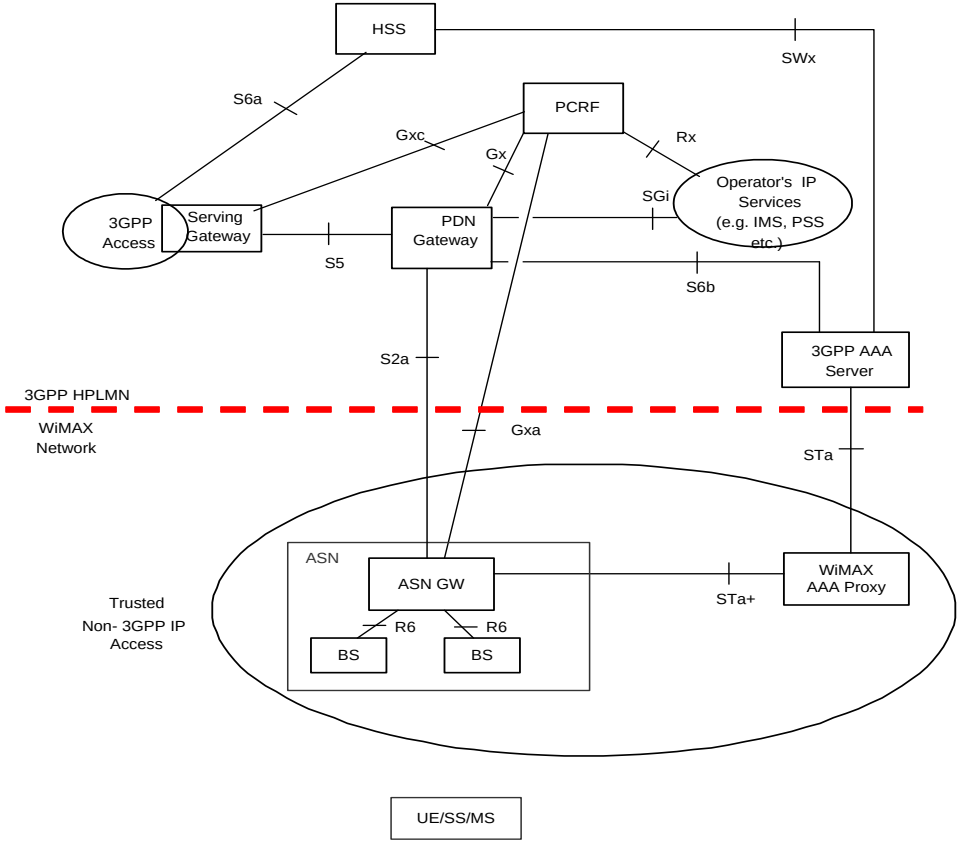
- QoS and Service Flow Management
  - Creation, modification and deletion of service flows; installation of static QoS profiles in the ASN
- ASN anchored mobility management
  - Handover support of the radio link between base stations within the same ASN or between ASNs
- CSN anchored mobility management
  - Mobility management based on Proxy Mobile IP between ASNs where the mobility anchor is in the CSN
- Radio Resource Management
  - Support function within the ASN to increase deployment efficiency of available radio resources
- Paging and Idle Mode support
  - Control procedures in the network to support the 802.16 functions for paging, location update and entering/exiting idle mode.

Heterogeneous Networking with 3GPP



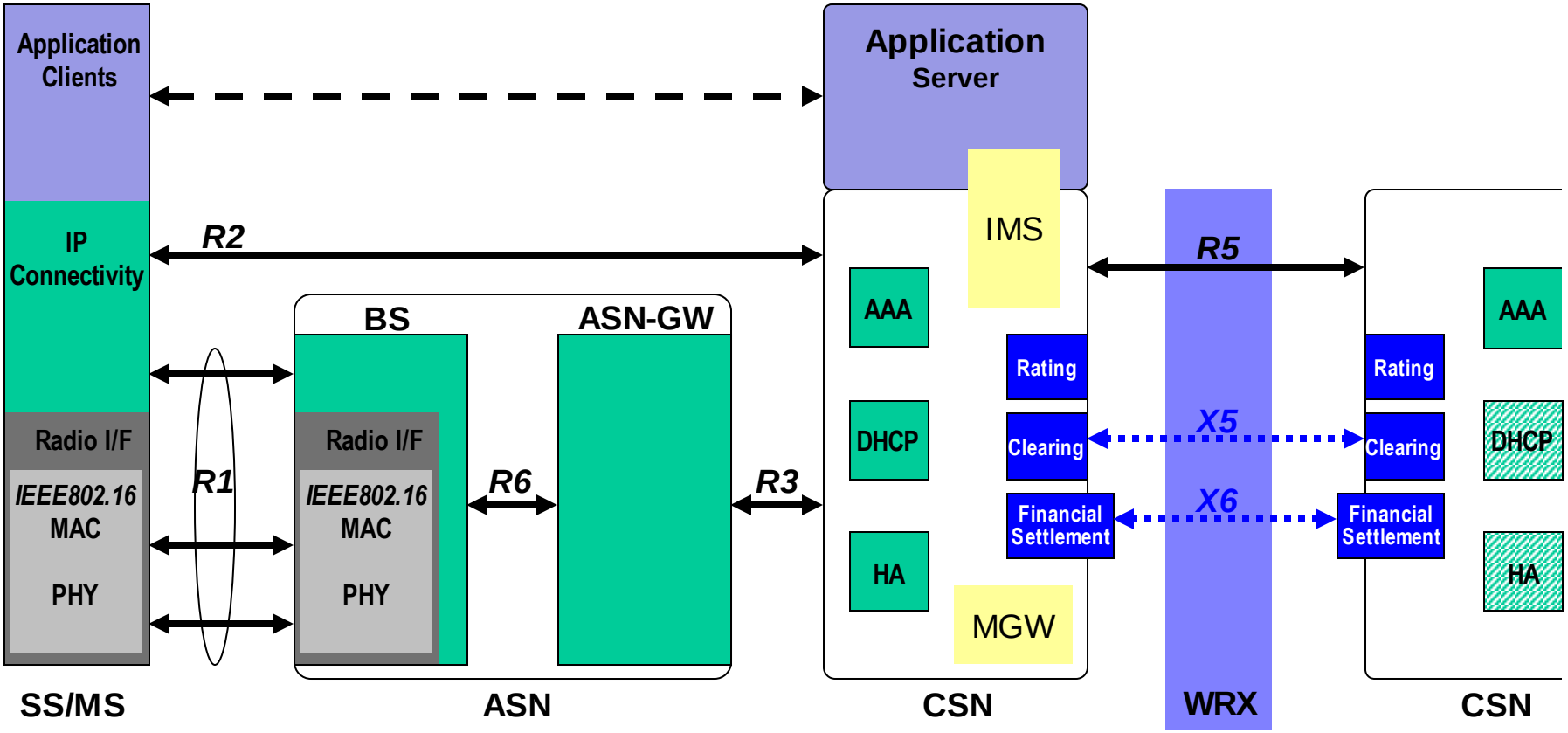
- 3GPP standardized the EPC architecture with access to the 3GPP LTE core network through other than 3GPP radio technologies, e.g.:
  - WiMAX
  - Cdma (mobile cellular networks following the 3GPP2 specifications)
  - WiFi

WiMAX Interworking with 3GPP EPC



- Wi-Fi is currently following a similar approach (SaMOG)
- While well suited for 3GPP operators, others may prefer other kind of solutions for heterogeneous networking.

Mobile WiMAX Specification Framework



- WiMAX provides 'generic' network specifications for:
  - User Network Interface
    - Authentication, IP-Configuration, Provisioning
  - Network Network Interface
    - Network sharing, Roaming

Leveraging WiMAX Specifications for heterogeneous networking in IEEE802

- While somewhat specific to IEEE802.16, WiMAX network specifications can be leveraged to define generic network interfaces across all IEEE802 technologies
  - User authentication and device provisioning
  - QoS and policy control
  - Network sharing and Roaming
  - (Mobility, when needed!)