Understanding Relevant Technologies

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Topics

- Public Safety LMR
- Satellite
- Broadband (WiMax/WiFi)
- Mobile Broadband (WCDMA/CDMA)

Wireless Access Direction

- Broadband to Edge
- RAN Agnostic
- IP Based
- Flat Architecture
- Core Based on IMS
- Harmonized ASN/CSN
- WiMax, WiFi, HDPA, EVDO
- SDR
- Interoperability via IP

LMR Radio System Types

- LMR Radio System Types
  - Conventional
  - Trunked
  - Hybrid (control station repeaters)
- All of the systems employed by public safety are for mobile communications
- Utilize a mosaic of frequencies
- All LMR Radio Systems are **Narrowband**
- No Interoperability Standard (P25, Opensky)

Interoperability Bridges

SR- 3001 Radio Interoperability System

Infinimux G4

INTEROP9

TRP1000 Transportable Radio Interconnect

Motobridge Soft Switched Radio Network

NFI Gateway

Cisco IP Interoperability and Collaboration System "IPICS"

ACU1000

LMR Direction

- Continued Proprietary System Approach
- Voice Communications
- Limited Data
- Convergence on 700/800 MHz
- 4.9GHz
- Nationwide Build-out required
- Multiple Devices still needed for interoperability

Satellite Communication

- Broad coverage area
- Independent of Terrestrial Facilities *
- Various Satellite Architectures
  - Bent Pipe
  - Partial Processing
  - Full Processing (RSA)
- Satellite Classifications
  - Low Earth Orbit (LEO)
  - Medium Earth Orbit (MEO)
  - Geosynchronous Orbit (GEO)
- Mobile (MSS) and Fixed (FSS) platforms
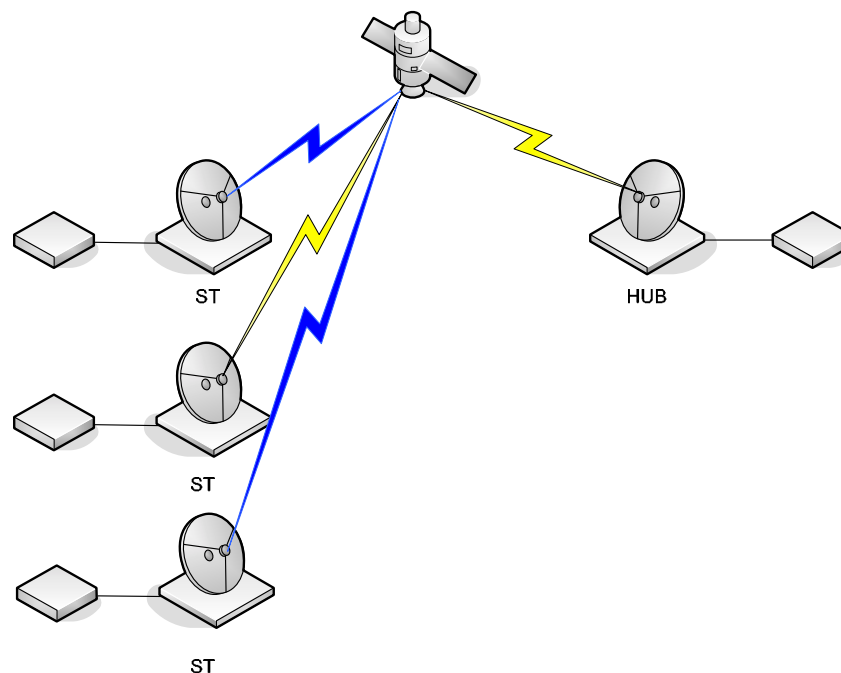
Bent Pipe

ST HUB
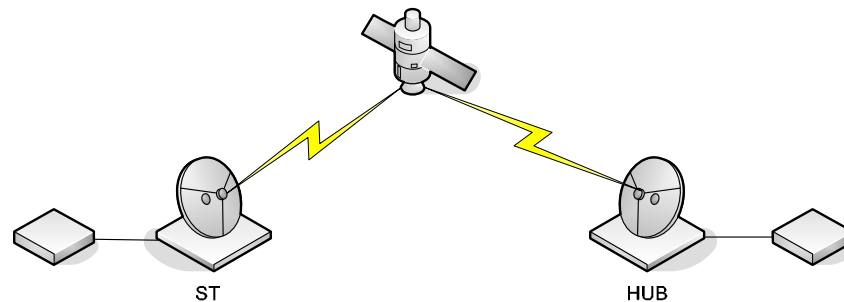
- Point to Point Connection
- Simple Structure
- RF Pipe
- No Processing at Satellite

Regenerative Satellite Architecture (RSA)

- Direct ST to ST
- On Board Switching
- Multiple Gateway
- DVB-S Downlink
- DVB-RCS Uplink
- Facilitates Broadband IP Network in Sky

ST

ST

ST

HUB

Satellite Direction

- Satellites will be a broadband conduit *

- IP

- Wideband payloads

- Mesh Network

- Multibeam, regenerative satellite

* Transponder limited

Connectivity Services Network (CSN)

- IP Based

- Broadband to Edge

- Core Based on IMS

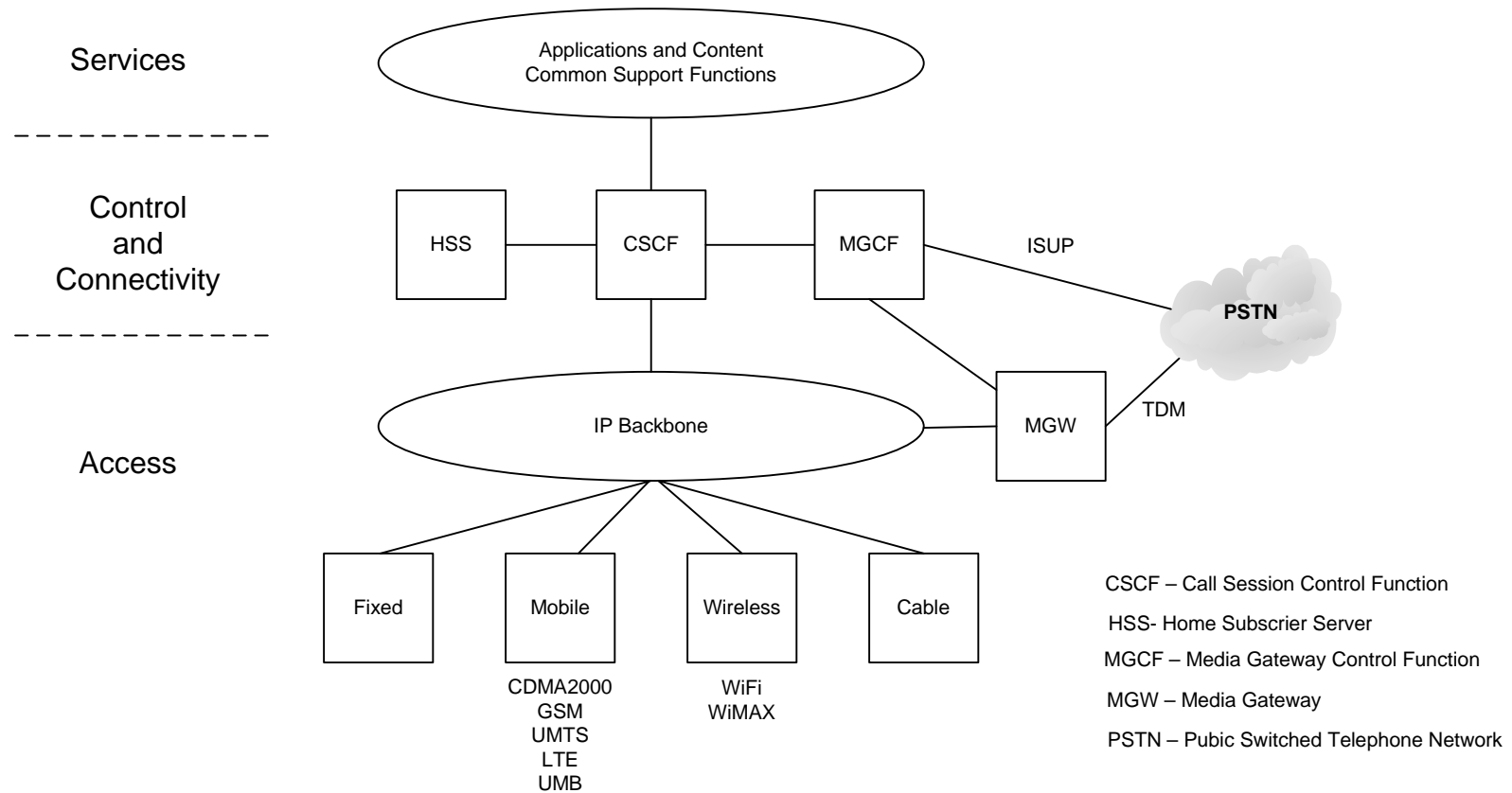- Flat Architecture

- ASN (RAN) Agnostic

IMS (IP Multimedia Subsystem)

- ## What is IMS?

  - IMS is the standard framework for implementing multi-media services over IP

  - Defined by 3GPP/3GPP2

  - Access Agnostic

  - SIP Based

  - Backward compatible with traditional TDM networks through a Gateway

- ## Therefore IMS enables the convergence of data, voice and various network topologies using a IP based infrastructure

IMS Architecture

Services

Control
and
Connectivity

Access

Applications and Content
Common Support Functions

HSS — CSCF — MGCF — ISUP

PSTN

IP Backbone — MGW — TDM

Fixed   Mobile   Wireless   Cable

CDMA2000
GSM
UMTS
LTE
UMB

WiFi
WiMAX

CSCF – Call Session Control Function

HSS- Home Subscrier Server

MGCF – Media Gateway Control Function

MGW – Media Gateway

PSTN – Pubic Switched Telephone Network

Wireless Mesh Network

- A wireless mesh network is an array of wireless devices that can communicate to each other via multiple paths
- Components of the wireless mesh network may or may not be the same ASN or frequency. (ie Cellular and WiFi)
- Utilizes IP (mobile/simple)
- Resiliency with added overhead

Internet
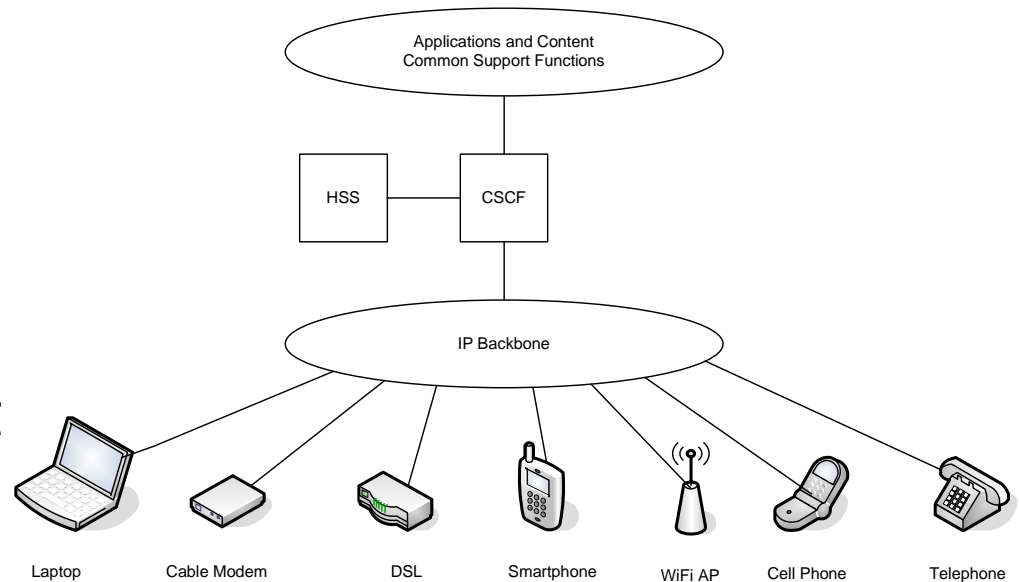
Access Points

Edge Devices

Mesh
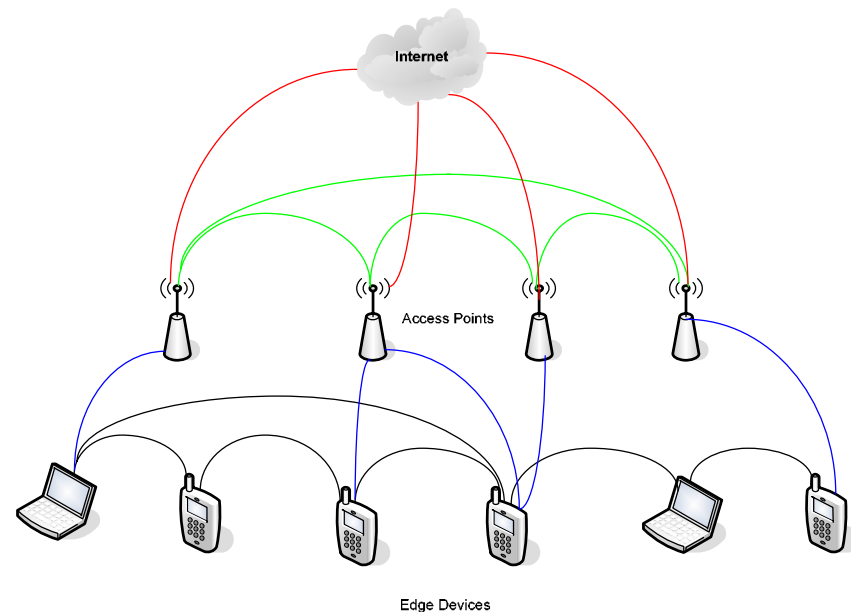
Wireless Star Network

- Traditional Configuration
- Concentration which all nodes or devices directly connected to a common element
- A link failure to a node will isolate that node from the rest of the network computer. All other nodes will continue to operate as normal.
- Failure at central, common, node will disrupt network

Star
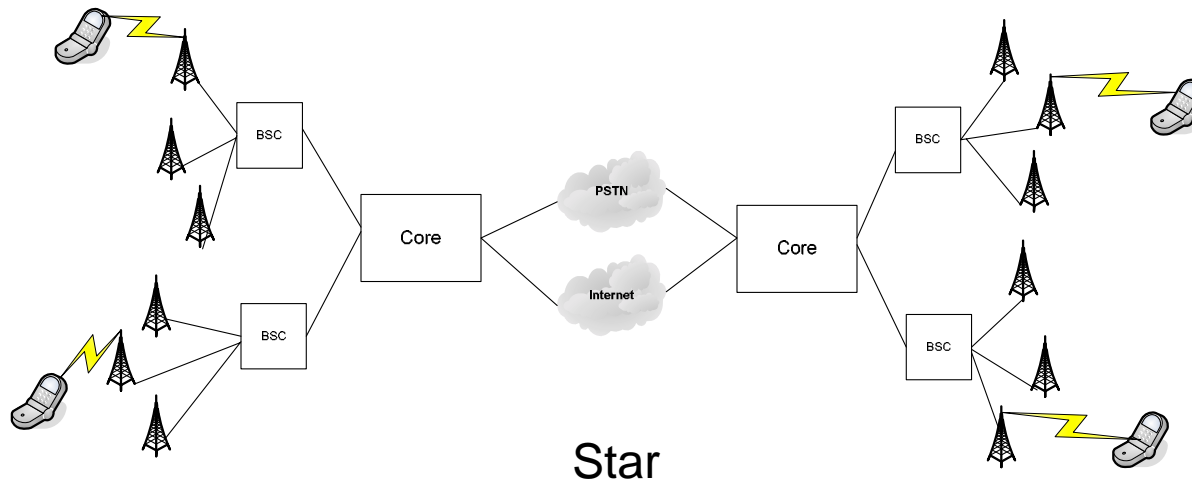
Flat Network

- A Flat network utilize IP to achieve connectivity

- Provisioning and Management of end devices enhanced

- Components of the flat network may or may not be the same ASN. (ie CDMA and WiMAX)

- Utilizes IP (mobile/simple)

- Large LAN

- Resiliency

Applications and Content
Common Support Functions

HSS   CSCF

IP Backbone

Laptop   Cable Modem   DSL   Smartphone   WiFi AP   Cell Phone   Telephone

Flat

ASN

- WiMAX (802.16, 802.16e)
- WiFi (802.11a,b,g,n)
- UMTS (WCDMA/HSDPA/HSUPA)
- CDMA (1xRTT/EVDO)
- UMA/FMC
- UMB
- LTE

WiMAX

- Broadband to the Edge (last mile)
- Standard 802.16e
- Utilizes licensed and unlicensed spectrum
  - MMDS in US
- Designed for a large coverage area.
- TDD Access Method
- OFDM – orthogonal frequency division multiplexing
- MIMO
- NLOS
- DL – 70Mbs, UL 70Mbs
- Mobile IP

WiMAX

- Advantages
  - Broadband to Edge (last mile)
  - Mobile
  - Standard approved and recognized
  - Complimentary to existing ASN's
- Disadvantages
  - Needs to be built

WiFi

- WiFi is a wireless LAN based on the 802.11 standards
- Wi-Fi uses unlicensed spectrum.
  - 802.11 b/g (ISM)
  - 802.11 a (UNII)
  - 802.11 n (ISM/UNII)
- Designed for smaller coverage areas..
- WiFi is now a standard feature for laptops, computers, and PDA's.
- The convergence of 802.11 with wireless mobility has been described as the real killer application.

WiFi

- **Advantages**
  - Wireless LAN
  - Established Standard
  - Universally Accepted (Laptops, PDA)

- **Disadvantages**
  - Limited Coverage from Access Point
  - Security
  - Unlicensed Frequency

UMTS

- UMTS - aka W-CDMA
- IMT2000
- Deployed world wide
- Utilizes GSM Core network (r99)
- Different ASN (RAN) than GSM
- Requires 10MHz (5MHz Tx/5MHz Rx)
- HSDPA   (DL-14.4Mbps)
- HSUPA (UP -5.8Mbps)
- Circuit and IP Core

UMTS (HSPA)

- Advantages
  - Established Standard
  - Universally Accepted

- Disadvantages
  - Overlay Network
  - RAN upgrade for HSPA
  - Multiple Core Network upgrades
  - Not Backward Compatible to GSM

EVDO- Rev A

- Enhancement to EVDO –Rev 0
- IMT2000
- Deployed world wide
- Utilizes CDMA2000 Core network
- Different ASN (RAN) than CDMA2000 (1xRTT)
- Requires 2.5MHz (1.25MHz Tx/1.25MHz Rx)
- Rev 0 DL – 2.1Mbps/UL – 153kbps
- Rev A DL – 3.1Mbps/UL – 1.8Mbps
- Packet Based (IP)

EVDO – Rev A

- ## Advantages
  - – Established Standard
  - – Spectral Efficient
  - – Backward compatible to EVDO –Rev 0 and 1xRTT

- ## Disadvantages
  - – RAN and PDSN upgrade for Rev A
  - – Overlay Network for 1xRTT

Ultra Mobile Broadband (UMB)

- OFDM /EVDO Rev C
- CDMA Technology Path
- Different RAN than EVDO Rev A
- Packet (IP)
- UMB peak data rates
  - DL - 280Mbps
 - UL to 68Mbps
- Standard Still in Development

Long Term Evolution (LTE)

- High Speed OFDM Packet Access (HSOPA)
- Super 3G and 3.99G
- GSM/UMTS Technology Path
- New air interface system and incompatible with legacy WCDMA
- 1.25MHz to 20MHz Flexilble bandwidths(1.25Mhz increment)
    - 100Mbps DL -20MHz
    - 50 Mbps UL – 20MHz
- FDD and TDD
- Packet (IP)
- Standards still in development

Wireless Mobility Paths
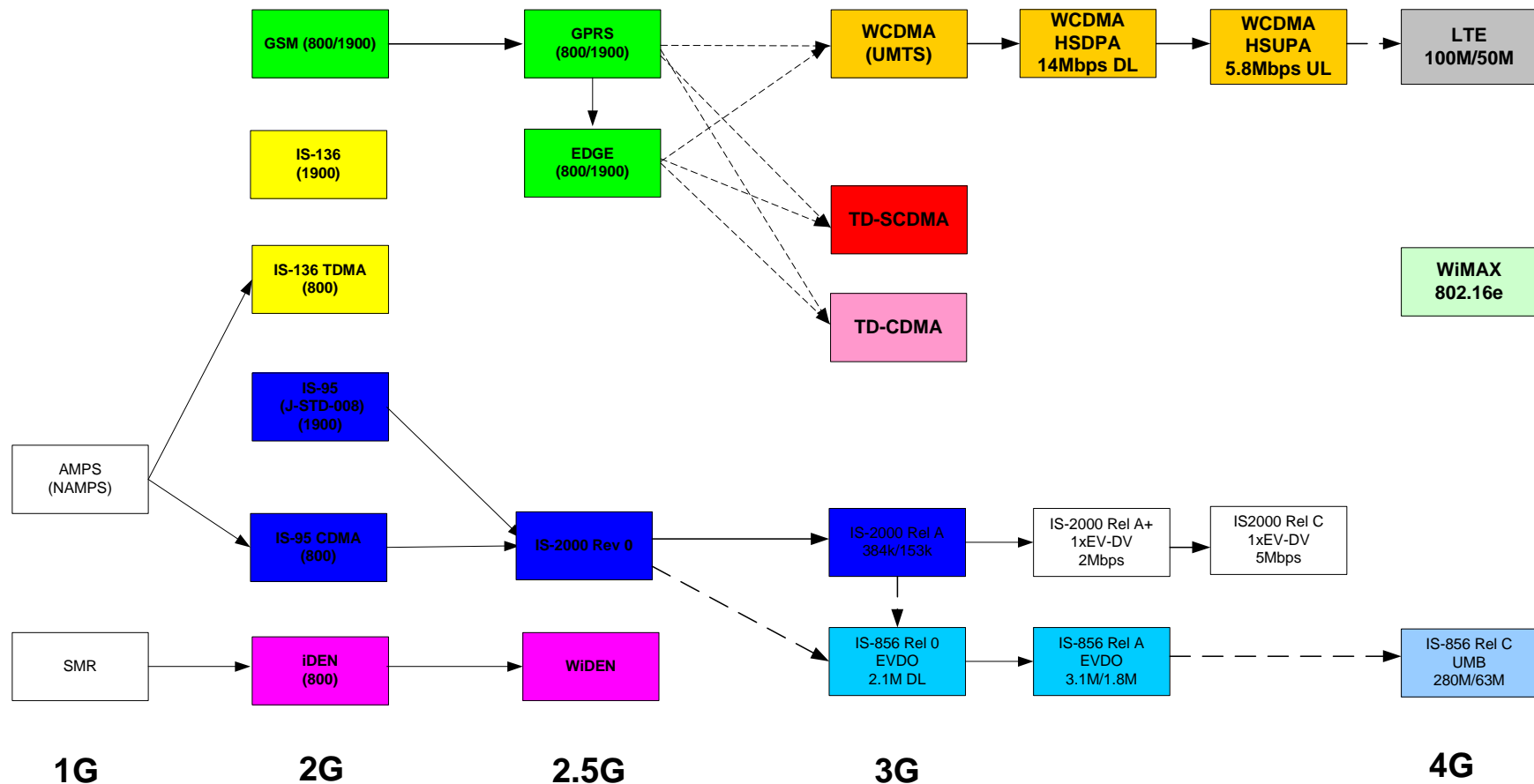
Software Definable Radio (SDR)

- SDR technologies utilize software to define ASN Modulation

- SDR's are being commercially deployed (FCC)

- Allows one ASN platform to utilize multiple technologies

- Modulation format can be altered quickly provided its in the waveform library

- Future proofing part of ASN

- SDR requires a PA and filters that are band specific

- Harmonization of the ASN Mosaic is possible with SDR

Fixed Mobile Convergence (FMC)

- Broadband to the Edge or anywhere
- Triple or Quad Play
  - Fixed Telephony
  - IP Telephony
  - Internet Access
  - Video
- Uses licensed and unlicensed spectrum
- Unlicensed spectrum technologies ie WiFi and Bluetooth
- Consistent user experience for their mobile voice and data services when transitioning between networks.
- Roam and handover seamlessly between private unlicensed wireless networks like GSM and LANs using a dual-mode Mobile phone.
- Enables mobile operators to deliver voice, data and IMS/SIP applications to mobile phones on any access networks.
- Femto cell

FMC
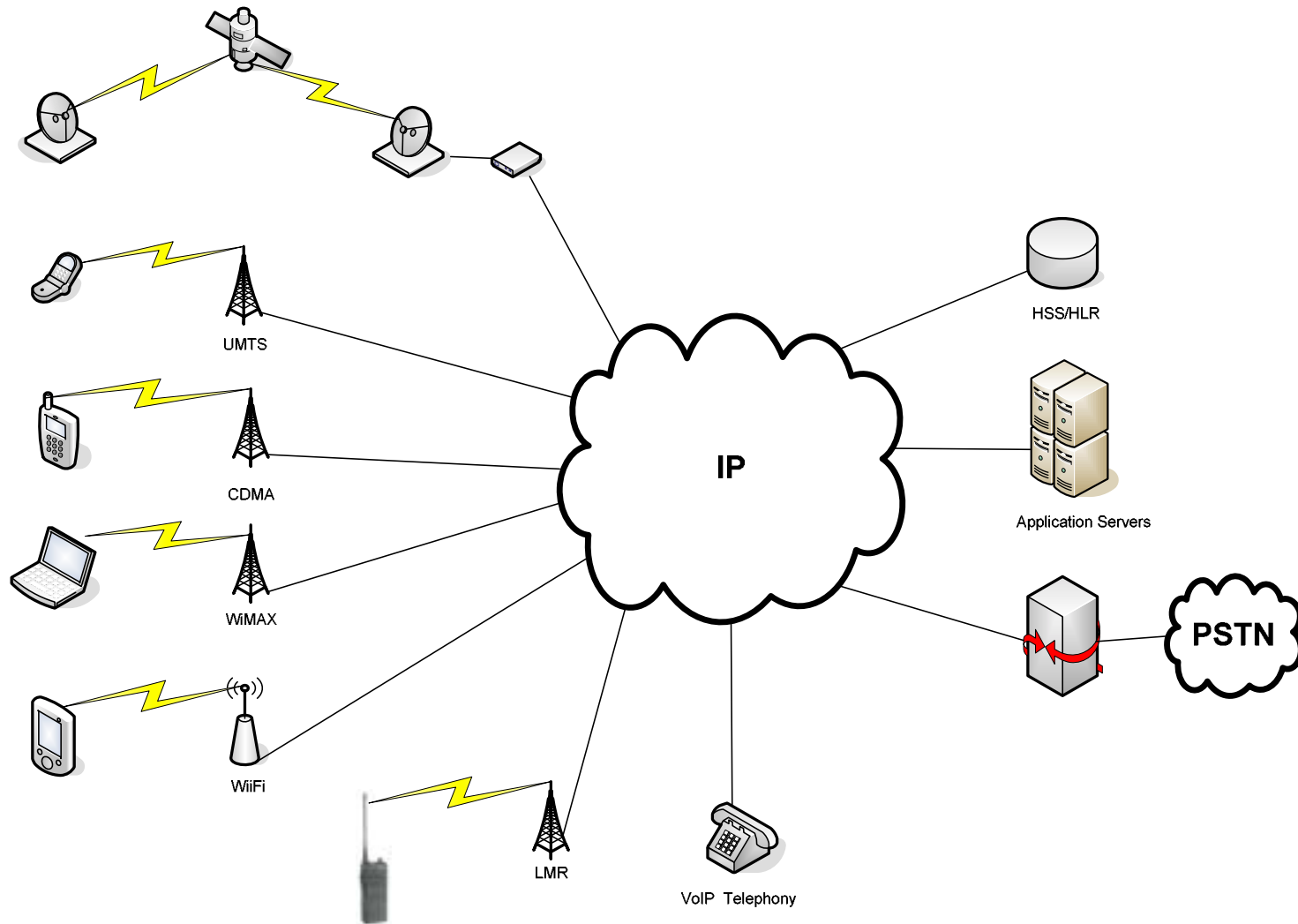
Summary

- Broadband
- RAN Agnostic
- IP Based
- Flat Architecture
- Core Based on IMS
- Harmonized ASN/CSN
- WiMAX, WiFi, EVDO,HSPA
- SDR
- Complimentary ASN's meeting user requirements
  - Government (DoD*, Federal, State, Local)
  - Private (Business, Consumer)
- Commercial Wireless can deliver Interoperable IP Broadband Today