



# CMP4204 Wireless Technologies

## Lecture 09

### 802.16 WiMAX, HiperLAN and HiperWAN



# HiperLAN

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

diarmuid@obriain.com

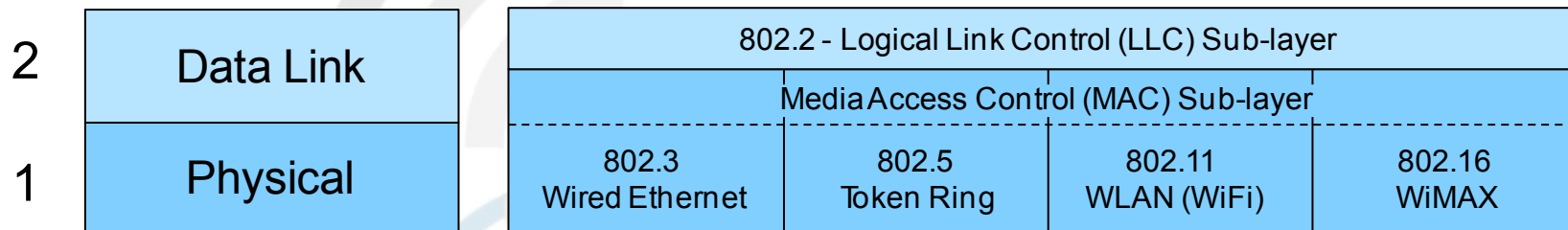


- IEEE Standard 802.16-2001, completed in October 2001 and published on 8 April 2002.
- Defines the WirelessMAN PHY and MAC air interface specification for wireless MAN.
- Frequencies from 10 to 66 GHz.
- 802.16d Fixed Broadband Wireless Access (FBWA).
- 802.16e Mobile WiMAX.
- 802.16m WiMAX2, 4G certified by ITU-R.

# WiMAX in the OSI PHY and Data Link Layers

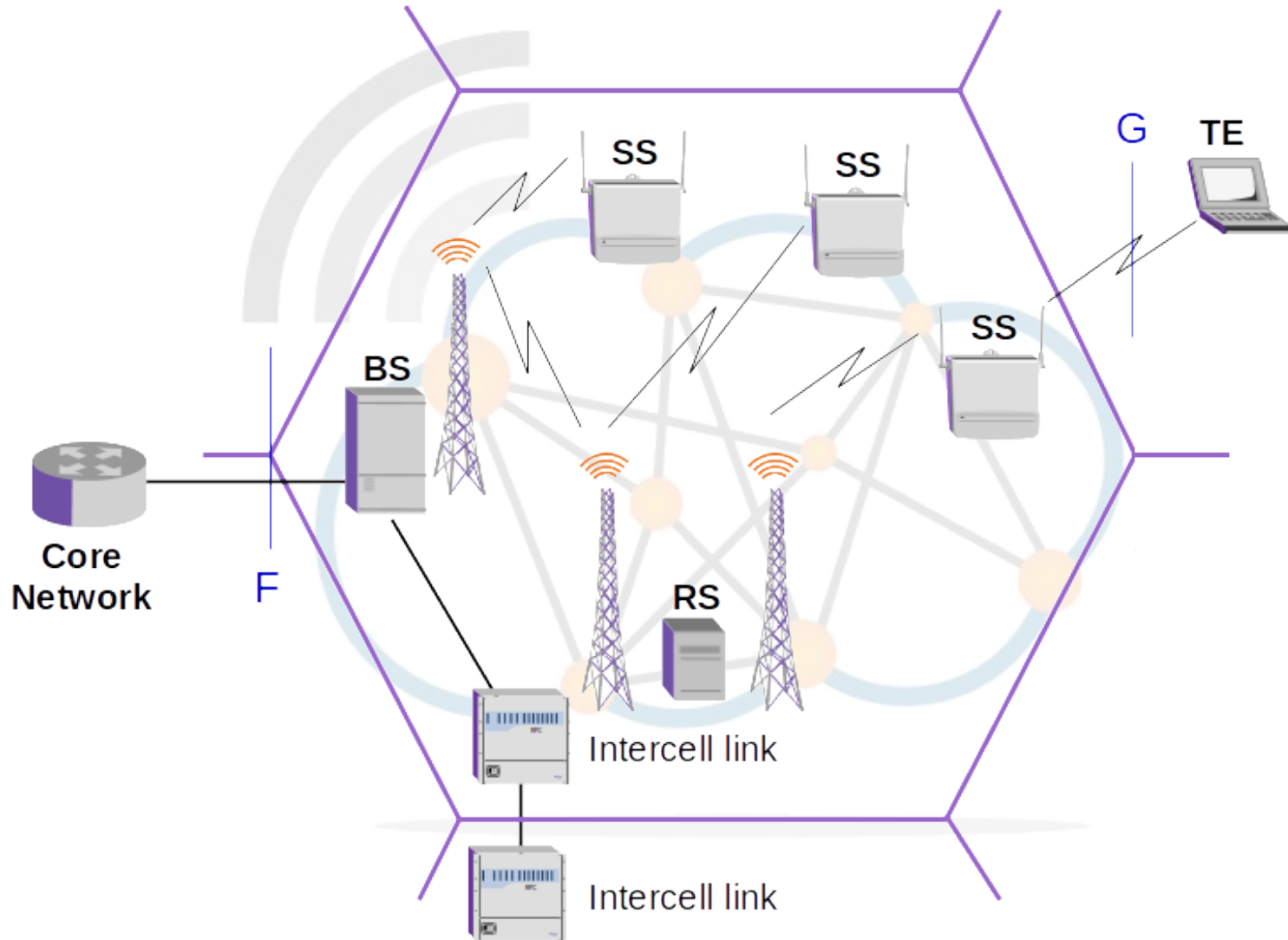


OSI  
Layer



- Uses IEEE 802.2 Logical Link Control (LLC) like wired Ethernet WiFi, Token Ring etc..
- Common appearance to the IP network layer.

# FBWA Cell Architecture

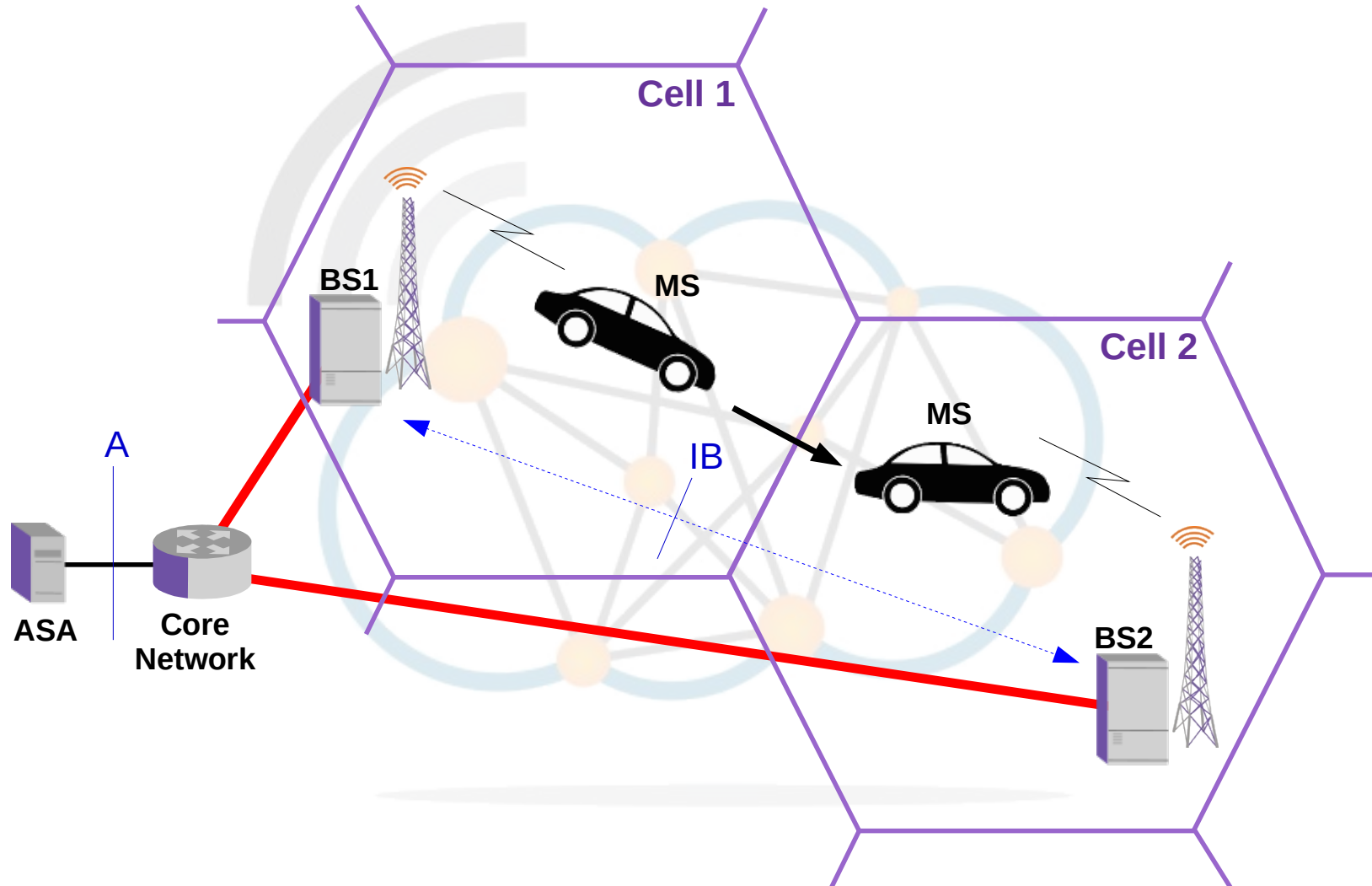


# Fixed Broadband Wireless Access



- Each FBWA system must contain a Base Station (BS) and Subscriber Stations (SS) Cells.
- Intercell connectors can be achieved by using either wireless, fibre optic or copper facilities to interconnect two or more BS units.
- BS can be connected to the SS by use of a Repeater Station (RS).
- F interface is the connection to the core network, which is typically IP or ATM
- G interfaces between SS are generally wired Ethernet or 802.11 WiFi.

# Mobile WiMAX operation





- BS are connected to an operator backbone.
- BS 1 is the serving BS for an MS.
- BS 2 is the neighbouring BS in the next cell on the path.
- If the MS moves closer to BS 2 the MS is handed over to the nearer BS.
- IB interface for the inter BS messaging.
- A interface for authentication and authorisation functions.
- U interface defines the physical and MAC operations.



- 802.16m (WiMAX2) WirelessMAN-Advanced Air Interface provided a future path for operators using 802.16e.
- Backwards compatibility with 802.16e as well providing a data rate 100 Mb/s using multiple channels using 4 x 4 MIMO.
- Approved by ITU-R as an IMT-Adv technology.
- 802.16m system can support both 120 Mb/s DownLink (DL) and 60 Mb/s UpLink (UL) per site simultaneously.





- LTE won the battle for 4G with WiMAX2
- TD-LTE natural competitor to WiMAX, vendors choose LTE.
- WiMAX migration to LTE
  - BS to eNodeB migration
    - WiMAX and TD-LTE very similar, OFDM and MIMO.
    - Upgradable BS to eNodeB.
    - Upgrade to FDD LTE more difficult.
  - Core network integration
    - Both WiMAX and LTE use an all-IP core network.
    - Upgrades possible, but may entail the replacement of some core elements.
  - Multimode UE
- WiMAX future - LTE
  - As 4G is rolling out there is obviously a choice to be made between WiMAX2 and LTE for many carriers. While there are a number of high profile WiMAX deployments worldwide, the vendors have chosen LTE and major carriers have committed to LTE over WiMAX.



- HiperLAN ETSI WLAN development in 1990s.
  - Physical layer
  - Media Access Control
  - Channel Access and Control (CAC) to deal with access requests for channels.
- Modulation
  - Frequency Shift Keying (FSK)
  - Gaussian Minimum Shift Keying (GMSK), a PM modulation method.
- HiperLAN features:
  - Range 50 m
  - Nomadic (slow) mobility (1.4 m/s)
  - Supports asynchronous and synchronous traffic
  - Bit rate - 23.2 Mb/s
  - Frequency range- 5.15-5.3 GHz and the 17.1-17.3 GHz spectrum.



- HiperLAN/2 functional specification was accomplished February 2000.
- 5 GHz band with a data rate of up to 54 Mbit/s data rate.
- The physical layer of HiperLAN/2 is very similar to IEEE 802.11a WLAN.
- Media access control is Dynamic TDMA. (CSMA/CA is used in 802.11).
- PHY layer
  - BPSK, QPSK, 16QAM or 64QAM modulation.



- Another standard created by ETSI to provide a wireless network communication in the 2 –11 GHz bands.
- It was seen as an alternative to IEEE 802.16 WiMAX.



- Failure in the Market
  - Competition from IEEE 802.11.
  - No commercial implementation.
  - IEEE 802.11a incorporated much of the HiperLAN/2 PHY specification.
  - HiperMAN lost out to IEEE 801.16 WiMAX.



# Thank You

**Diarmuid Ó Briain**

CEng, FIEI, FIET, CISSP

[diarmuid@obriain.com](mailto:diarmuid@obriain.com)