



Introduction to 3G

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19th January 2007



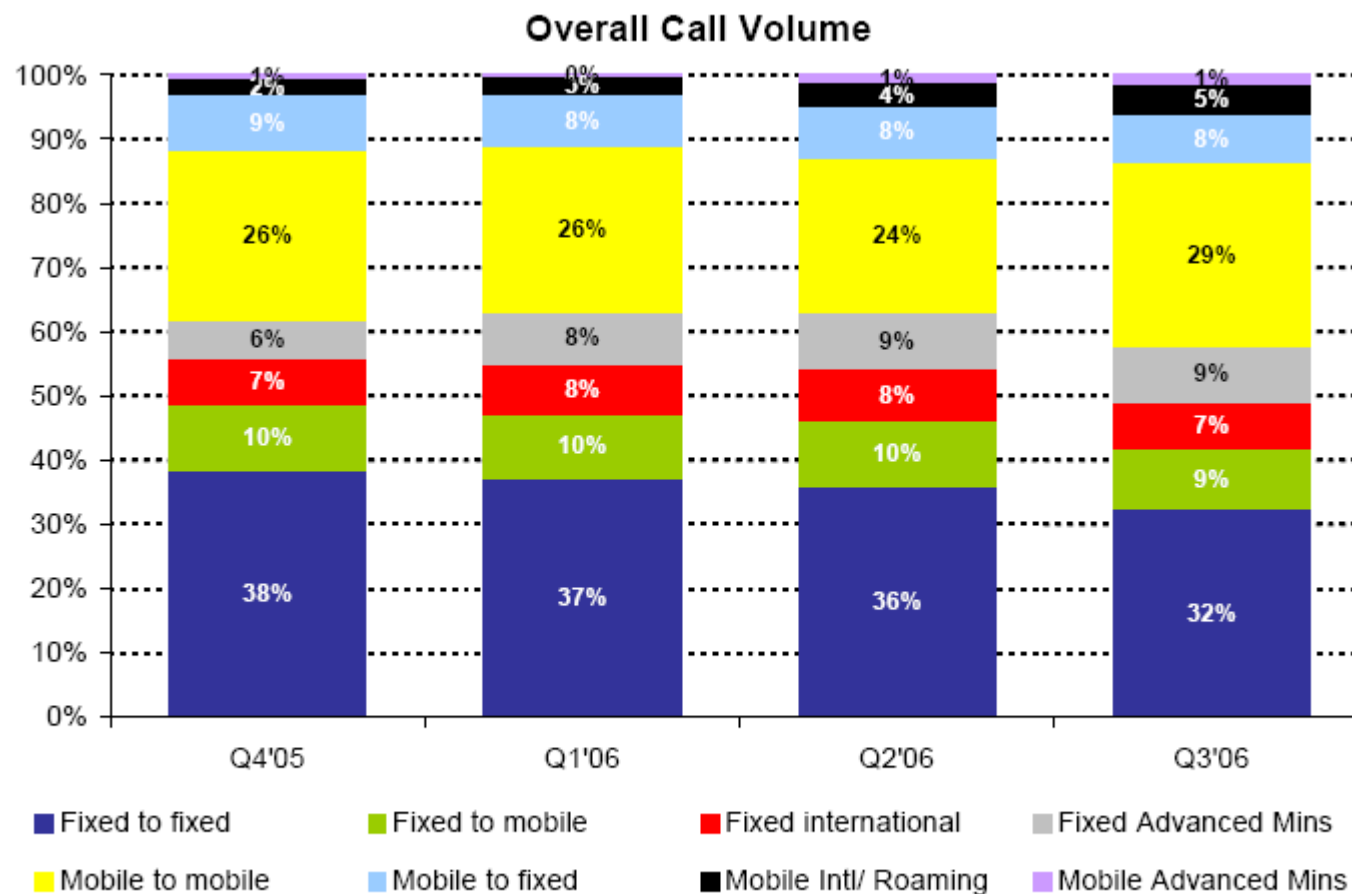
Agenda

- Telecoms in Ireland
- Licensing in Ireland
- 3G Drivers
- Network Architecture
- Sharing the Radio Spectrum
- Scrambling and Channelisation Codes
- Power Control
- Stealth Solutions
- Designing a 3G network
- Future of Telecoms



Telecoms in Ireland

Current Irish Telecommunications Market



Source: Quarterly Key Data Questionnaire

Advanced service minutes include minutes to premium rate numbers, freephone numbers, callsave, operator services, VPN minutes and other services.

Current Irish Telecommunications Market

- Irish mobile market composed of both 2G and 3G networks
- 2G
 - Second generation: also referred to as GSM - Global System for Mobile communications)
- 3G
 - Third generation: also referred to as UMTS (Universal Mobile Telecommunications System) or WCDMA (Wideband Code Division Multiple Access)
- 4 companies in the Irish mobile telecoms market:



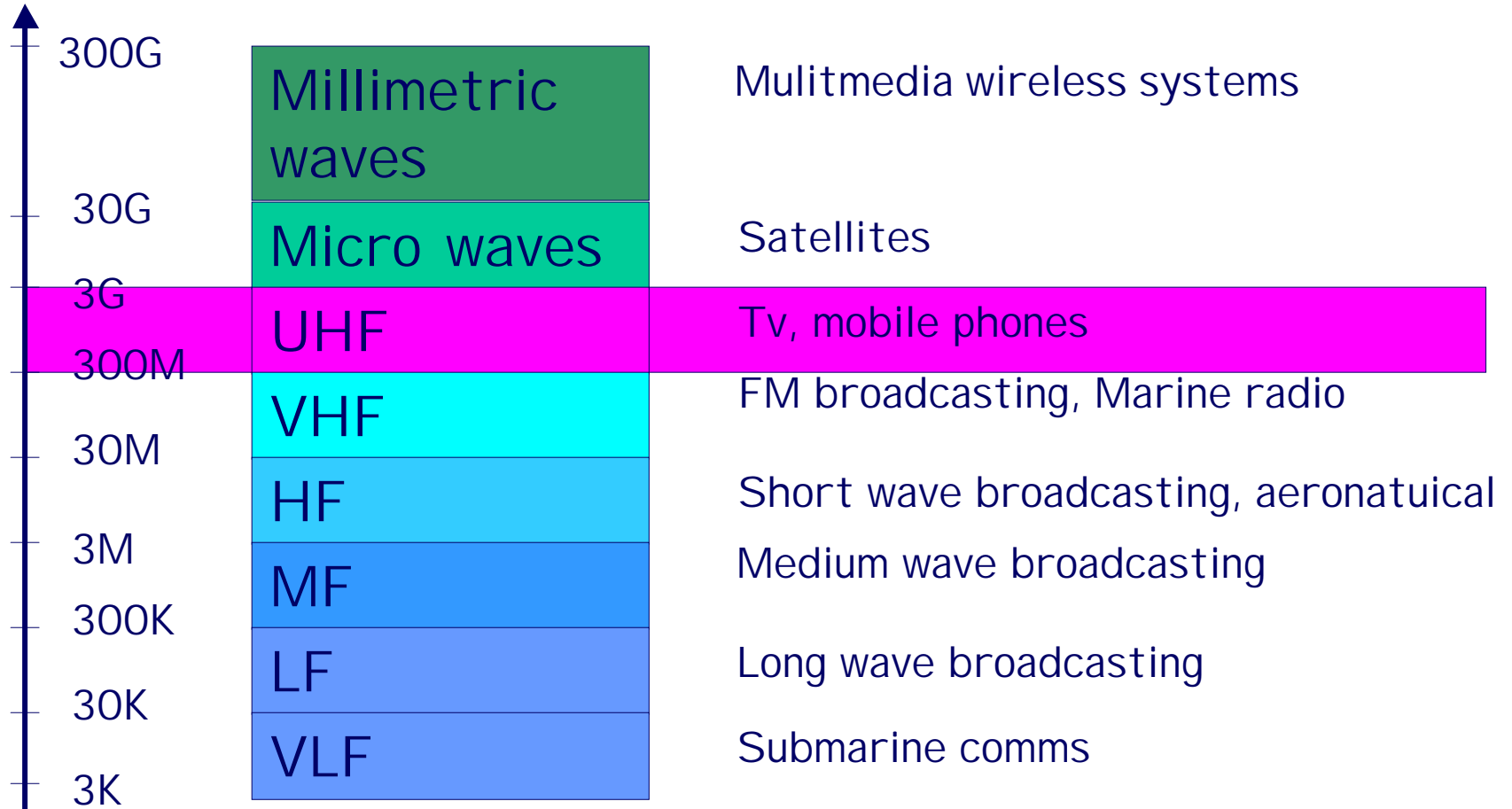
Coming soon:



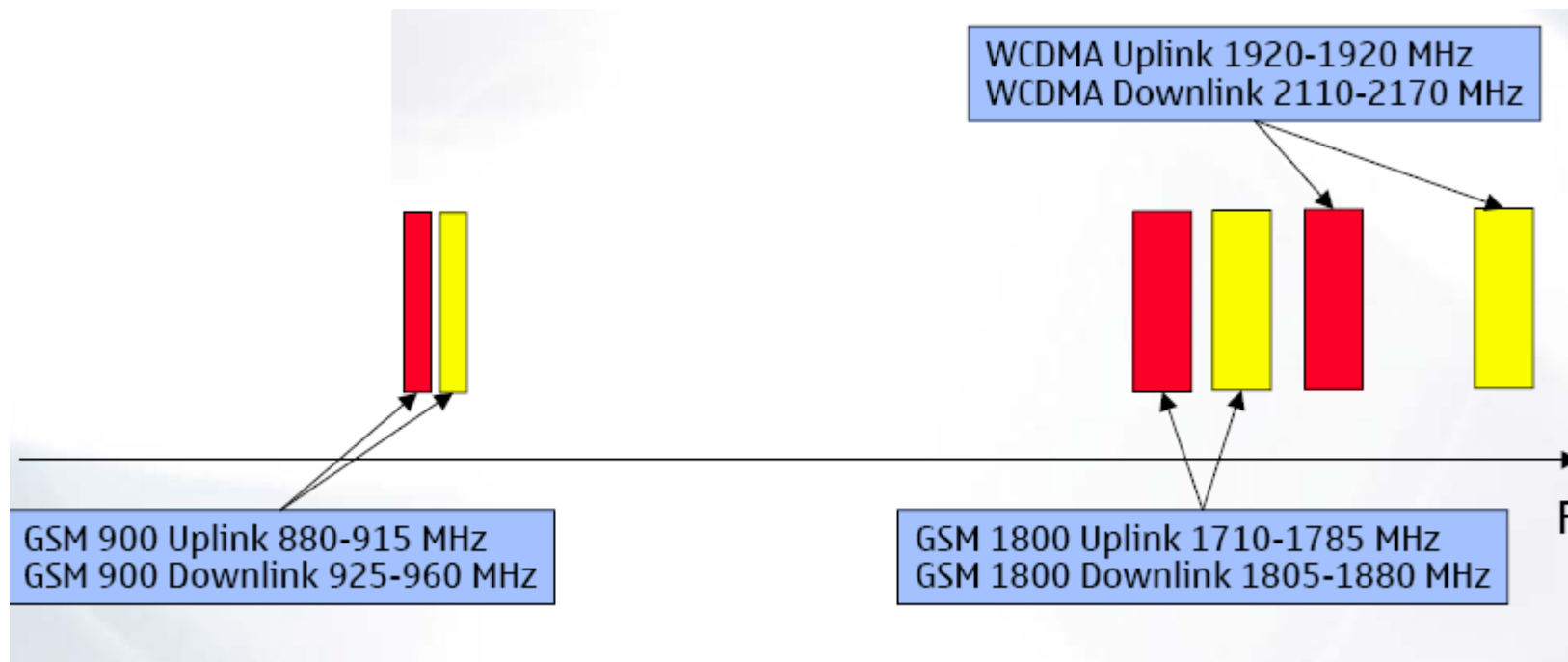
Licensing in Ireland

Licensing in Ireland

Frequency (Hz)



Licensing in Ireland (Mobile)



3G Licences in Ireland

- In 2001/02 The Communications Regulator of Ireland (ComReg) invited applications for four 3G licenses
 - 1 "A" licence: Coverage provided to at least 80% of the population by end 2005 (53% of the population by mid 2004)
 - 3 "B" licences: Minimum of 53% population coverage by end 2006. (33% of the population by the end of 2004)*
- Cost of licence : €114.3 million**
- Hutchison 3G (Three) Ireland was awarded the "A" licence
- "B" licences were purchased by Vodafone and O2

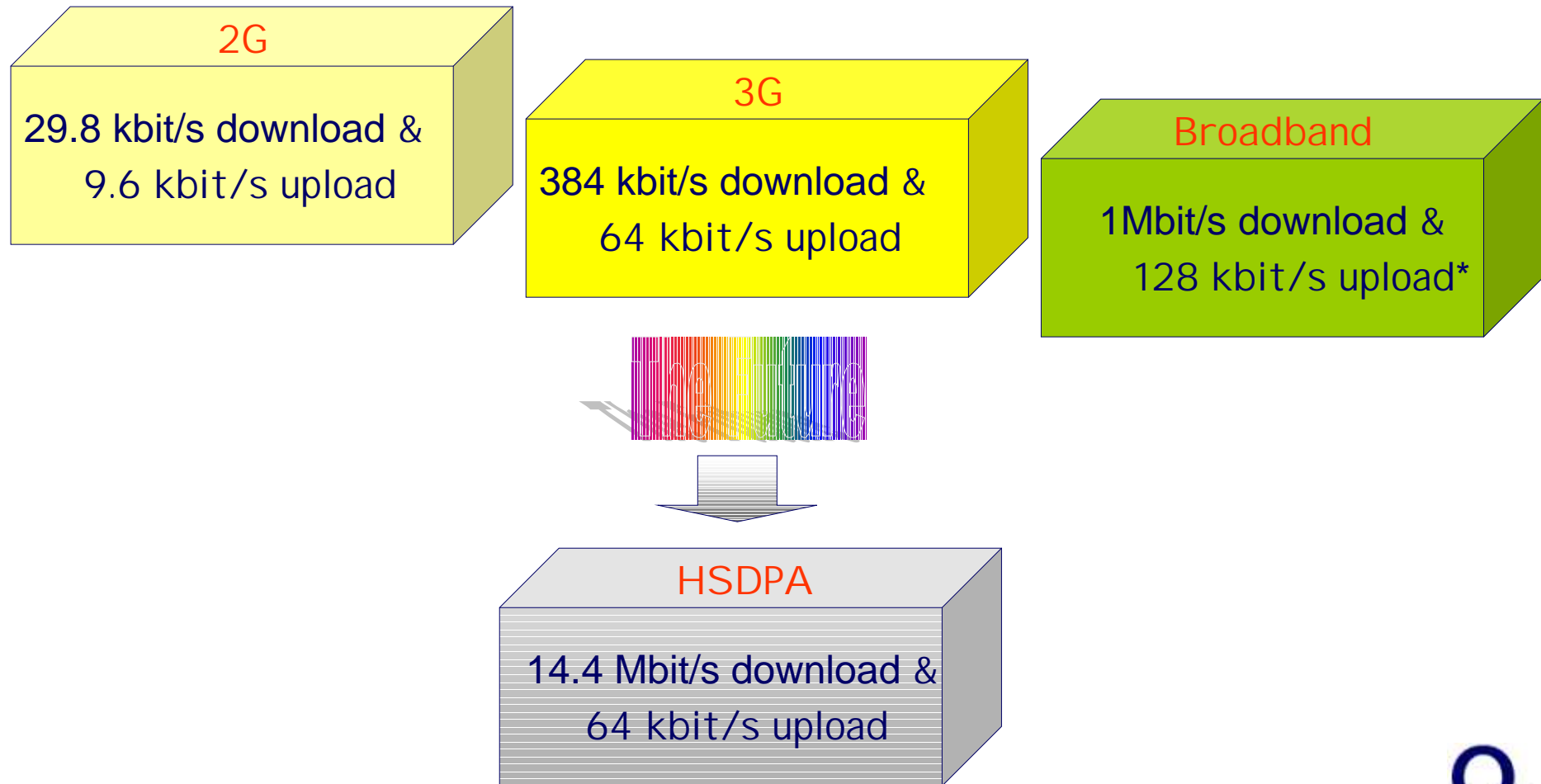
* <http://www.odtr.ie/docs/pres071200.doc> - Office of Director of Telcommunication Regulation

** <http://www.enn.ie/news.html?code=9618040>

3G Drivers

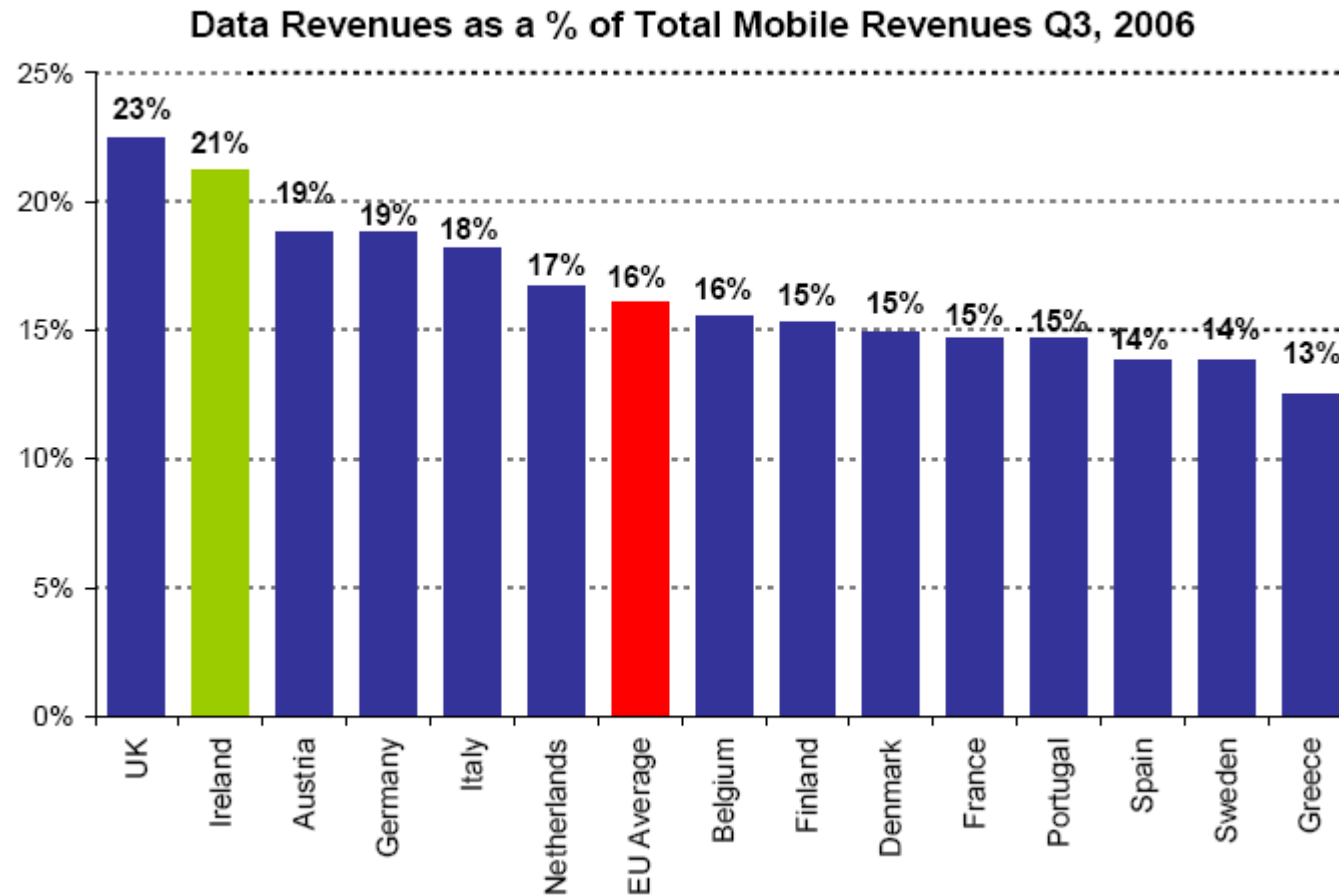
Why 3G?

- Makes higher data rates possible



* <http://www.eircom.ie/cgi-bin/bvsm/bveircom/store/productDetails.jsp> - 6/11/06

Current Data Revenues



Source: Yankee Group

Includes data revenues from SMS messaging, MMS messaging, GPRS data services, 3G data services.

Current Data Services Available from O2

- Examples of I-mode content below



Check your bank balance



Order flowers for a friend



Check real-time flight details



Real-time stock market information



Know when your team has scored



Fill time with a game



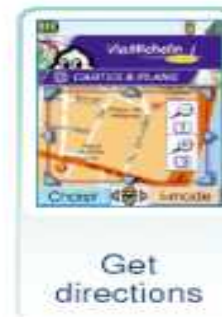
Find a new job



Buy tickets for a concert



Find a new apartment



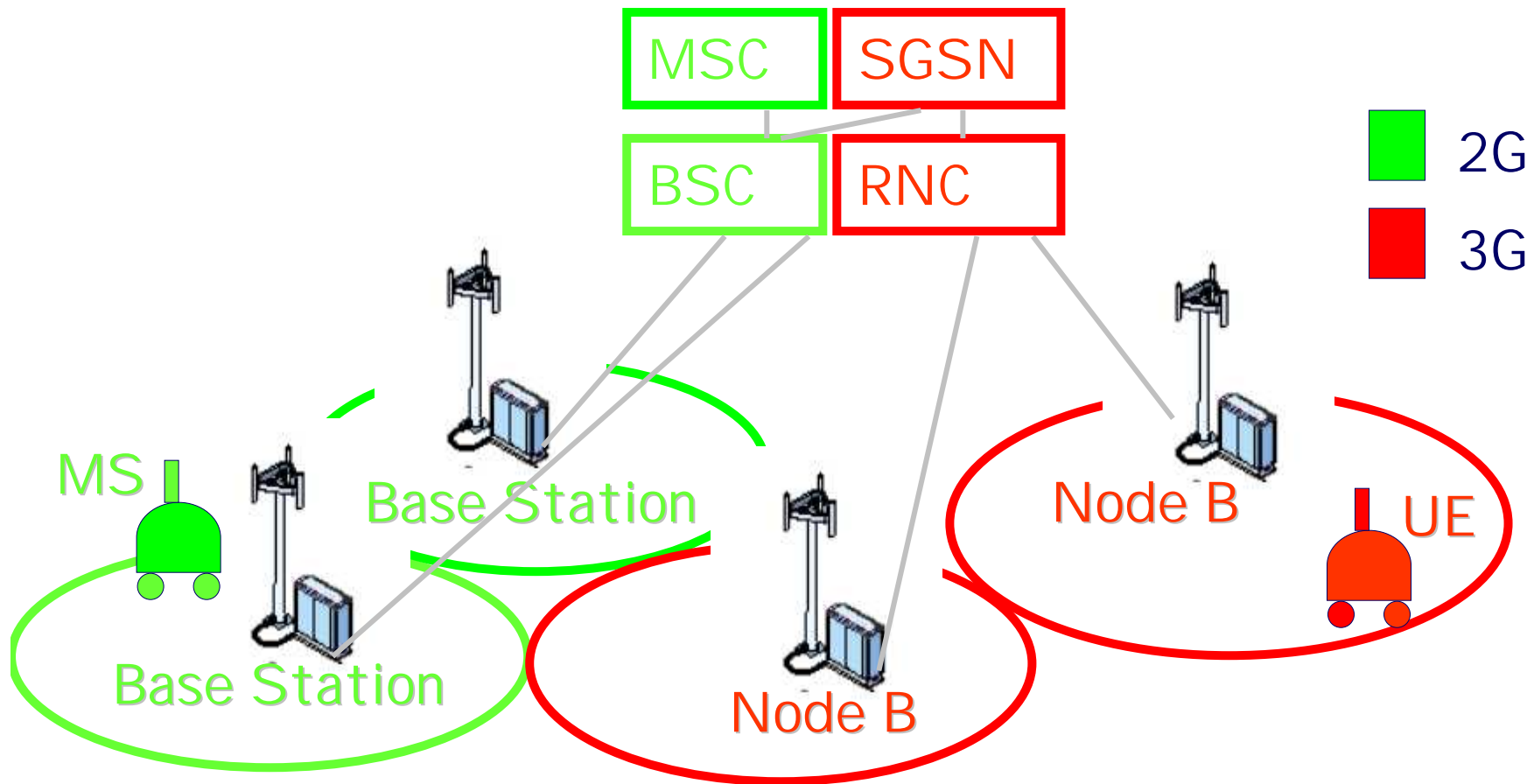
Get directions

- In December 2006 O2 launched Napster Mobile on 3G i-mode handsets



Network Architecture

2G & 3G Network Architecture



BSC - Base Station Controller

MS- Mobile Station

MSC- Mobile services Switching Centre

RNC-Radio Network Controller

SGSN- Serving GPRS Support Node

UE- User Equipment

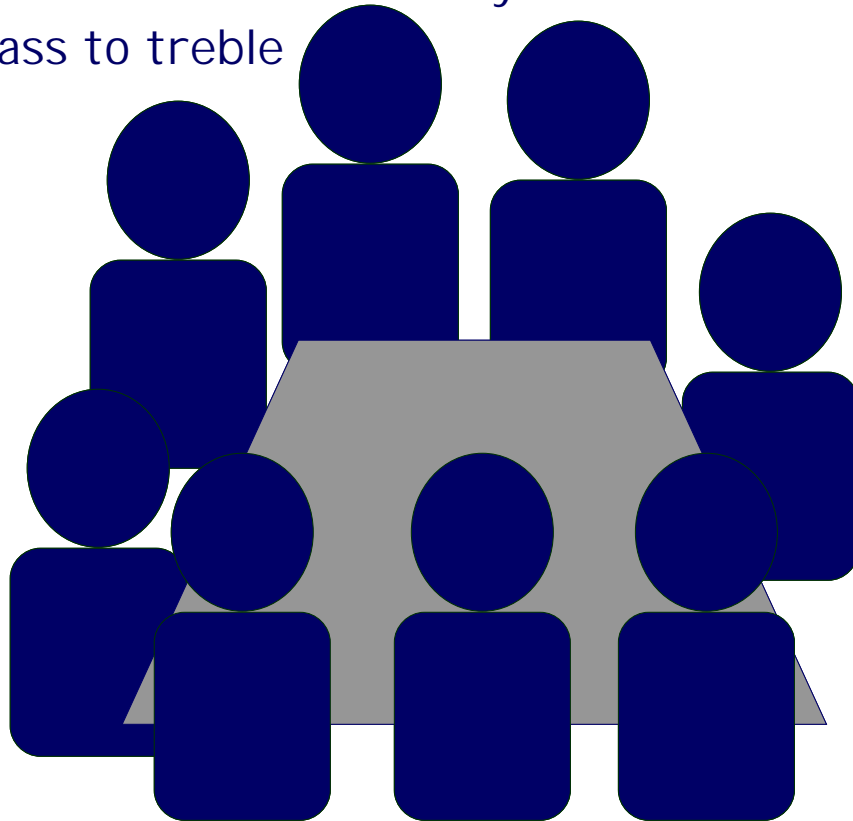
Sharing the Radio Spectrum

Sharing the Radio Spectrum

- 3 different methods for sharing the radio spectrum
 - Time Division Multiple Access (TDMA)
 - Frequency Division Multiple Access (FDMA)
 - Code Division Multiple Access (CDMA)
- GSM uses a combination of TDMA and FDMA
- UMTS uses CDMA

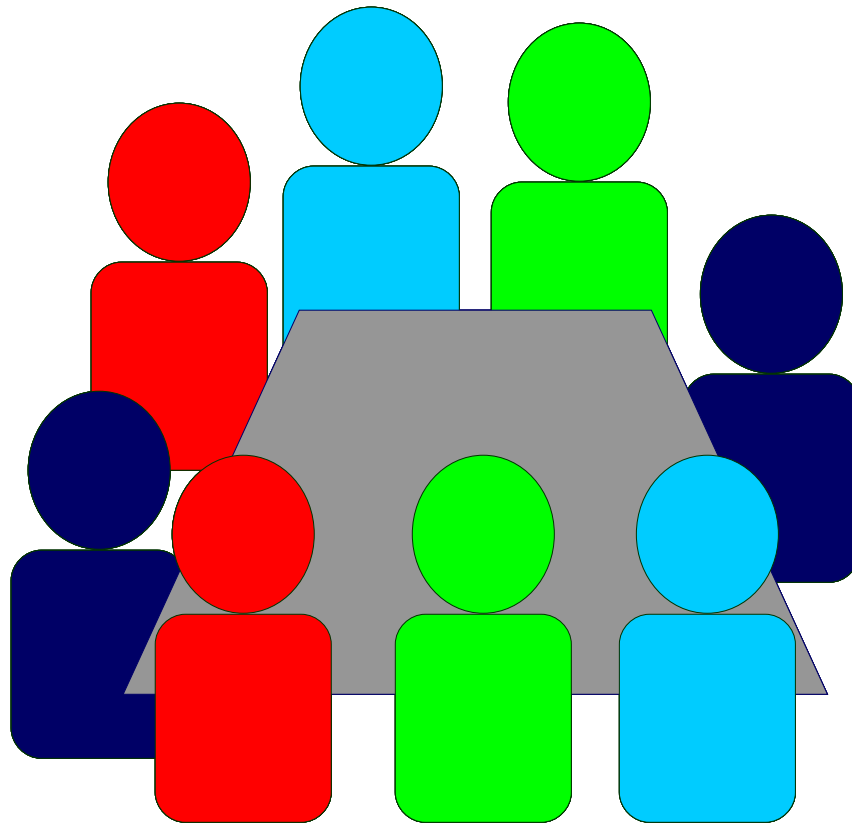
Sharing the Radio Spectrum

- GSM uses Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA)
- Qualcomm founder Irwin Jacobs “dinner party” analogy
- FDMA - everyone talks simultaneously but at different musical pitches from bass to treble



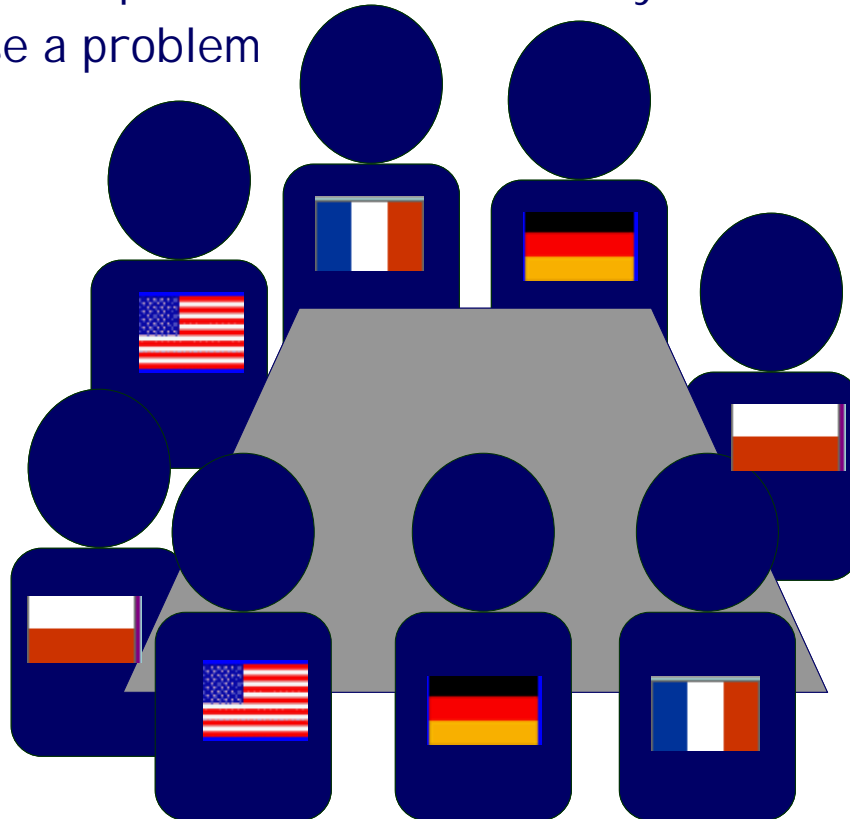
Sharing the Radio Spectrum

- TDMA - Each couple takes it in turn to speak, while the others remain silent



Sharing the Radio Spectrum

- UMTS uses CDMA - Code Division Multiple Access
- Everyone speaks at the same time, but each couple speak a different language
- Because each couple can't understand anyone else, background noise doesn't cause a problem

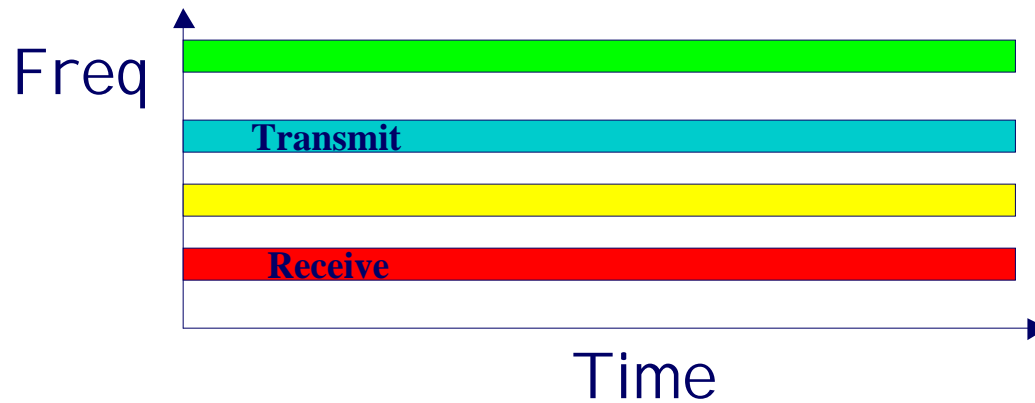


Lessons from the Analogy

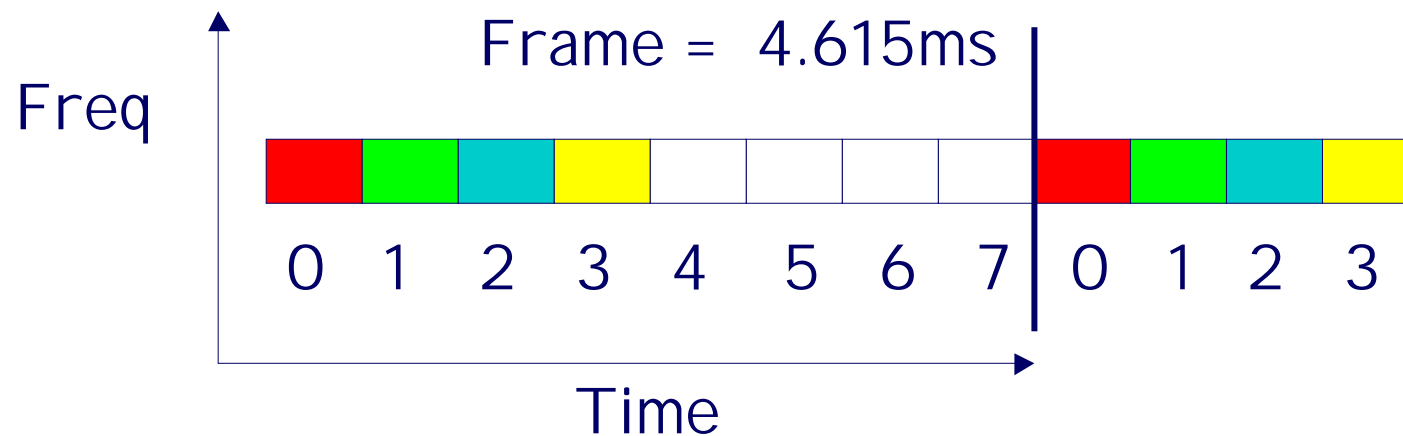
- 3G capacity limited by overall interference. No option of avoiding interference through frequency planning (unlike GSM). Poorly chosen 3G site may result in a reduction in the 3G overall network capacity.
- Trade off between coverage and capacity

FDMA & TDMA

- FDMA (GSM)- users transmit and receive at the same time using different frequencies

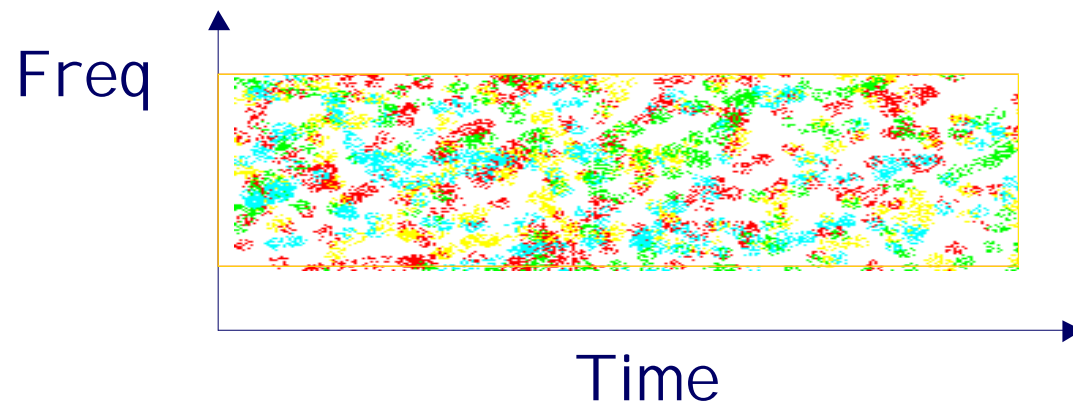


- TDMA (GSM) -each user takes a turn transmitting/receiving

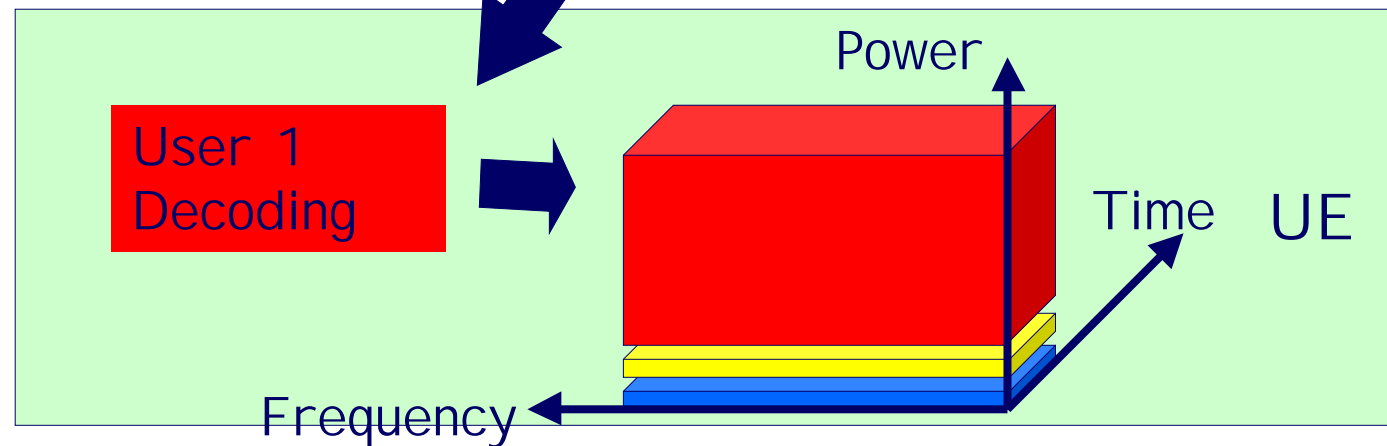
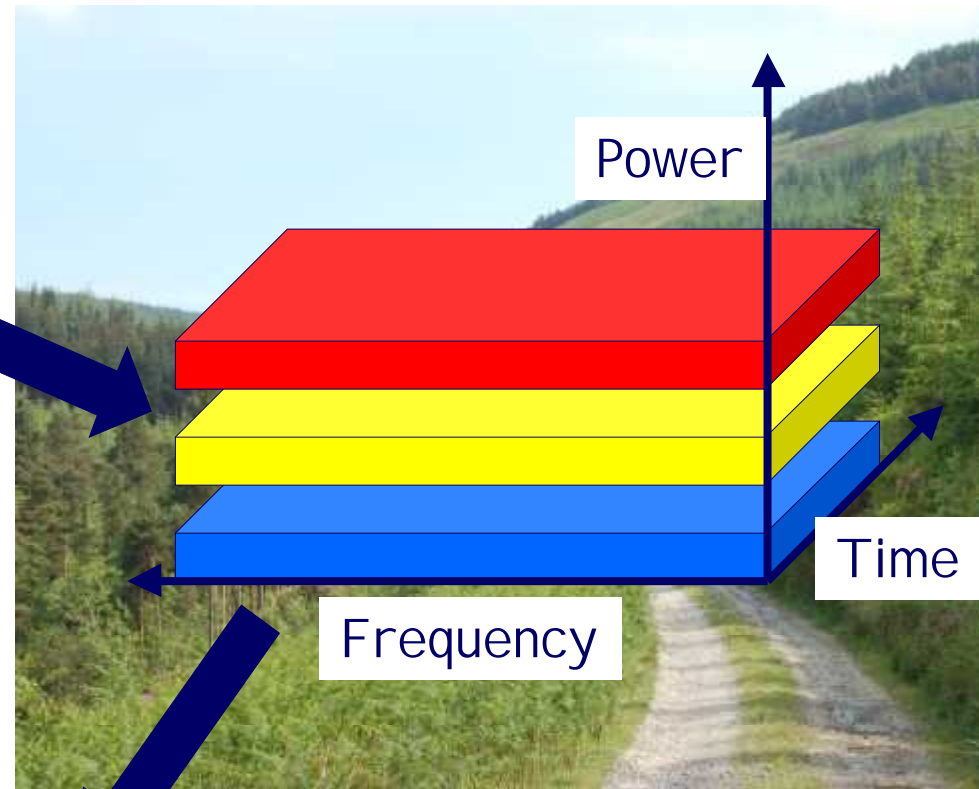
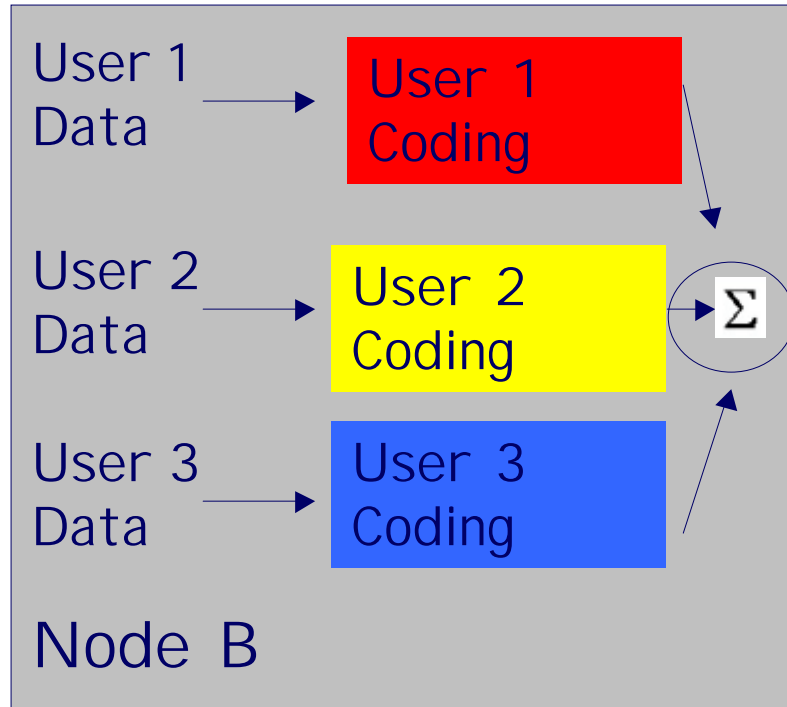


CDMA

- CDMA (UMTS)- users transmit and receive at the same time using different codes
- Each user is assigned a unique code that allows the users signal to be spread on the common channel
- The received signal is cross- correlated with each of the possible user codes to retrieve the users signal

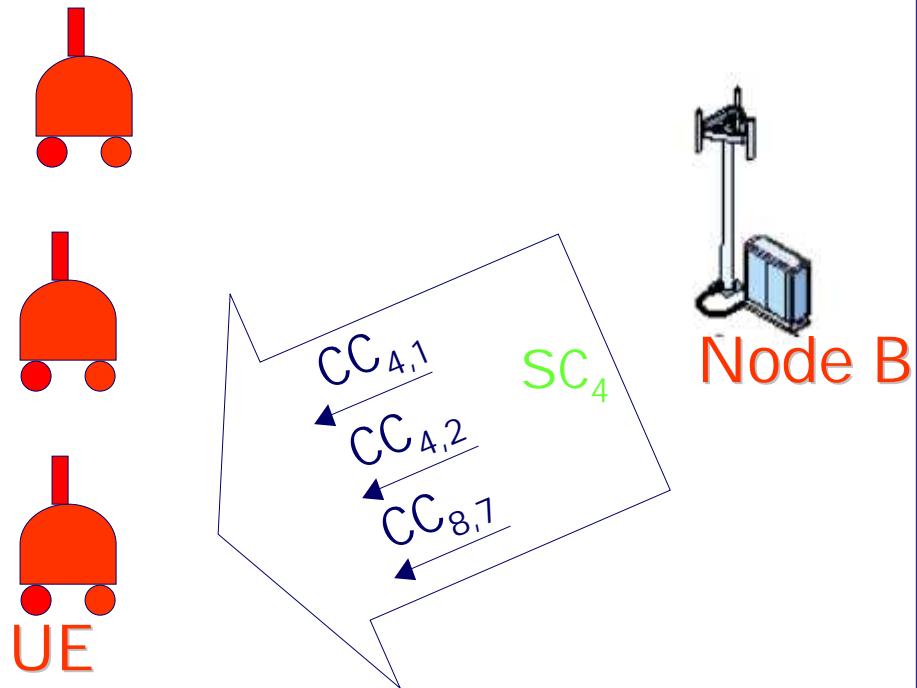


Spreading



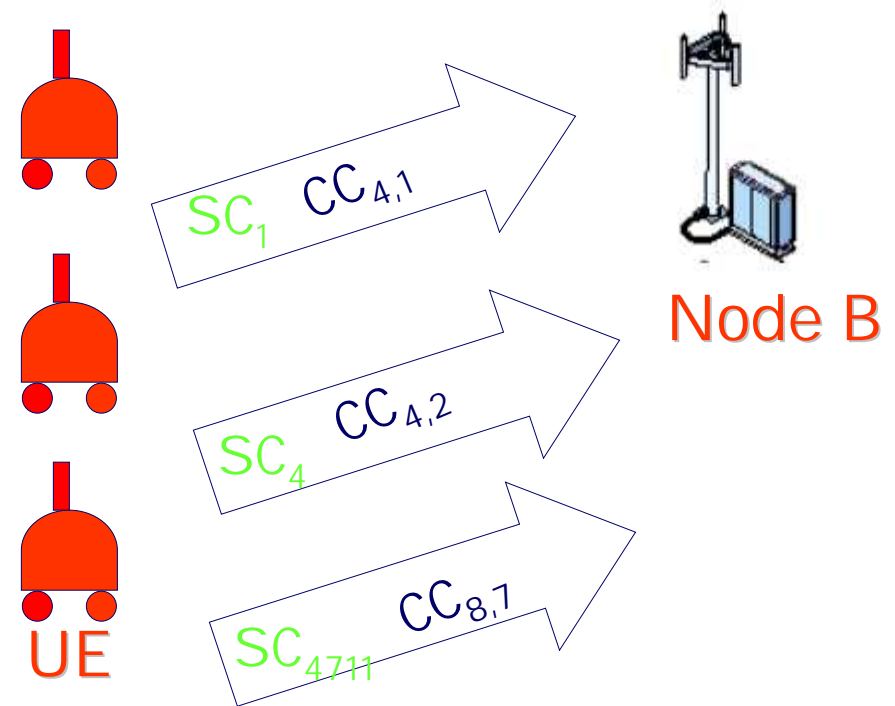
Scrambling and Channelisation Codes

Downlink Codes



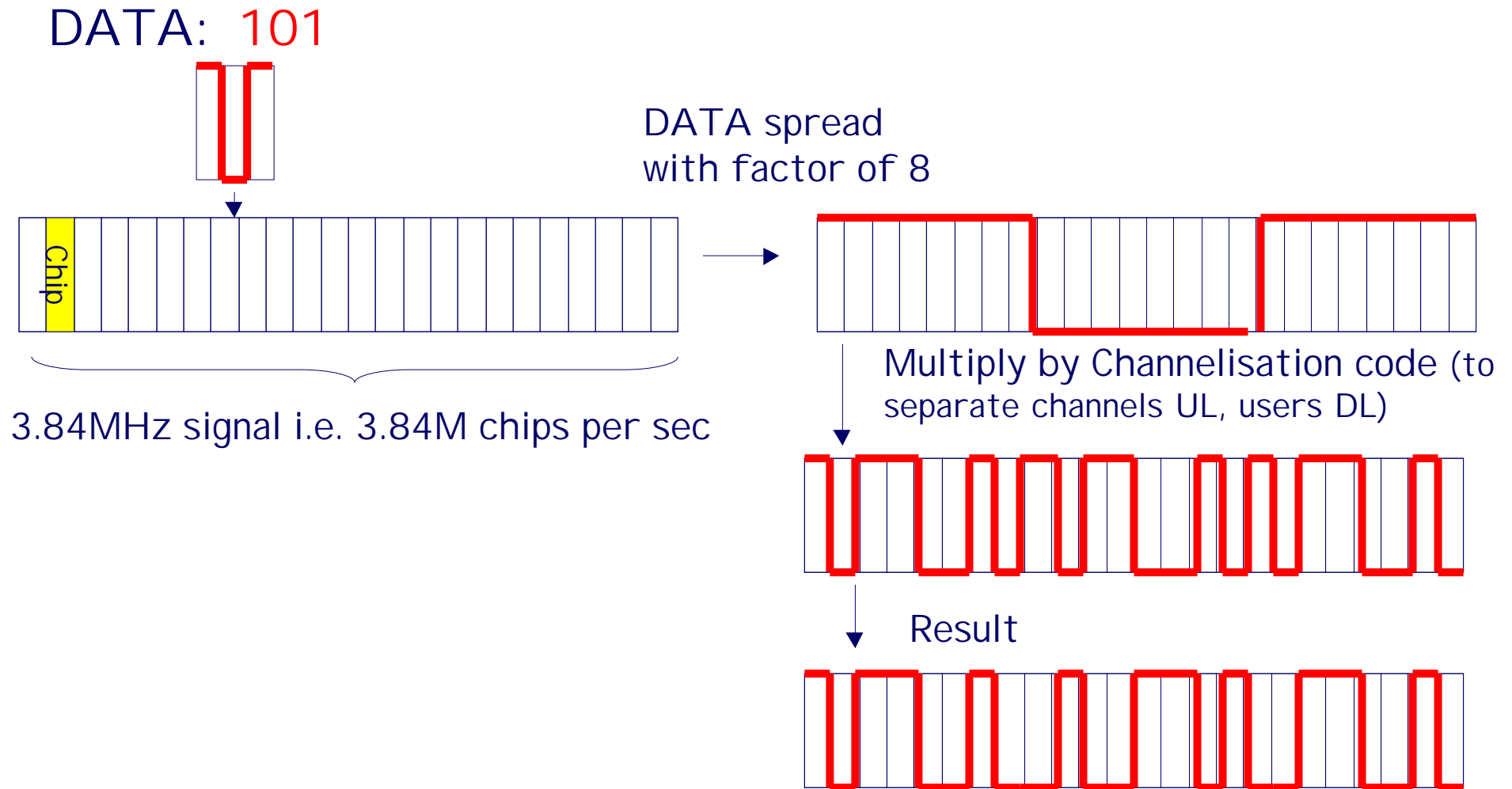
- SC defines the cell
- CC determines bitrate

Uplink Codes

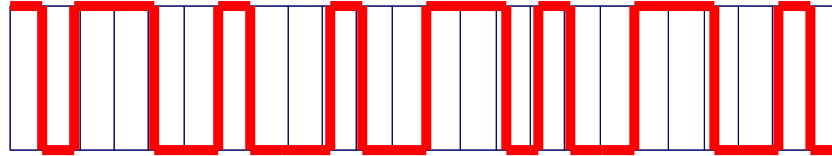


- SC defines the UE
- CC determines bitrate

UMTS Codes



UMTS Codes Continued



Apply Scrambling code - to separate users UL, Cells DL



Apply Scrambling
code



Apply Channelisation
code



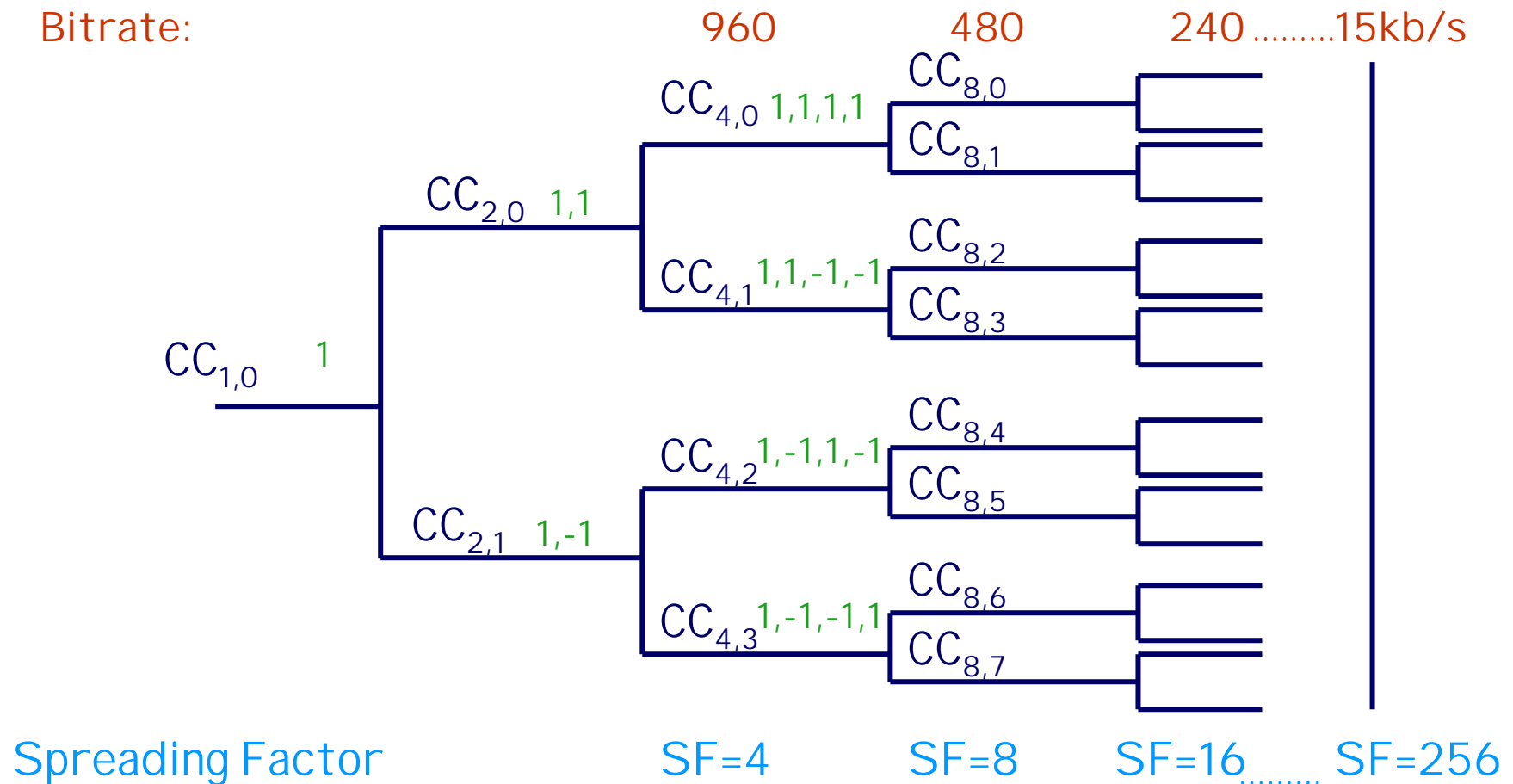
DATA: 101

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Channelisation Codes

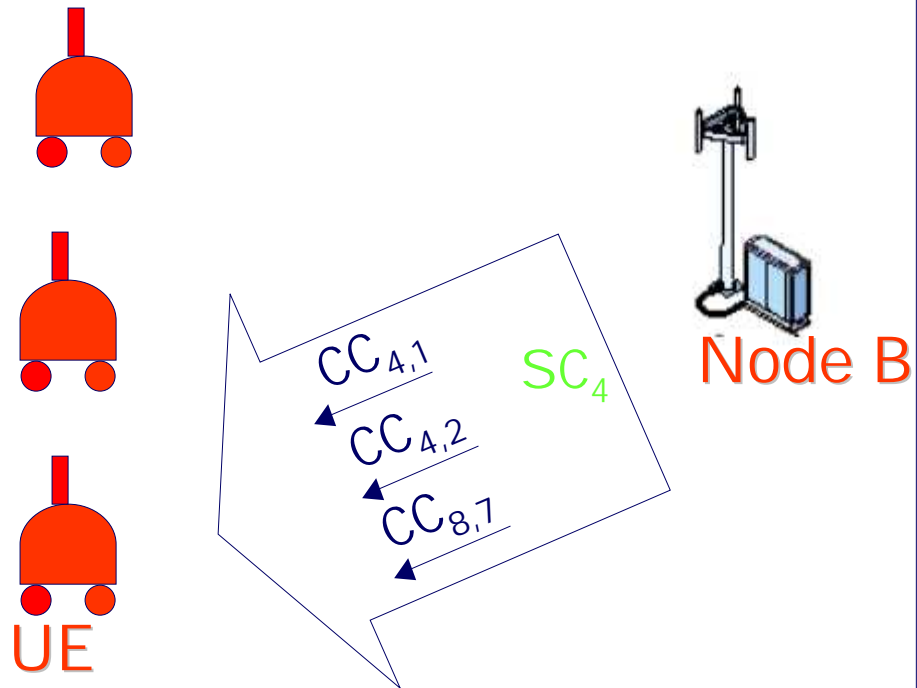
- Channelisation codes are dynamically allocated and determine the bitrate.

Bitrate:



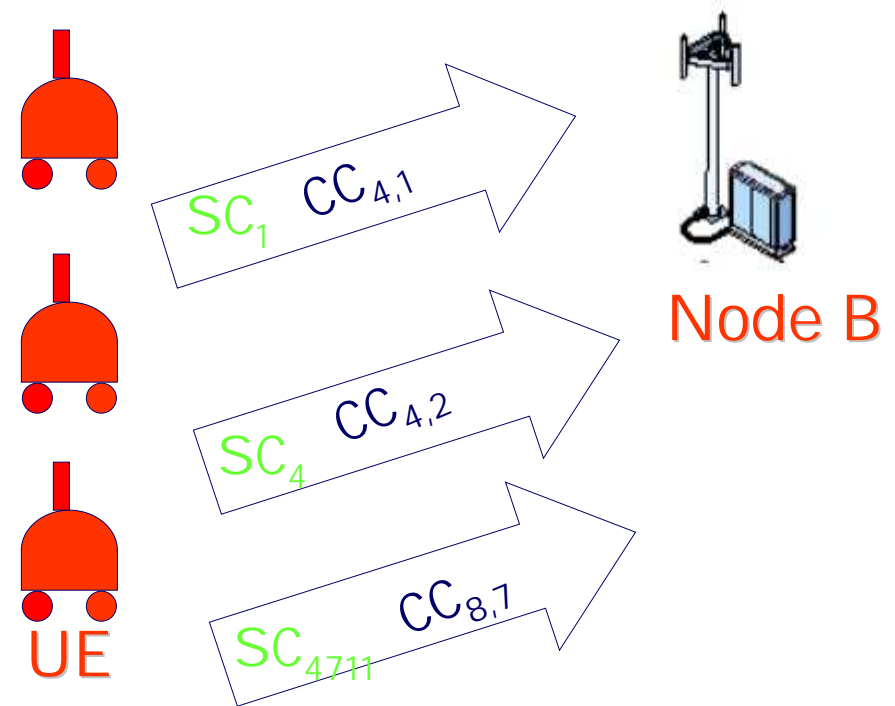
Restriction: when a code is intended to be used, no other code generated from the intended code can be used (as for higher SF); no code between the intended code and the root can be used (as for lower SF)

Downlink Codes



- SC defines the cell
- 512 primary SC
- CC determines bitrate

Uplink Codes



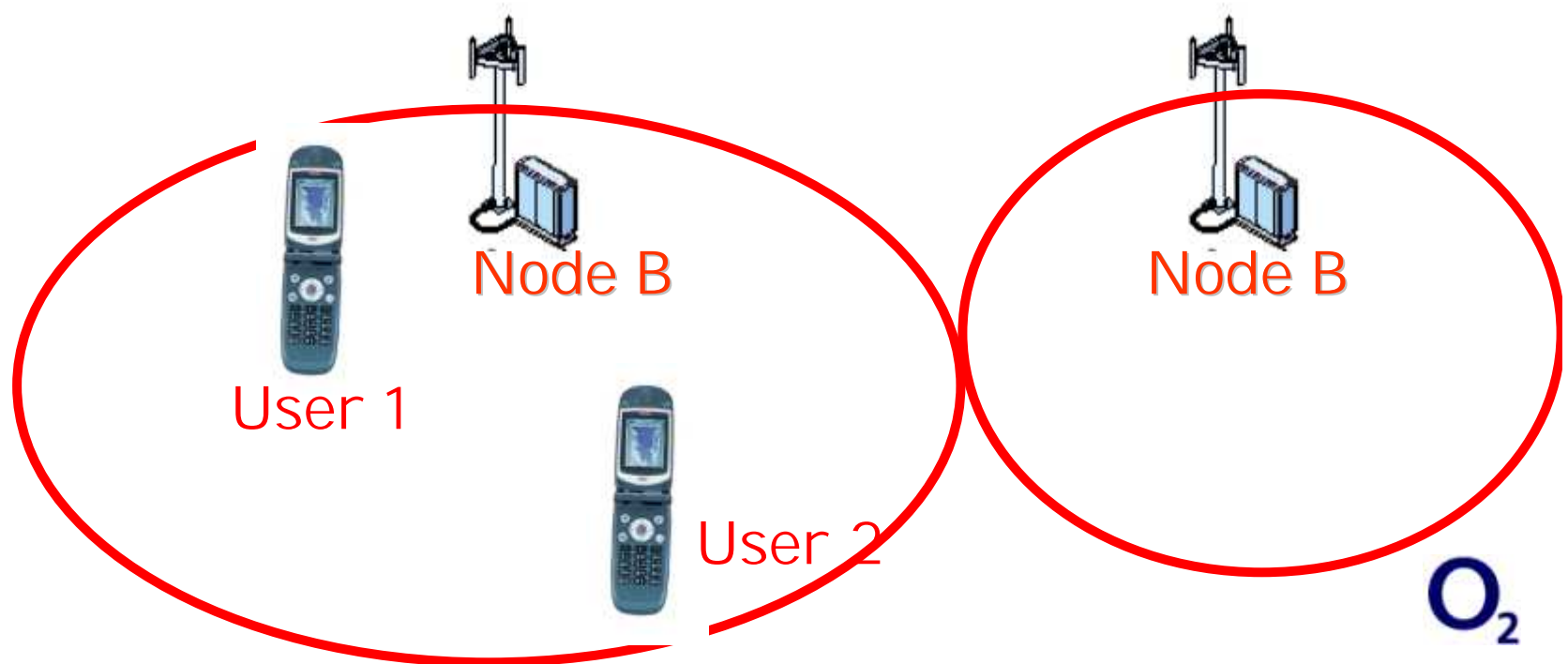
- SC defines the UE
- 16.8 million SC codes in uplink
- CC determines bitrate

Power Control

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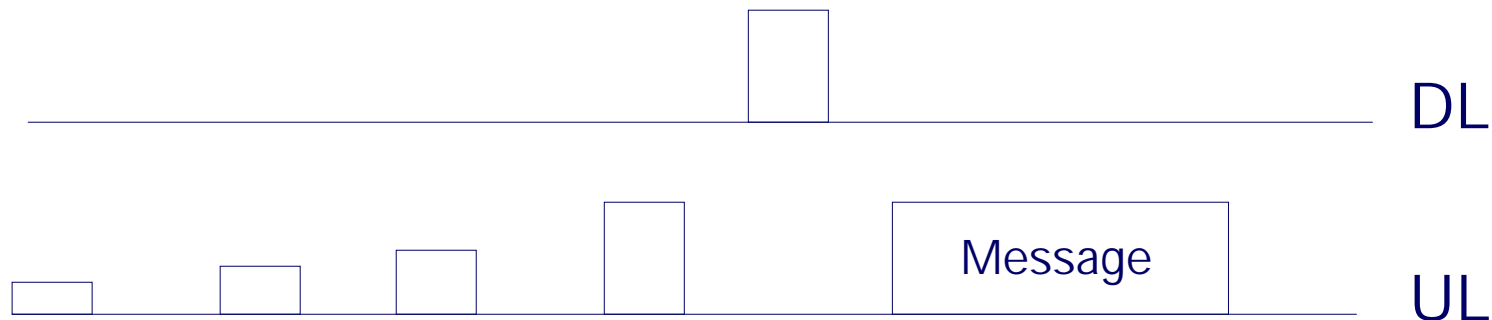
Power Control

- Handsets further from Node B must use higher power, handsets closer to Node B use lower power so all are received equally at the node B



Power Control - Outer Loop

- Power control is used to control the transmit powers of the different UE s so that their signals reach the Node B with the same level.
- Power control reduces interference in the system, as the total amount of radiated power from the UE s across the network is reduced. It also helps reduce battery consumption in the UE.
- Outer loop power control is used to determine the initial output power the UE should use



- In GSM the mobile initially transmits with maximum power and then steps down as appropriate

Power Control - Inner & Outer Loop

- Commands the UE to increase or decrease power level to achieve quality targets
- Command - react cycle is 1500 times per second (compare with every 480ms with GSM)

Stealth solutions

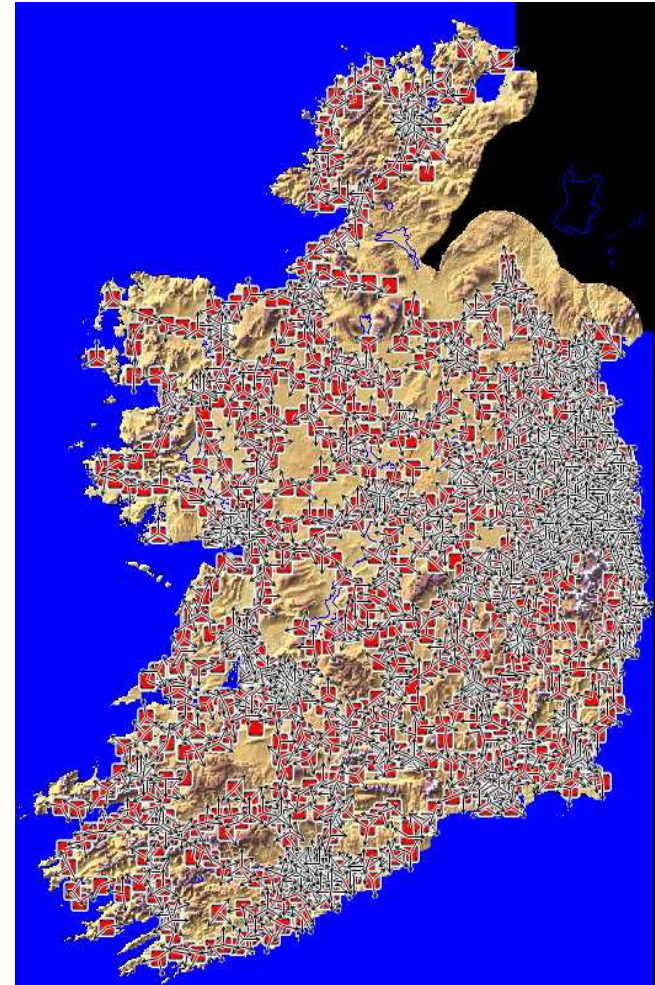
Stealth Solutions



Designing a 3G Network

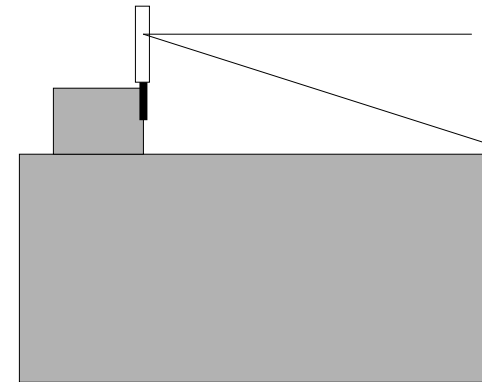
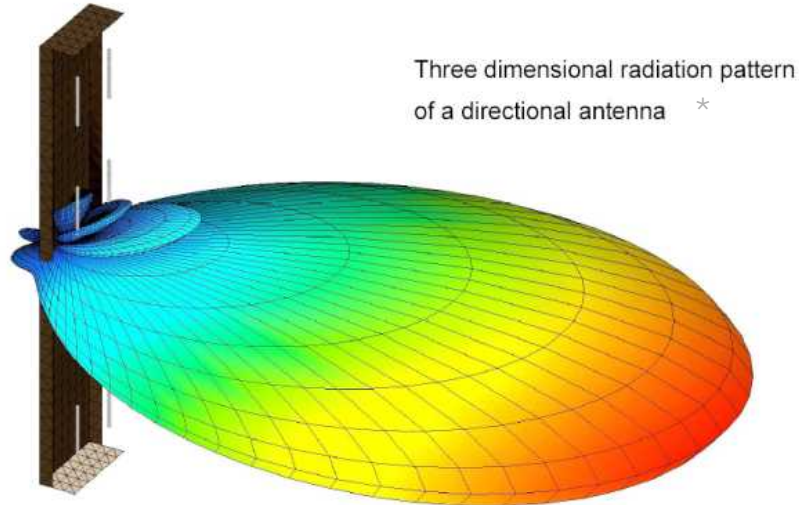
Designing a 3G network

1. Nominal plan is selected to meet minimum regulatory requirements e.g. 53% population coverage (ideally using existing 2g sites)
2. Use the nominal plan to pick candidate sites
3. Visit area and try to select suitable sites & rank in order of preference
4. Property dept. approach landowners in order of priority to organise survey and try to agree terms
5. Once agreements are in place contracted to construction company to build site
6. Hardware and performance of site tested before site goes live
7. Monitoring afterwards



Site Selection/Design

- Each site is visited and photographed before a decision is made.
- Looking for well controlled sites, higher than surrounding clutter.
- Antenna locations must be free from blockages or clipping



- Once site has been selected interference is controlled by antenna re-orientation and downtilt adjustment.

* www.kathrein.de

Trade Offs

- Minimum site to site distance
- Site/Antenna height
- Antenna placement
- Antenna orientation
- Close to traffic
- No antenna clipping or blocking in the vicinity of the antenna.
- Correct antenna separation with GSM.
- Minimum antenna separation with other operators.
- Feeder usage

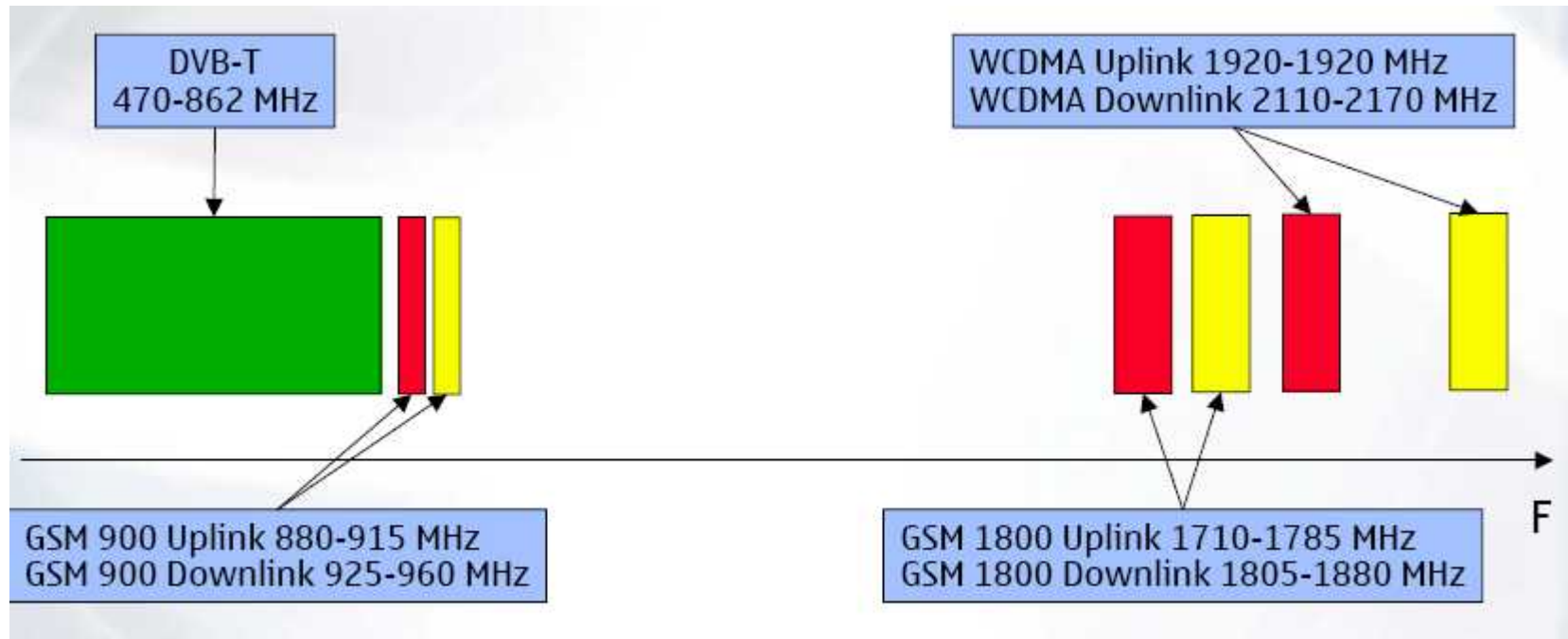
Goals

- Minimise large areas of cell overlap
- Within an area try to ensure that cells are of a similar size.
- Ideally maintain a relatively uniform distance between neighbouring sites
- Key for antennas to be 'just above' average surrounding building height to limit interference

Future of Telecoms

Mobile TV

- DVB-H Digital Video Broadcasting for Handheld Devices
- Allows users to view TV on their mobile handset



- Trial by o2 at the Ryder cup in Oct 2006
- Trial involved a single transmitter from a single high site to establish what the requirement would be to provide 95% ground floor coverage

Mobile TV

- In order to become a commercial service would be necessary to go through a bidding process for a licence



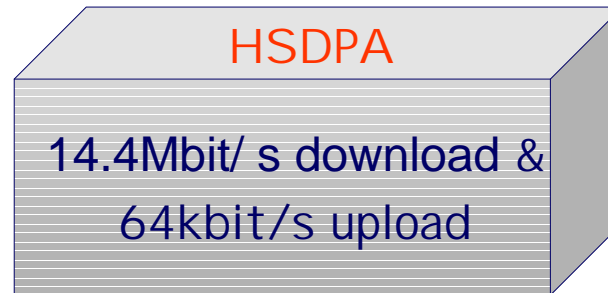
- Technical considerations include battery life, mobility, billing

iPhone



- iPhone is a combination of three products
 - A revolutionary mobile phone
 - A widescreen iPod with touch controls
 - Internet communications device with desktop-class email, web browsing, maps
- www.apple.com/iphone

HSDPA



- Speed
 - Higher bit rates: up to 14.4 Mbps (theoretical max)
 - Higher rates achieved by better modulation (1 symbol to 4bits)
 - More advanced audio & video content & larger file transfers (e.g. streaming applications)
 - Reduced download times
- Latency
 - Better Web browsing (WWW) end-user experience
 - New services with very high requirements on response times, e.g. gaming applications

Summary

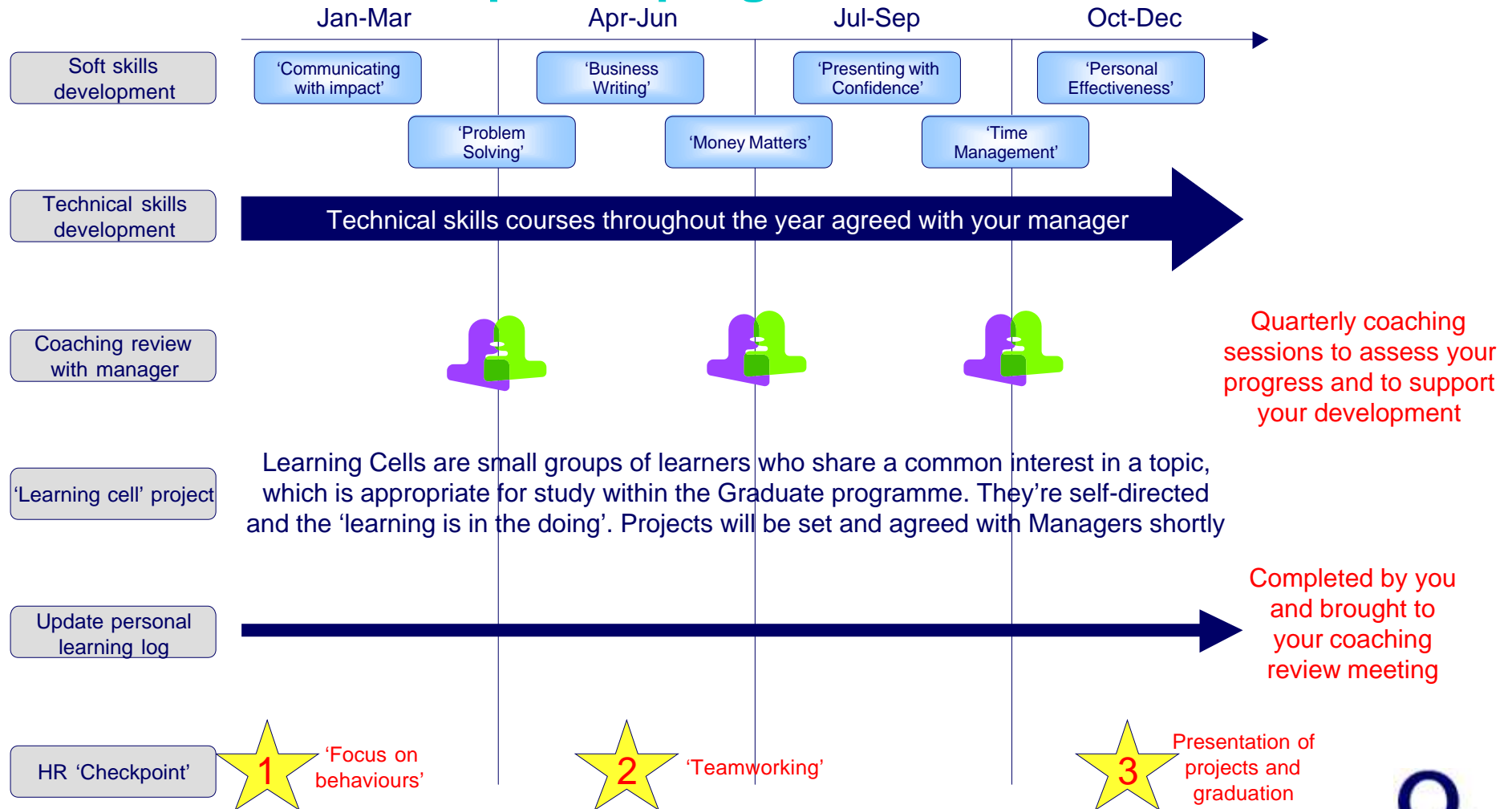
- Main concepts of 3G
 - Spreading
 - Power control
 - Single frequency
 - Control of interference by isolating coverage

When and how are graduates recruited?

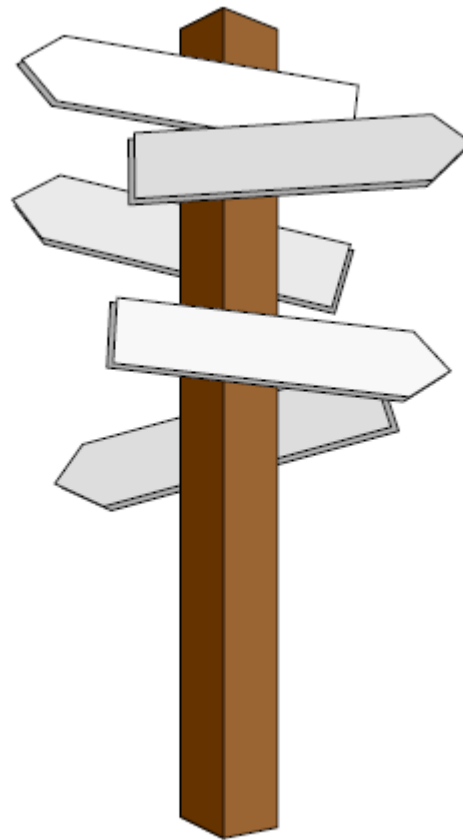


- Technology graduate roles will be advertised in June/July (www.o2.ie and www.gradireland.ie)
- Interviews and assessment will follow
- Appointments in August/September

Graduate development programme



Questions and Answers



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Thank You

Fiona Kelly

O2 Radio Engineer

19th January 2007

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