Delivery of radio services over IP bi-directional networks

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Presentation

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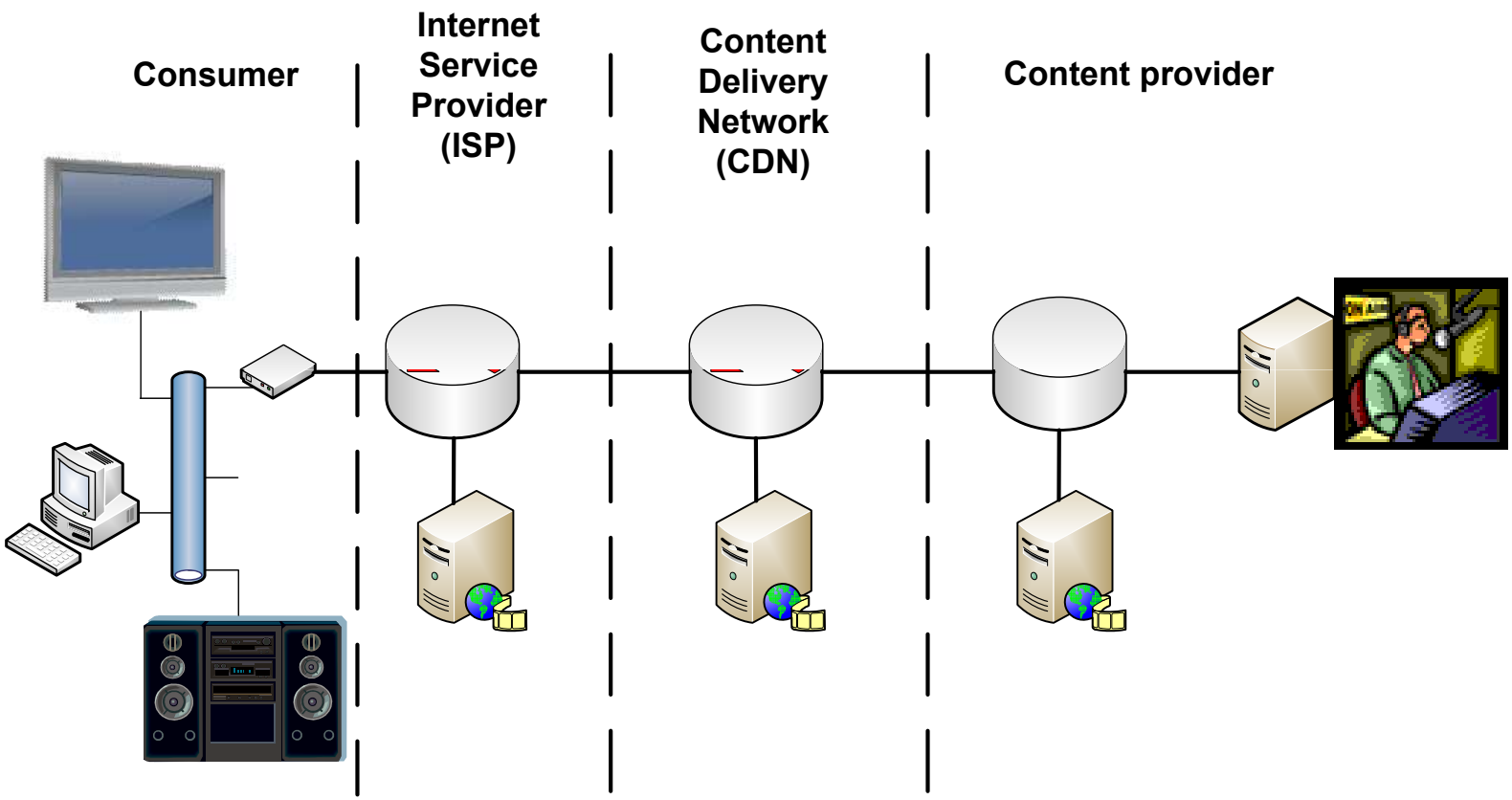
Radio on the internet



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Radio on the internet in the UK – simple assumptions

- Radio service – 48 kbits/s AAC+, with IP over head 55 kbits/s
- 22 hrs of listening to radio each week 80/20 home/car
- 17 hrs listening at home
- This equates to 2 G bytes of data shifted per month
- There are 2.36 people living in each UK house hold (Census 2001)
  - Assume some duplication of listening so multiply by 2
- Assume 4 G bytes per broadband connection per month radio traffic
- Assume Broadcaster is paying 3p per G byte shifted
- Assume 27 million house holds in UK
- Total cost £35 m per annum – cost to the broadcaster

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BT packages

Broadband and Calls Packages

SPECIAL Introductory price
£6.99 a month for 3 months

£25 John Lewis GIFT VOUCHER
Sign up to broadband with any package to claim your gift voucher
Online exclusive How to claim >

- ✓ **Fast broadband (Up to 20Mb!)**
- ✓ **Wireless BT Home Hub**
- ✓ **10GB allowance** – perfect for everyday internet use
- ✓ **Basic online security** – to stop those nasty viruses in your email
- ✓ **Includes UK evening and weekend calls**
- ✓ **Free connection if you need a new line** – when you order online

For even better value

Pay only £4 more a month and get:

- 4x as much broadband
- Advanced security
- Revolutionary TV set-top-box
- Access to Europe's biggest on-demand

TV, Broadband and Calls Packages

Fast broadband and on-demand TV shows and blockbusters

£25 John Lewis GIFT VOUCHER
Sign up to Vision with any package to claim your gift voucher
Online exclusive How to claim >

- ✓ **Wireless BT Home Hub**
- ✓ **A whopping 40GB allowance** – watch vides, surf the net and download music galore
- ✓ **Advanced McAfee Security** – to protect your family online
- ✓ **Pause, rewind and record live TV** – store up to 80 hours of your favorite shows
- ✓ **A sleek Vision+ box** – giving you 70 Freeview channels and pay-per-view on-demand shows

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Last mile – copper is the bottle neck – some still on very low speeds

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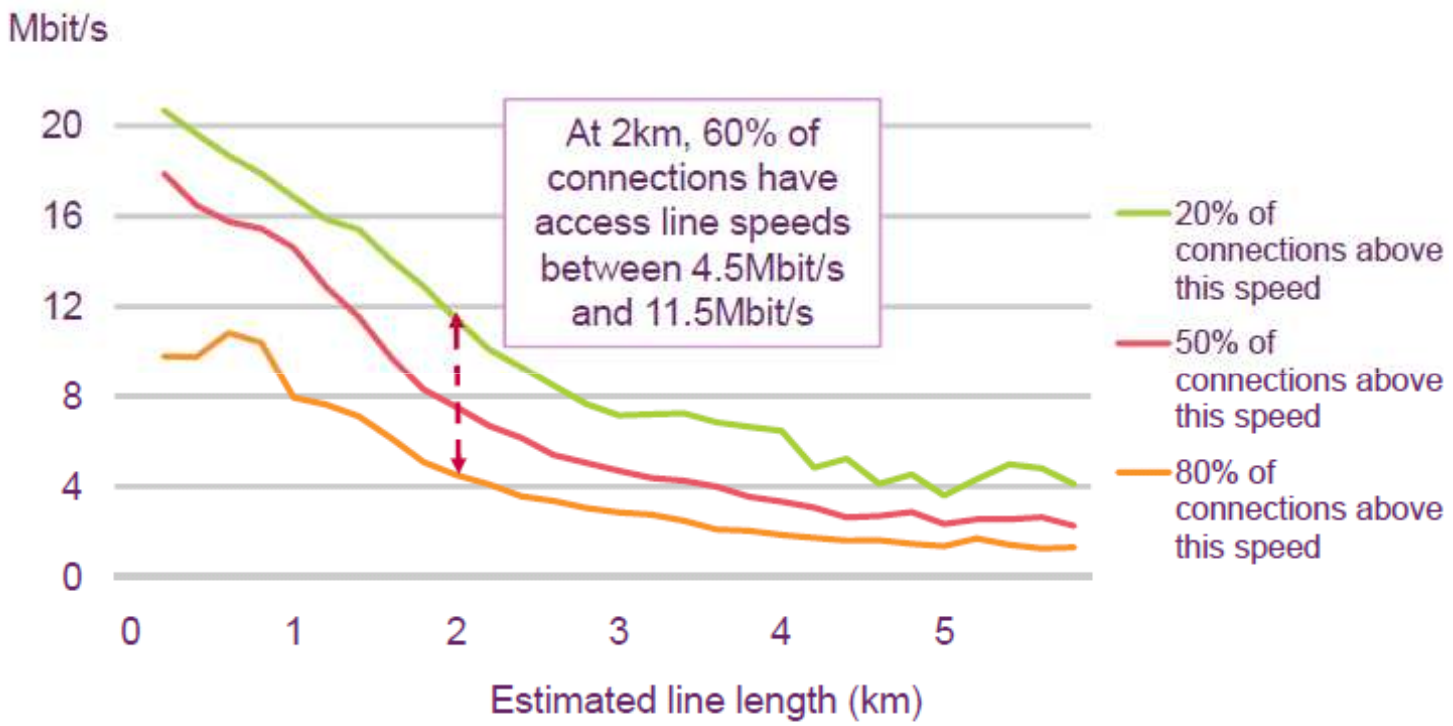
CU – ADSL2+ speeds in the UK

Distribution of access line speeds for ADSL2+ broadband services



Source: Ofcom calcuations based on data provided by two DSL operators

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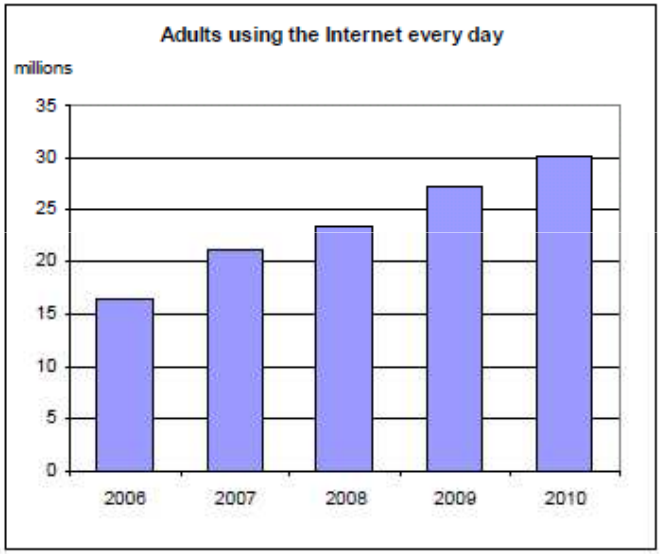
Internet access 2010 – UK Office of National Statistics

The 2010 Internet Access survey of households and individuals measures home access to the Internet and individuals' use of the Internet across the UK.

The key findings from the survey show that:

- 30.1 million adults used the Internet every day or nearly every day, almost double the estimate in 2006
- 9.2 million adults had never used the Internet
- 31 per cent of Internet users connected via a mobile phone, up from 23 per cent in 2009
- 17.4 million adults used the Internet to watch television or listen to the radio, an increase from 6.4 million in 2006
- 73 per cent of households had Internet access
- 31 million people bought or ordered goods or services online in the last 12 months



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Conclusions for fixed

- Not everyone gets more than dial up bit rates – but 90%+ of homes can get enough bit rate to receive radio
- Only 73% of homes have internet – so approximately 70% can listen to radio delivered over fixed internet access v 98%+ for broadcast radio services
- People on basic packages use 40% of there data cap to listen to 17 hrs a week – more advanced packages designed for streaming services – may require a broadcaster/ISP relationship
- Cost to broadcasters £35m per annum for radio listening
- You need a PC or internet radio to listen to the radio – device cost significantly greater than digital/analogue radio and more complex to install

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Mobile

- 20% of listening is in cars
  - Lets think about mobile networks
- Lets assume radio is delivered over a 3G or LTE (4G) network built by a mobile operator

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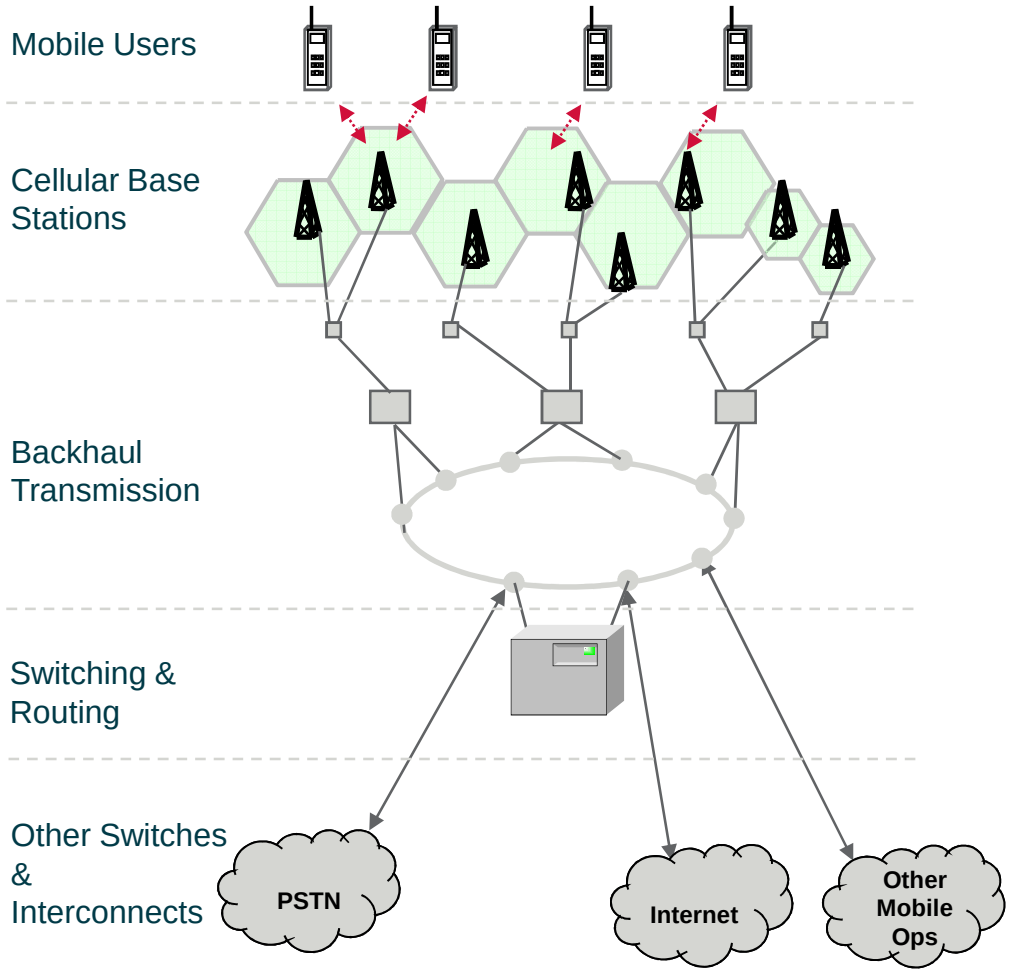
Mobile Networks - Generic Architecture



- 2-way communications
- Radio basestations cover specific areas, providing targeted coverage and capacity to users in their locality
- The technology provides seamless handovers between cells as the user moves within the coverage area

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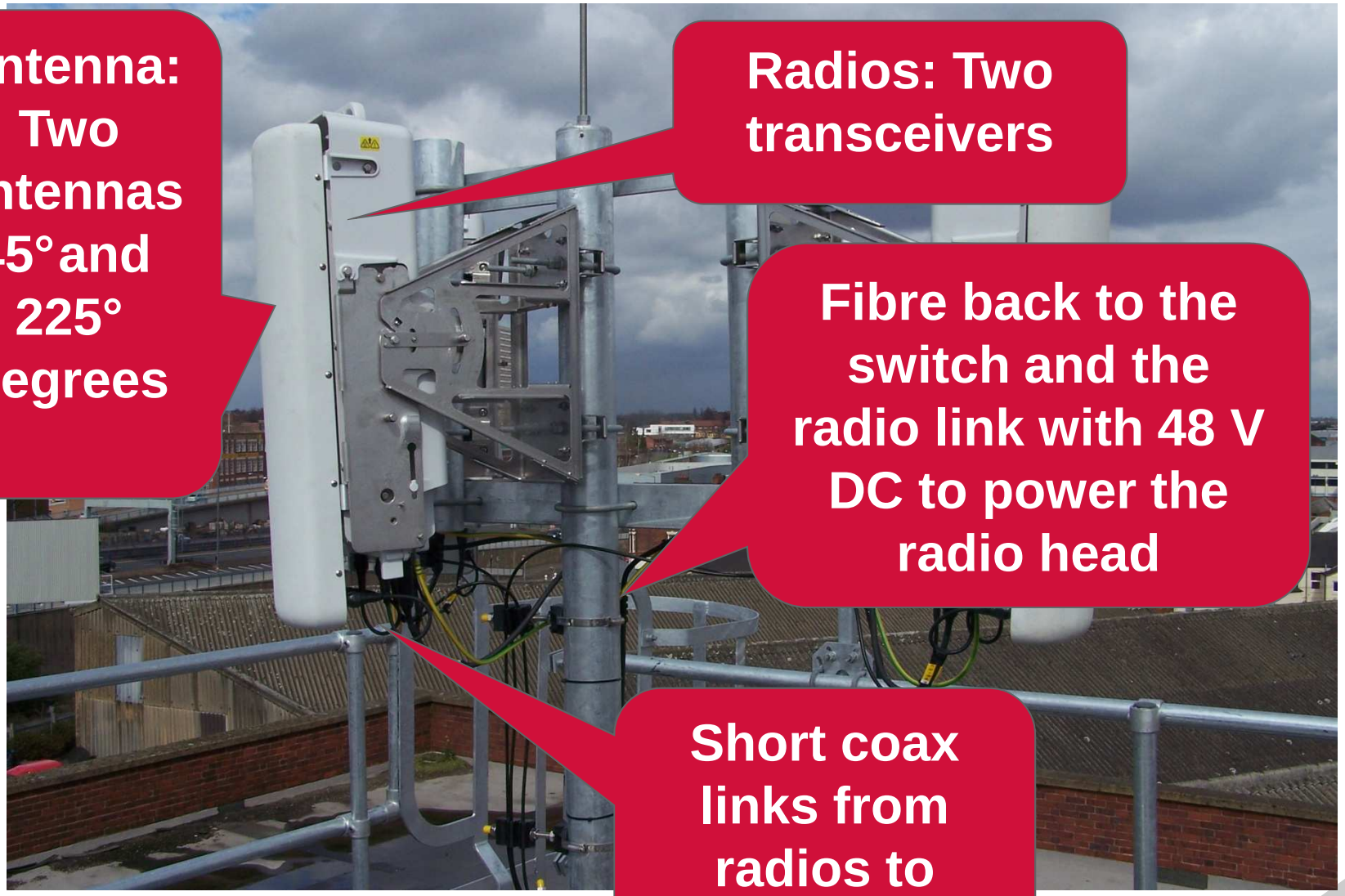
LTE (4G) Base station



Bit rates for a channel given completely over to a single modulation scheme

Mod.	Code Rate	5 MHz Channel		10 MHz Channel	
		Downlink Rate, Mbps	Uplink Rate, Mbps	Downlink Rate, Mbps	Uplink Rate, Mbps
QPSK	1/2 CTC, 6x	0.53	0.38	1.06	0.78
	1/2 CTC, 4x	0.79	0.57	1.58	1.18
	1/2 CTC, 2x	1.58	1.14	3.17	2.35
	1/2 CTC, 1x	3.17	2.28	6.34	4.70
	3/4 CTC	4.75	3.43	9.50	7.06
16QAM	1/2 CTC	6.34	4.57	12.67	9.41
	3/4 CTC	9.50	6.85	19.01	14.11
64QAM	1/2 CTC	9.50	*6.85*	19.01	*14.11*
	2/3 CTC	12.67	*9.14*	25.34	*18.82*
	3/4 CTC	14.26	*10.28*	28.51	*21.17*
	5/6 CTC	15.84	*11.42*	31.68	*23.52*

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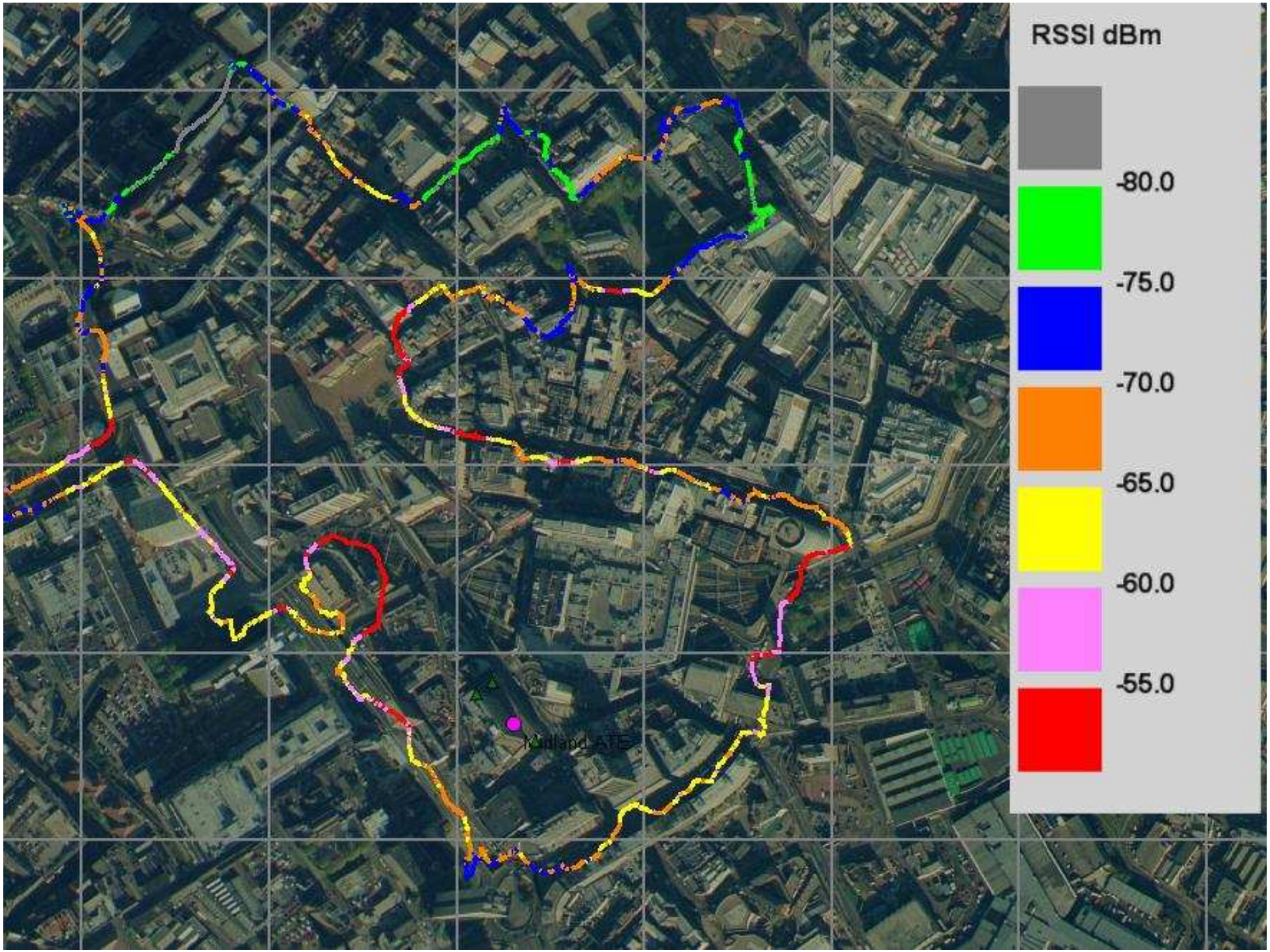
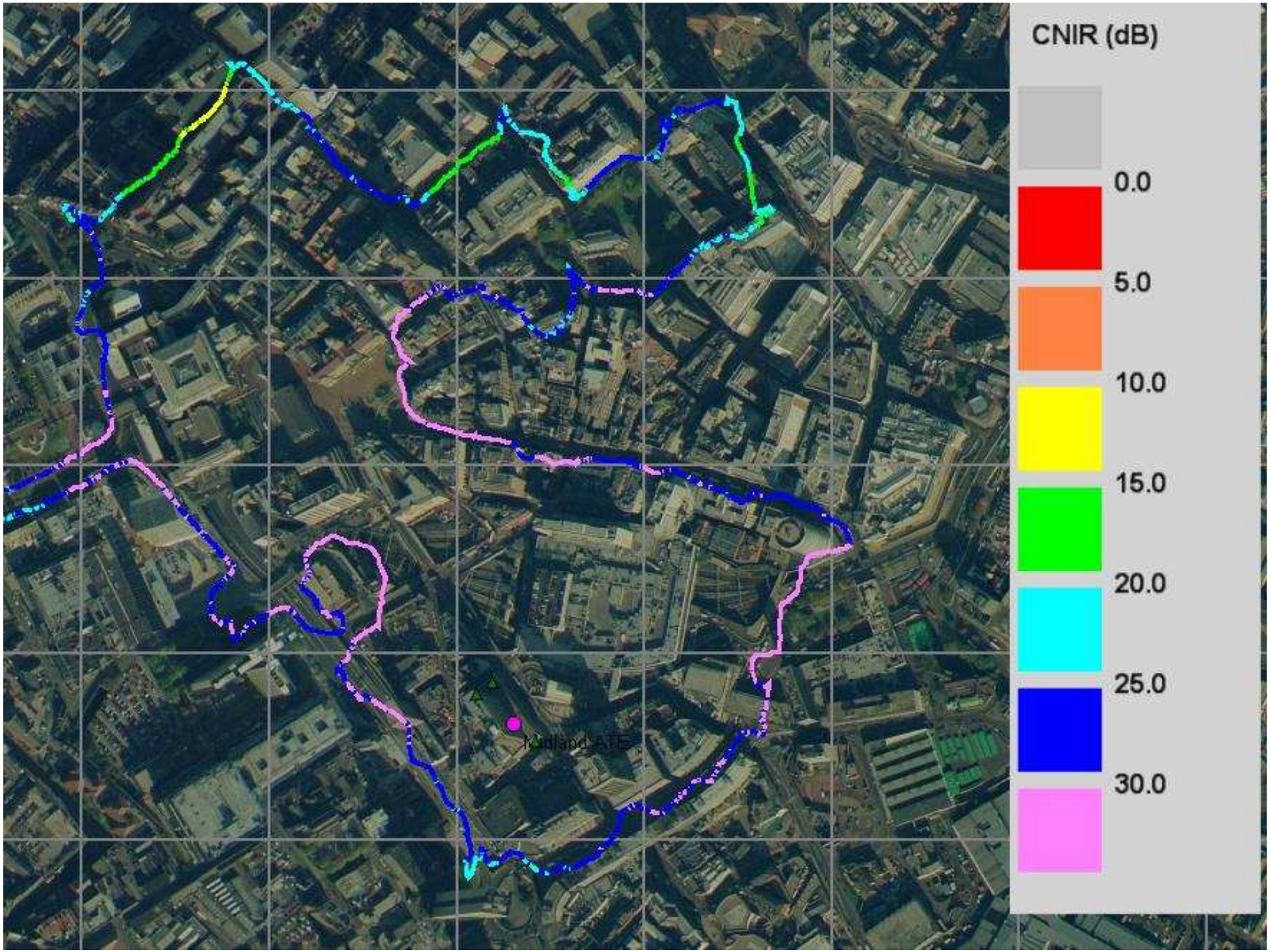
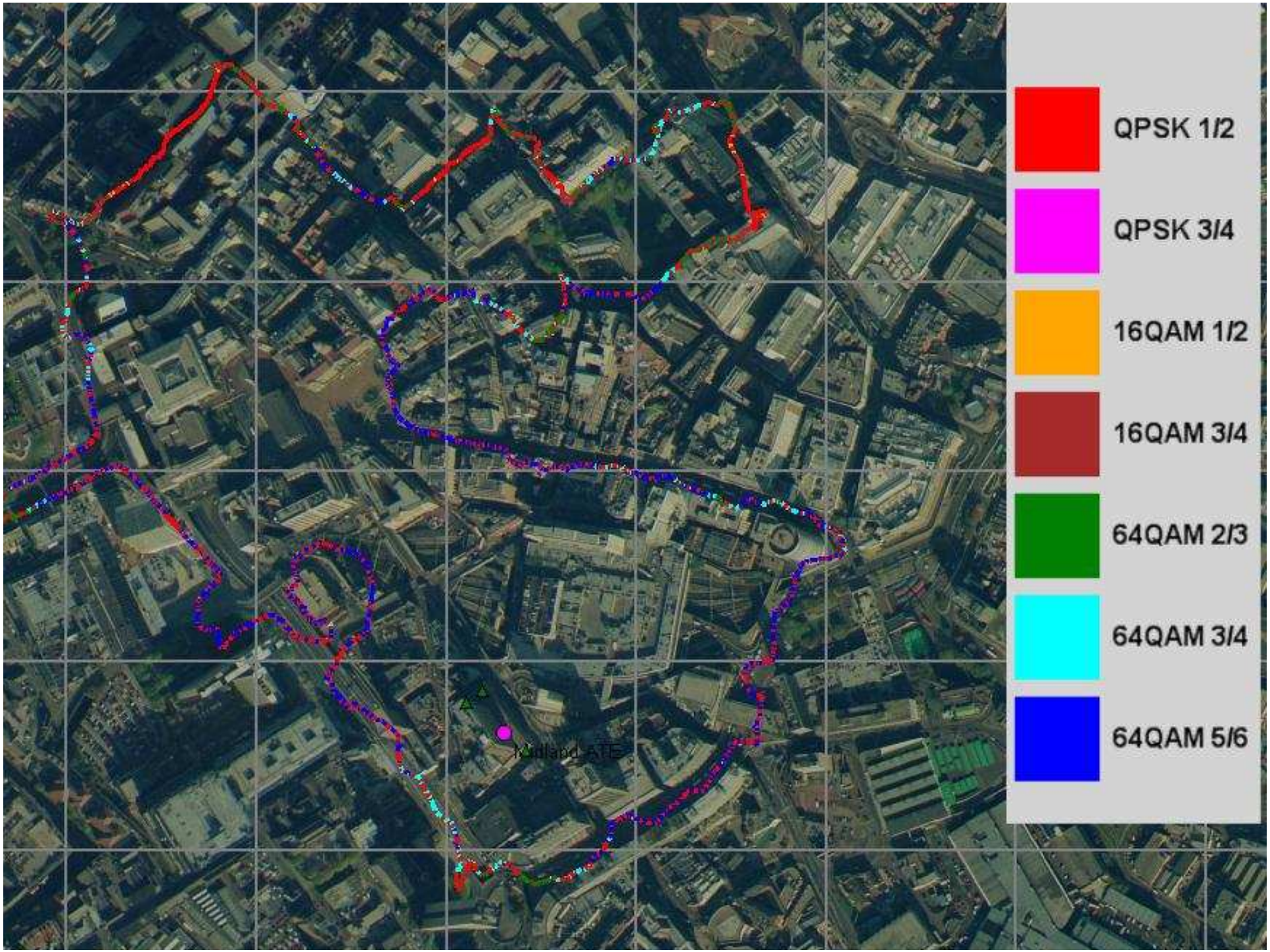

RSSI dBm
-80.0
-75.0
-70.0
-65.0
-60.0
-55.0
Midland ATE

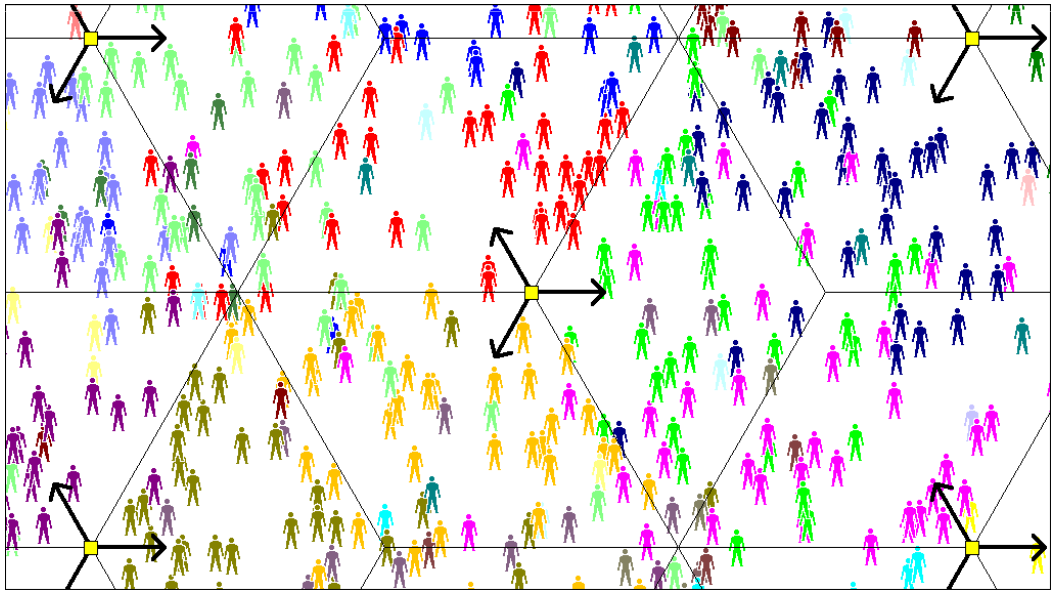

CNIR (dB)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Midland ATE


QPSK 1/2
QPSK 3/4
16QAM 1/2
16QAM 3/4
64QAM 2/3
64QAM 3/4
64QAM 5/6
Kirkland ATE

Bit per Hz calculation – how much data does the network deliver when a cell is fully loaded

Simulation process:

- Distribute users at random locations across cell areas
- Calculate propagation loss from each sector to each simulated user
- Assign users to best sector
- Assign modulation mode to each user, according to C/N+I
- Add up traffic for site – reject users who do not get any radio resource
- Calculate number of users that achieve required bit rate



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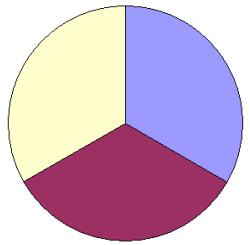
Bits per Hz

- DAB/DMB – 1.1 Mbits/s useable bandwidth for 1.5 MHz – fixed modulation QPSK – 0.7 bits per Hz
- DVB T2 – 40 Mbits/s useable bandwidth for 8 MHz – assuming high order modulation 256 QAM – 5 bits per Hz
- LTE over a cell to handhelds/portables - 2 bits per Hz – so for 10 MHz of spectrum 20 Mbits/s of capacity per sector per frequency to be shared with all users
- 20 Mbits/s – can deliver 363 radio streams at 55 kbits/s
  - Cell radius 500m gives a cell area of 0.75 sq km
  - Sectorised antenna so 1/3 of area 0.25 sq km



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LTE network costs

- 6000 sites for 60% coverage of UK by population
- 16000 sites 90%+ coverage of UK by population – rural road coverage limited
- Each site £150k cost to build with £35k operating cost including back haul, back office and call centres
- £2.4 billion investment with £560 million operating costs plus spectrum costs of £1 billion
- Assume cost of money 2% - interest £68 million – 7 year pay back linear depreciation - £486 million
- Cost per year to run the network £1.1billion
- Per customer £50 per year handset subsidy - £30 customer retention
- Assume – 4 million customers - Operator needs £330 revenue per customer to break even
- Will the network operators allow a consumer to listen to the radio while mobile between 30 minutes to 3 hrs a day free?

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Network 3 bundles

The One Plan.

For the first time there's a plan that has more than enough of everything, at a more affordable price.

Pay Monthly.

24 month plan
2,000 any network minutes
5,000 Three-to-Three minutes
5,000 texts
1GB internet
From £25 a month.

Choose a phone

SIM Only.

12 month plan
2,000 any network minutes
5,000 Three-to-Three minutes
5,000 texts
1GB internet
£25 a month.

Buy now £

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3 tariff pay as you go

Voice call Charges.

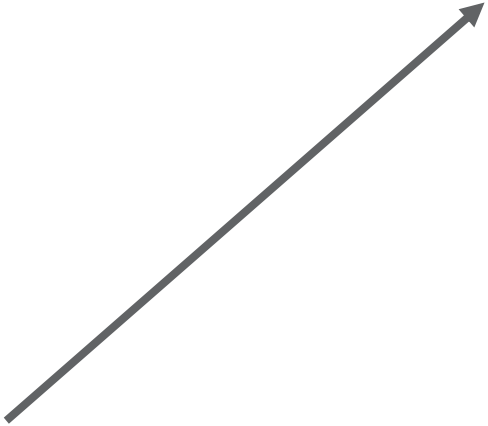
Voicemail (flat rate):	£0.15 per minute
Three-to-UK landline (flat rate):	£0.25 per minute
Three-to-Three UK (flat rate):	£0.25 per minute
Three to other UK mobile networks (flat rate):	£0.25 per minute

Video call Charges.

Three-to-Three UK:	£0.50 per minute
Three to other UK mobile networks:	£0.50 per minute
Videomail:	£0.25 per minute

Other Charges.

UK text messages:	£0.10
UK picture messages:	£0.30
UK picture mail:	£0.30
UK video messages:	£0.50
Internet browsing:	£0.10/MB



2 minutes and 30 seconds of listening

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Conclusions for wireless networks

- Large number of cells/sites – need to seamlessly hand over cell to cell for good QoS experience in a car
- Networks designed for IP traffic will be designed for population centres where people can browse not for major road links
- Network and spectrum costs will mean that Operators will need to charge – pay as you go example
  - £0.1 for 2 minutes and 30 seconds
  - 30 minutes of radio listening in the car to work - £1.20
  - 5 times a week - £6
  - Per year - £300

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Thank you