Starlink & LEO
Edge Networking

ESN/Mission Critical Communications

Rural Broadband

IoT and Cellular Backhaul

About me:

- Worked for Raytheon and Reuters negotiating with US & UK Governments for RADAR, IFF and communication technology exports

- During 90's and early 2000s worked with Alcatel, and for Nokia, on HDML, WAP, Smart Messaging and Data enhancement for low bandwidth networks

- 2010's worked as an adviser to Airwave on their ESMCP Lot 2/3 bids, specifically devices and edge of network coverage, including
  - Autonomous LTE
  - HPUE
  - Dual Mode (TETRA/LTE) User devices and gateways

Existing Starlink

- No of satellites – 3,266 – Generation (Gen)V1.0 & v1.5

- Using Ku Band (12-18GHz), Ka Band (26.5-40GHz) (Potential issue with Dish Network using 12GHz for 5G services)
    - Allegedly Starlink will be affected up to, perhaps beyond, 13 miles (21km) from a Dish base station.
    - Future use of 2GHz spectrum (FCC filing July 25, 2022)
    - July 27, 2022 application for more spectrum

- Five orbital shells

Shell 1	53.0 Degrees	550km	1,584
Shell 2	70.0 Degrees	570km	720
Shell 3	97.6 Degrees	560km	348
Shell 4	53.2 Degrees	540km	1,584
Shell 5	97.6 Degrees	560km	172

- UK Ground Station
    - Goonhilly
    - Chalfont Grove
    - Isle of Man
    - …

Data courtesy of Mike Puchol – https://starlink.sx

Current UK Performance

- Starlink Business
  - Peak downloads as high as 600Mbps, but typically 350 – 420Mbps
  - Upload as low as 15Mbps and as high as 30Mbps
- Starlink Residential
  - Download speeds for UK float around 150-190Mbps with spikes above 200Mbps
  - Upload speeds circa 9Mbps and 20 Mbps
- Latency averages at 28ms but can be as high as 45ms

FAST

Your Internet speed is

420 Mbps

Latency

Unloaded	Loaded
32 ms	**34** ms

Upload

Speed

18 Mbps

Factors affecting performance

- Network Saturation

- Satellite Version

- Mount Location,
  - Sometimes constrained
  - Environment, trees, buildings etc
  - Climate, wind
  - Power availability / Client choice!

- Dish Type
  - Business/High Performance/Pole/Flat
  - More satellites & more receiver elements

- Fair use policies
  - Data Caps
    - Residential 1TB/Unlimited
    - Business 500GB/1TB/3TB – Exhausted 1Mbps
    - 7am/11pm accounting
  - Priority Access accounting 7am/11pm

- 12GHz Rain Fade

- In Motion use

Size Comparison

Deployment Scenarios

- ESN/Mission Critical Communications/First Responders
- Rural Broadband - Bluetown
- Farm and IoT Connectivity
- Pop-Up Connectivity – Horse Racing, Exhibitions, Gigs
- Rural LTE Backhaul
- Disaster Recovery
- Mobility
  - Maritime
  - Air
  - Trains
- Oil Rigs, Mines…
- Remote Surveillance
- Military / Dual Use
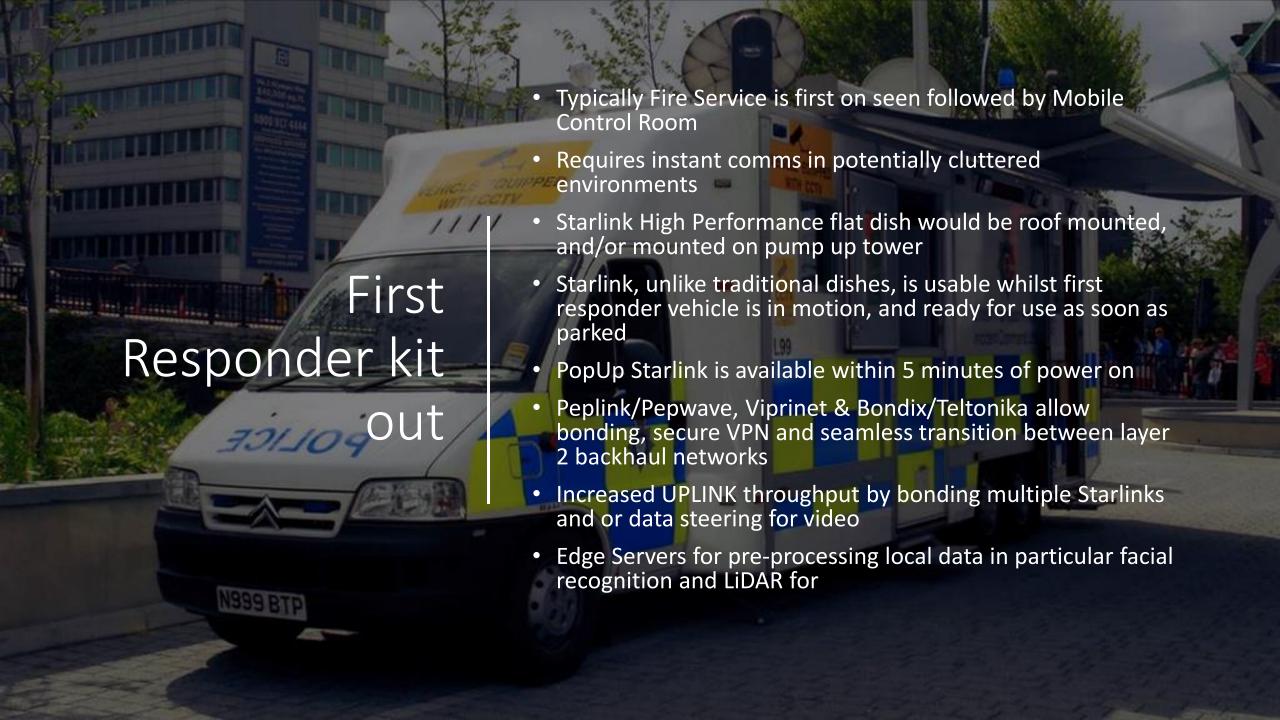
Similarities between Scenarios

- Backhaul
- Local Distribution
- Access Network
- On-Boarding
- Service Management

Backhaul – Capacity and Resilience

- UK TETRA & US P25
  - Traditional TETRA has 99% UK LAND coverage, Plus A2G, and Coastal
  - TETRA base stations have high levels of power resilience, and overlapping coverage
  - TETRA building penetration is better
  - PTT over D2D works!
- ESN & Critical Comms Mitigation
  - Improved throughput and resilience
    - Primary LTE CAT20 / 5G, falling to
    - HPUE for Critical Comms, falling to
    - Bonded Starlink, falling to
    - OneWeb / Globalstar

First Responder kit out

- Typically Fire Service is first on seen followed by Mobile Control Room

- Requires instant comms in potentially cluttered environments

- Starlink High Performance flat dish would be roof mounted, and/or mounted on pump up tower

- Starlink, unlike traditional dishes, is usable whilst first responder vehicle is in motion, and ready for use as soon as parked

- PopUp Starlink is available within 5 minutes of power on

- Peplink/Pepwave, Viprinet & Bondix/Teltonika allow bonding, secure VPN and seamless transition between layer 2 backhaul networks

- Increased UPLINK throughput by bonding multiple Starlinks and or data steering for video

- Edge Servers for pre-processing local data in particular facial recognition and LiDAR for

Problems with Starlink Hardware

- Wi-Fi Access Point is only suitable for VERY basic home use. No management page apart from mobile app

- No DC PoE Option, but third parties, such as dishypowa.com, are creating plug and play solutions for RV/Residental Starlink

- Starlink uses Ethernet cables but to their own colour coding

- Connectors are non standard

- VERY Limited range of cables making installation difficult

- Power draw at start up to 190Watts for high performance dish

- High performance power supply is beveled on most sides making mounting more difficult than it should be

- Starlink mounts are good, but included bolts and drills, IMO, are not suitable for UK use

Local Distribution

- Terragraph multi gig self organising and medium distance
  - Siklu provides 360 degree coverage with multiple antenna options but at high cost
  - Upto 3.8Gbps per sector
  - Cambium great value for rural deployments
- PtP for very long distance links 80GHz
- PtMP for short range distribution 60Ghz
  - Siklu and Cambium
- Outdoor Wi-Fi Mesh
  - Can replace PtMP in certain deployments
- LoRaWAN/Sigfox for IoT
  - Useful for grain store management
  - Farm security

Access Networks

- Ethernet – Copper and Fibre

- Wi-Fi – 6e and 7

- Autonomous LTE e.g. Quortus

- TETRA Gateway for Device 2 Device

- Our pop up solution, on behalf of Clarus, for rapid deployment is shown here with IP68 rated case for carry, and <5 minutes deployment.

Test Deployment

- Starlink Residential as Primary

- High Gain antenna & CAT 8 EE Interface as Failover

- Draytek 3910 Multi VLAN Management Config + PoE and Fibre Switch

- Nomadix Gateway Multi VLAN Access Network Config

- Siklu PtMP for Root data distribution

- Ruckus Outdoor Wi-Fi T710 and Wi-Fi Mesh using vSZ-H management controller, VLAN segmented Wi-Fi

- Milesight LoRaWAN for IoT

- Fixed IP using Netcelero for VPN remote access

- Local Micro PC for remote management

- GoZoneWiFi for public and secure onboarding

- 1500WH UPS Power supply

- Note: 80GHz long range distribution link not shown

- Remote CCTV and LiDAR also not shown

Onboarding Service

- Using Starlink low latency the AAA can be remote

- We have an instance of GoZoneWiFi Carrier edition, allowing consumer, paid for and secure authenticated access

- WBA – Wireless Broadband Alliance OpenRoaming™ and Passpoint® is an option for pop up events and

- For ESN/Critical Comms a local EPC's HSS can be preconfigured with first responders USIM/eSIM credentials (Gisecke & Devrient)

Military and Surveillance Use

- Ukraine has demonstrated the need for high bandwidth comms for front line communications and command and control

- In particular CCTV, IR and Drone footage can be live streamed

- Starlink provides a backpack for portability, and by adding in compact, but high power battery pack, front line units have faster comms than previously possible at the price

- There have been some claims that Starlink has been integrated with semi submersible drones for surveillance and weapon guidance

- This could/would break USEAR Dual Use/ITAR controls if this is proven

- Starlink v2 satellites will enable normal handsets to connect to the network. By using the laser interconnects that will enable remote ground stations to be used for backhaul leading to interesting use cases.

Management and Other Issues

- Starlink uses CGNAT so residential does not have a fixed IP address
  - Workaround using Netcelero
  - VPN connectivity and 5 port forwards for CCTV and other uses
- Starlink Business has a routable fixed IP address but it's issued from a DHCP pool and assigned to a user's device
- This may lead to reassignment of the fixed IP address in certain circumstances so a DDNS setup may be a good backup.
- Support is problematic, although Clarus now has direct API access to Starlink so can handle many issues
- There is no process to transition support from existing Starlink Business clients at this time
- InMotion use is expensive
- We have no certified power consumption or wind loading tests yet. These are requirements
- Starlink Business T&Cs exclude the use of providing public Wi-Fi

Questions

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