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5G HUDDLE

27 April 2016

A glimpse into the future:

What will 5G mean for me?

Adrian Grilli

Secretary, Radio Spectrum Group, European Utility Telecom Council

Director, Federation of Communications Services

Managing Director, Joint Radio Company Ltd

Cable Test.MPG JRC Spectrum.mp4

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A glimpse into the future:

What will 5G mean for me?

A utility telecom manager's perspective…

What in the world does 5G look like?

OR

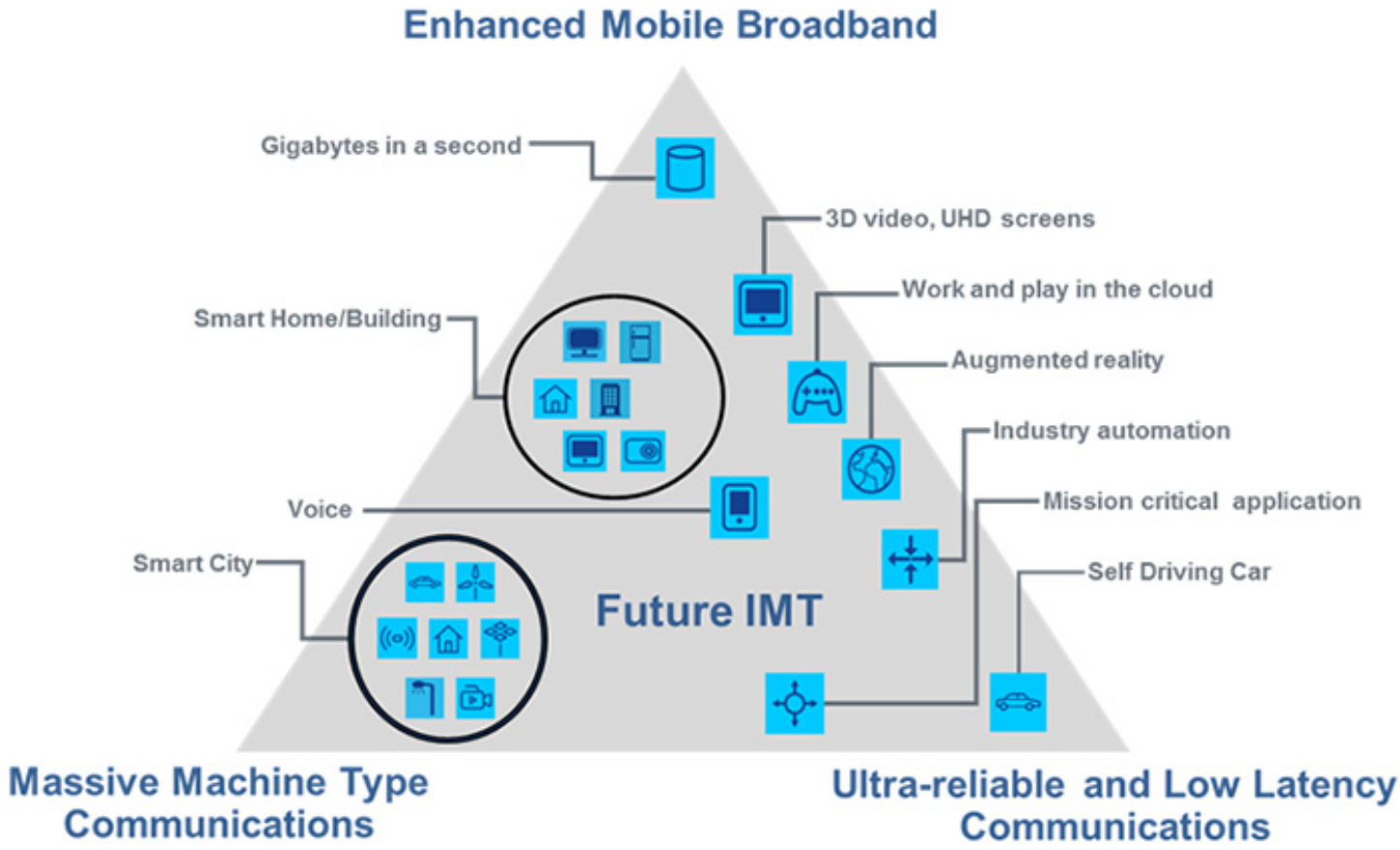
What does the world of 5G look like?

500Kv_switch.mpg

5G HUDDLE: 27 April 2016

- **ITU 5G Overview**
- **Utility operational communications requirements**
- **Technology options**
- **Delivery models**
- **Requirement for spectrum**
- **Customers**
- **Conclusions**

5G OVERVIEW


Enhanced Mobile Broadband
Gigabytes in a second
3D video, UHD screens
Work and play in the cloud
Smart Home/Building
Augmented reality
Industry automation
Voice
Mission critical application
Smart City
Self Driving Car
Future IMT
Massive Machine Type Communications
Ultra-reliable and Low Latency Communications

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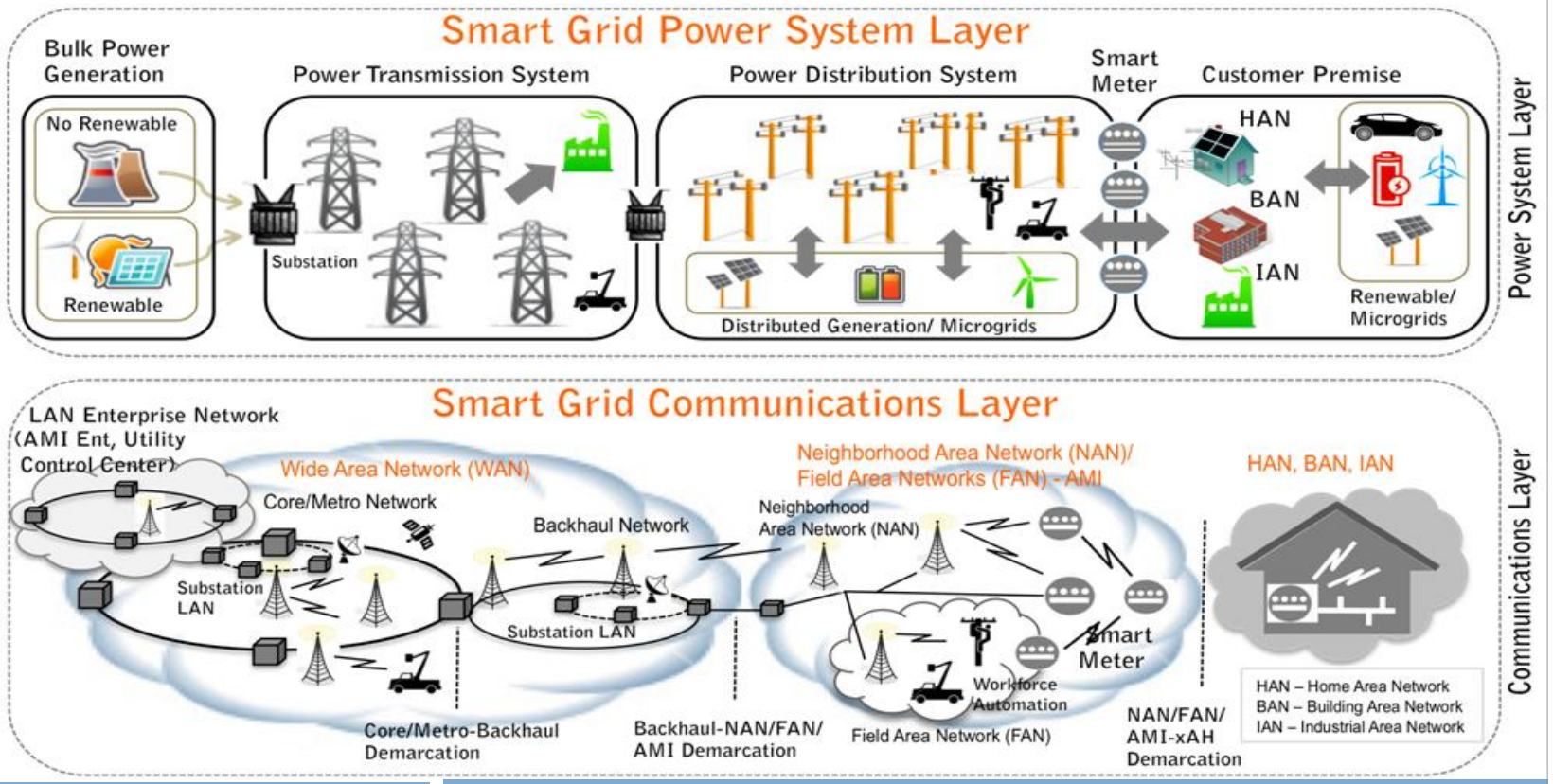
The Smart Grid Communications Physical Architecture



> 5GHz microwave
copper
fibre

150-900MHz private

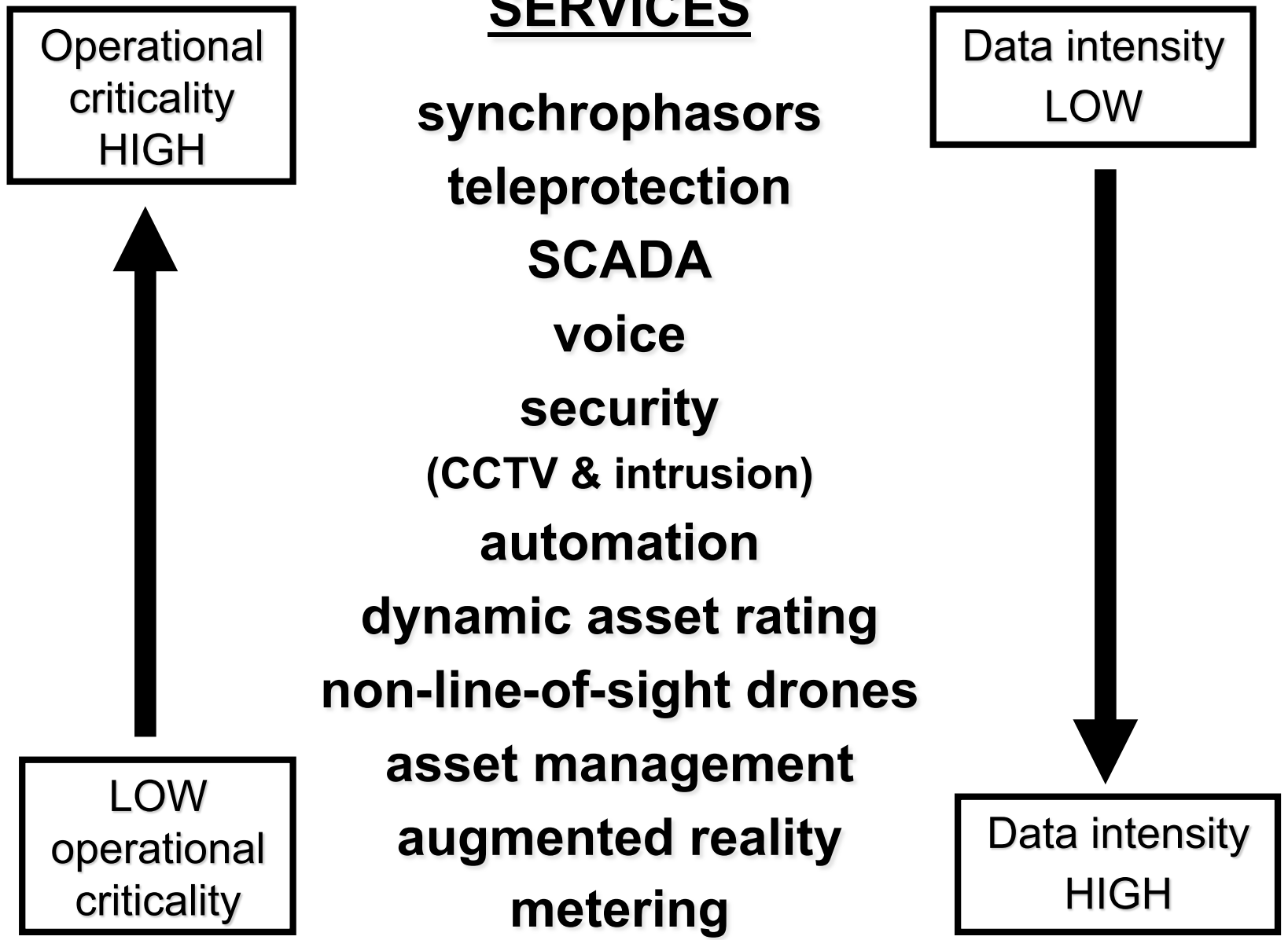
Satellite

Public cellular

1 - 5 GHz private

PLC & Deregulated

Diagrams courtesy of IEEE

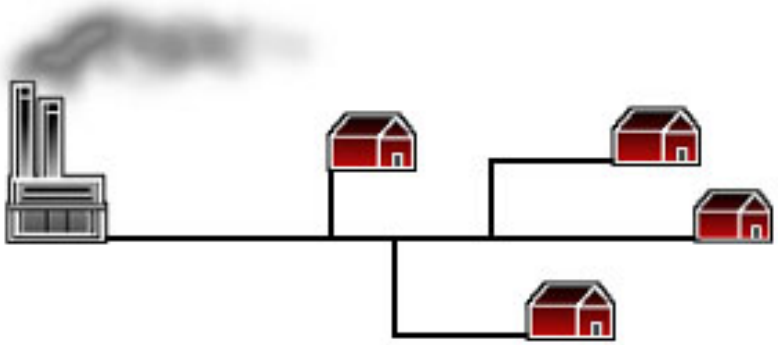

Operational criticality HIGH
LOW operational criticality
SERVICES
synchrophasors
teleprotection
SCADA
voice
security
(CCTV & intrusion)
automation
dynamic asset rating
non-line-of-sight drones
asset management
augmented reality
metering
Data intensity LOW
Data intensity HIGH

UK Electricity Distribution requirements only

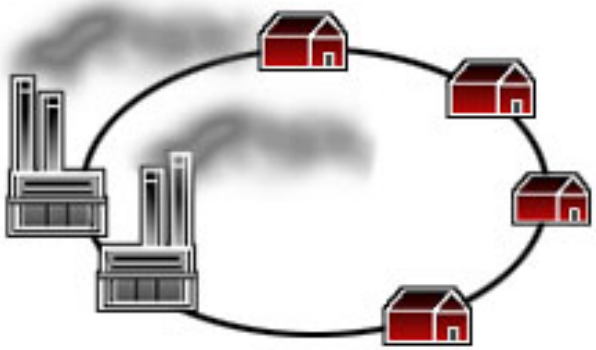
(excluding transmission, generation and supply)

Application	data rate (kbits/s)	Duty cycle	number of UK devices	Availability
Protection	64	continuous	2000	99.999%
Mobile data collection	2000	on demand	1000	90.000%
Intelligent substations	2000	continuous	3000	99.999%
CCTV	100	on demand	10,000	99.900%
SCADA	10	continuous	100,000	99.900%
Operational voice	10	on demand	10,000	99.000%
Network automation	2.4	on demand	1,000,000	99.000%
Control of renewable generation & storage	2.4	on demand	100,000	99.000%

Radial distribution



Ring distribution



Smart Grid Telecommunications Requirements

- High availability
- High reliability
- Resilient architecture
- Mains power independence
- Low latency and guaranteed symmetry
- Cyber security
- Wide area coverage
- Cost effective
- 2.4kbits/s – 10Mbits/s bandwidth
- Capable of supporting distributed control
- longevity of support for technology
- Graceful degradation
- Air-ground-air operation
- Flexible payloads, but primarily uplink centric

Power independence

Cabinet Office

National Risk Register of Civil Emergencies

2015 edition

Widespread electricity failure

Risk outline

2.106 A nationwide loss of electricity is an extreme scenario and to date a total system shutdown has not occurred in the UK. However, whilst this risk is considered very unlikely, our reliance on electricity means that even localised losses can have a severe impact on those affected.

2.107 A nationwide loss of electricity, for which the technical recovery process "Black Start" could take up to 5 days, would affect millions of consumers and critical services. If significant damage is caused to the transmission lines, it could be weeks before some parts of the network are fully recovered and power is restored.

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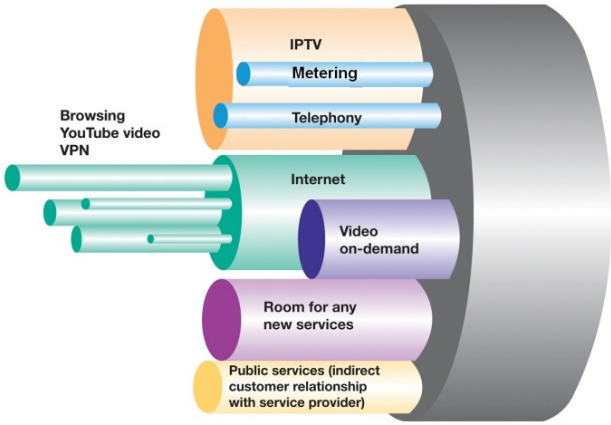
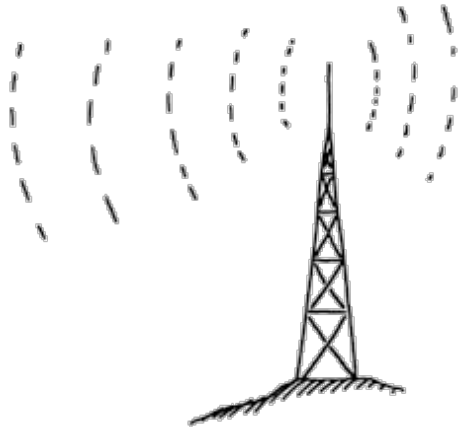
Telecoms Options

- **Fibre**
- **Copper**
- **Power Line Communications**
- **Radio**





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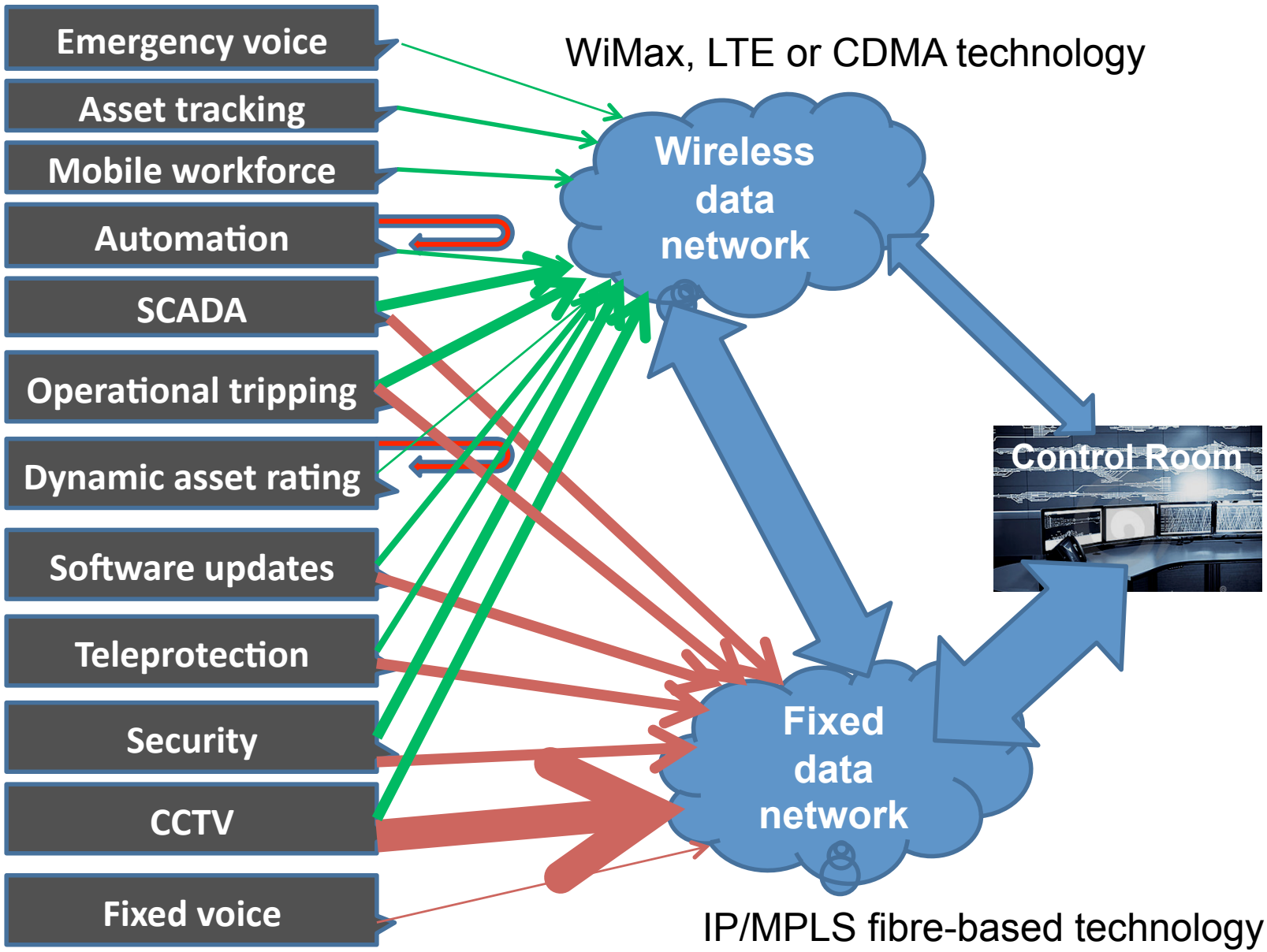

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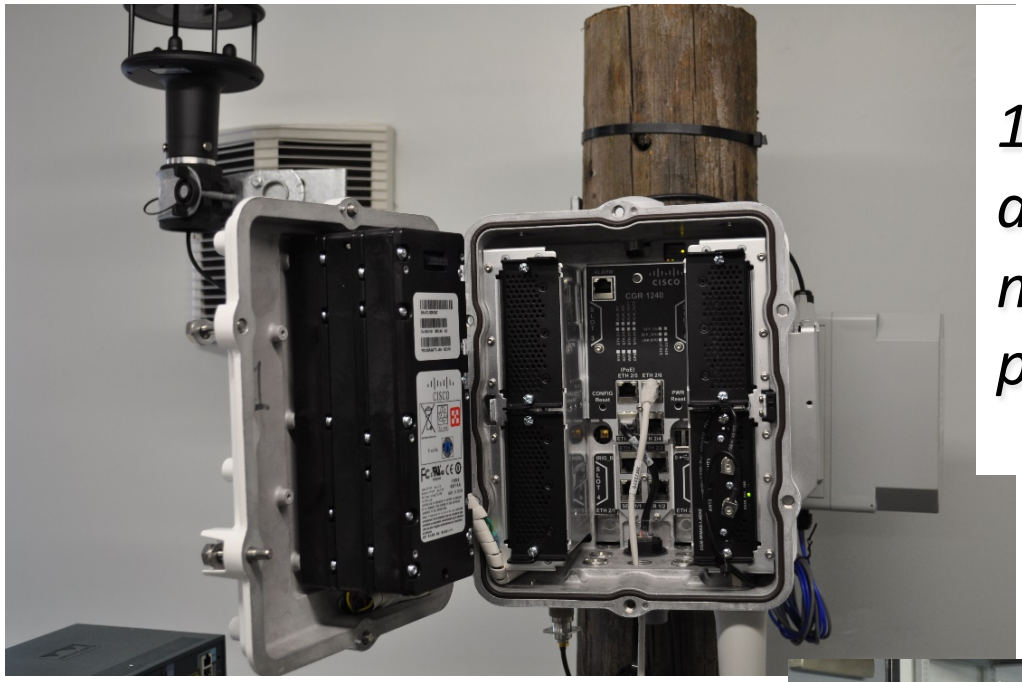

1.4 GHz WiMax distribution automation node with 72 hours power resilience

2.4 GHz WiFi cable clamp for dynamic cable rating based on actual temperature

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Delivery models

Public network

Fixed
PSTN
Broadband

Mobile
Licensed carriers

Private network

Single network

- Self-provided by utility
- Provided by commercial undertaking
- Joint venture with telco

Shared network

- Provided & owned by utility
- Shared ownership & operation
- Shared commercial

Licence exempt

Standardized
Wi-Fi
Bluetooth
Zigbee
Weightless
LoRa
Z-wave
Sigfox
LTE unlicenced

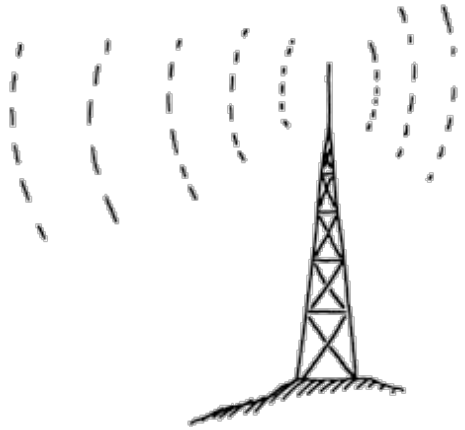
Proprietary
Silver Spring
Connode
etc

Radio

- **Flexible**
- **Cheap**
- **Quick to deploy**
- **Resilient**
- **Rapidly repairable**
- **Complementary to fixed telecoms**

BUT

- **Needs access to radio spectrum**



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EUTC Spectrum Proposal

Within Europe, multiple small allocations within harmonised bands:

- **VHF spectrum (50-200 MHz)** for resilient voice comms & distribution automation for rural and remote areas. [2 x 1 MHz]
- **UHF spectrum (400 MHz band)** for SCADA, automation, smart grids and smart meters. [2 x 3 MHz]
- **Lightly regulated or licence-exempt shared spectrum** for smart meters and mesh networks. (870-876 MHz)
- L-band region (1400 MHz) for more data intensive smart grid, security and point-to-multipoint applications. [10 MHz]
- **Public microwave bands (1500 MHz – 58 GHz)** for access to utilities' core fibre networks/strategic resilient back-haul.
- **Public satellite bands** to complement terrestrial services for particular applications.

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Network Operator	Network Operator Licence Area	Customers interrupted by short interruptions (<3 mins)	Customers off >3 mins	Faults repaired	Customers Restored Within		
					12 Hours	1 Day	2 Days
ENW	ENWL	50,148	46,879	297	93.2%	97.9%	100.0%
NPG	NPGN	28,838	48,937	242	99.6%	100.0%	100.0%
	NPGY	26,721	19,403	245	99.7%	100.0%	100.0%
WPD	WMID	40,772	34,962	380	99.7%	100.0%	100.0%
	EMID	24,719	18,248	296	100.0%	100.0%	100.0%
	SWALES	111,106	23,207	284	100.0%	100.0%	100.0%
	SWEST	140,536	57,695	756	98.2%	100.0%	100.0%
UKPN	LPN	3,926	14,070	212	99.2%	100.0%	100.0%
	SPN	140,656	230,859	1,066	77.4%	89.3%	95.8%
	EPN	168,402	88,002	811	97.7%	99.6%	100.0%
SPEN	SPD	26,651	24,829	411	94.8%	97.9%	99.9%
	SPMW	110,980	48,087	502	87.9%	96.9%	99.8%
SSEPD	SSEH	105,608	35,437	315	98.7%	100.0%	100.0%
	SSES	406,772	228,474	1,091	69.8%	93.2%	97.4%
	GB	**1,385,835**	**919,089**	**6,908**	**85.2%**	**95.3%**	**98.3%**

Table 1: Customer disruptions 23-28 December 2013 by Distribution Network Operator License Area

Telemetry for Western Power Distribution.mp4

CONCLUSIONS

- Radio communications vital for control of advanced intelligent networks.
- Better communications help restore power more quickly.
- Utility customers require secure, dependable, affordable and sustainable services.
- Utility services facilitate international development goals.
- How 5G services will be delivered appears unclear:
  - Operator delivered, licence-exempt, private networks?
  - If a combination of above, how will access be controlled?
  - If Private 5G networks are part of the vision, where will they get their spectrum?

JRC Spectrum.mp4