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Innovation opportunities for 5G & IoT

PCSE Europe Forum Conference, Oxford, UK

9th December 2015

5G & IoT Topics

- About the WTIC and current activities
- Future Technologies Network innovation paper
- Scope and evolution
- Use cases and challenges
- Potential collaboration items based on conference themes

About the WTIC

www.wtic.org.uk

WTIC Current activities

- 5GHz
- 5G
- 700MHz
- Radio modelling
- Internet of Things

Trials and Test beds

WTIC hosted by DTG Testing
Wireless Test & Innovation Centre

1. Contents
2. Introduction
3. Executive summary, conclusions and recommendations
4. 5G use cases and commercial considerations
5. 5G Technology and Innovation
6. Spectrum
7. Standards, test and measurement

Source: http://www.techuk.org/insights/reports/item/6008-5g-innovation-opportunities-a-discussion-paper

5G vision, seamless services with perception of sufficient bandwidth and coverage in any context

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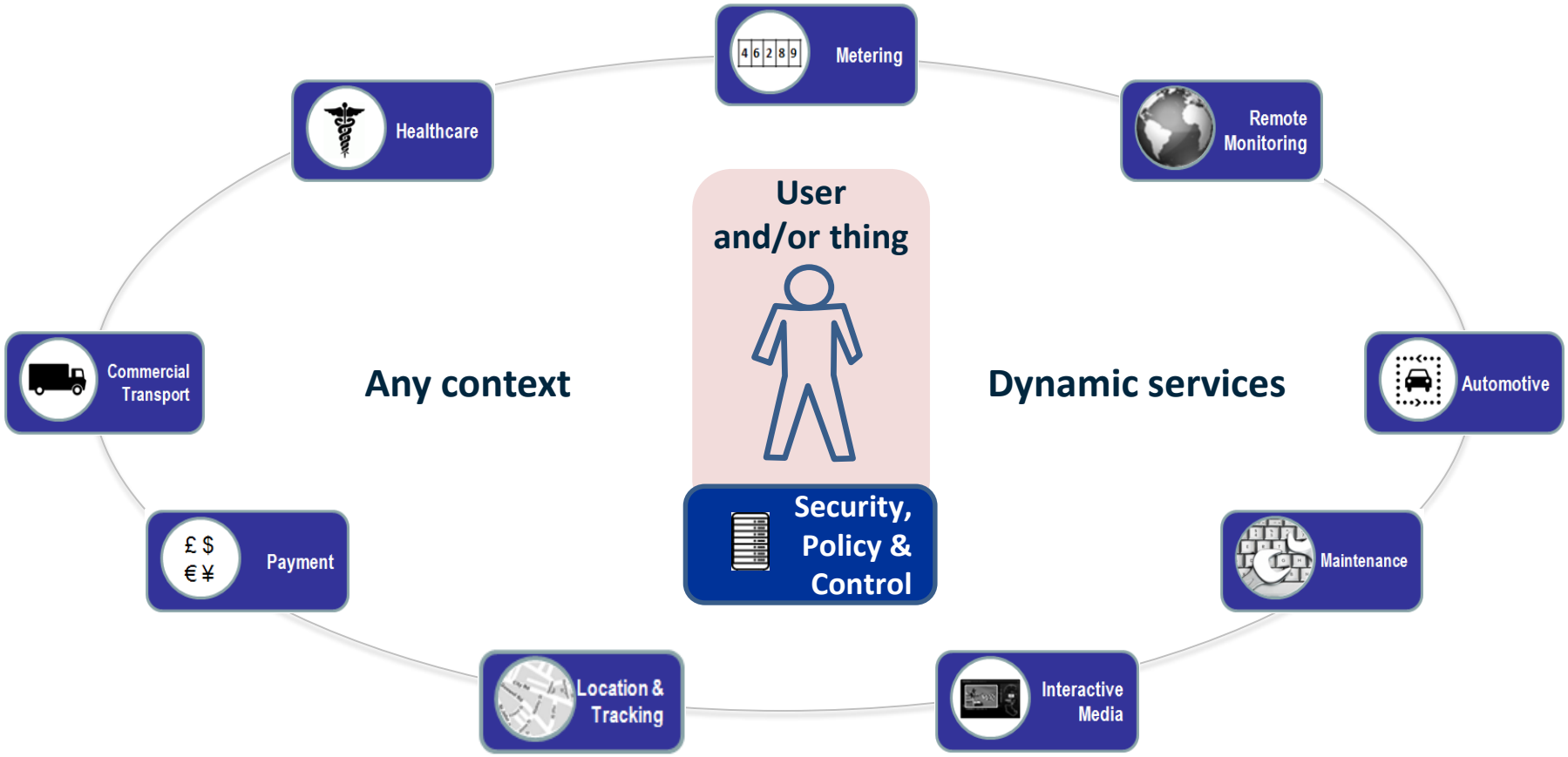


Next generation services enabled, abstracted complexity

Technology and innovation opportunities

		NETWORK INNOVATION (Network of Networks and interworking)				RADIO INNOVATION (including licensed and licence-exempt)		
Core 5G requirements		Mobile (Cellular)	Fixed (Satellite, Broadcast, xDSL, Fibre, Wireless)	Content delivery (CDN – edge / user)	Core Networks / Management (SDN/NFV)	<1GHz	1-6GHz	>6GHz
1	1-10Gbps connections to end points in the field (i.e. not theoretical maximum)	5G Radio Access Technology	Access technologies	Content / stored data nodes near to the EDGE and USERS	Backhaul and core network connectivity	Leveraging best available existing air interfaces and evolution to 5G RAT		Developing new technologies and 5G RAT
2	1 millisecond end-to-end round trip delay (latency)	CROSS NETWORK = 5G DIGITAL FABRIC Interworking Innovation enabled through Trials and Test Beds. Including cross boundary Security, Policy, Control, Identity and Monetisation				MULTIPLE RADIOS = 5G DIGITAL FABRIC Spectrum usage and management innovation enabled through trials and test beds. Multiple networks, bands and/or air interfaces and control and/or user plane		
3	1000x bandwidth per unit area							
4	10-100x number of connected devices							
5	(Perception of) 99.999% availability					Low capacity, good for control / coverage	Medium Capacity, good for control and user plane	High capacity, good for user plane
6	(Perception of) 100% coverage							
7	90% reduction in network energy usage	MAJOR CHALLENGE - Radical low energy technology evolution at multiple levels for each area: materials, device, systems and cross network						
8	Up to ten year battery life for low power, machine-type devices							

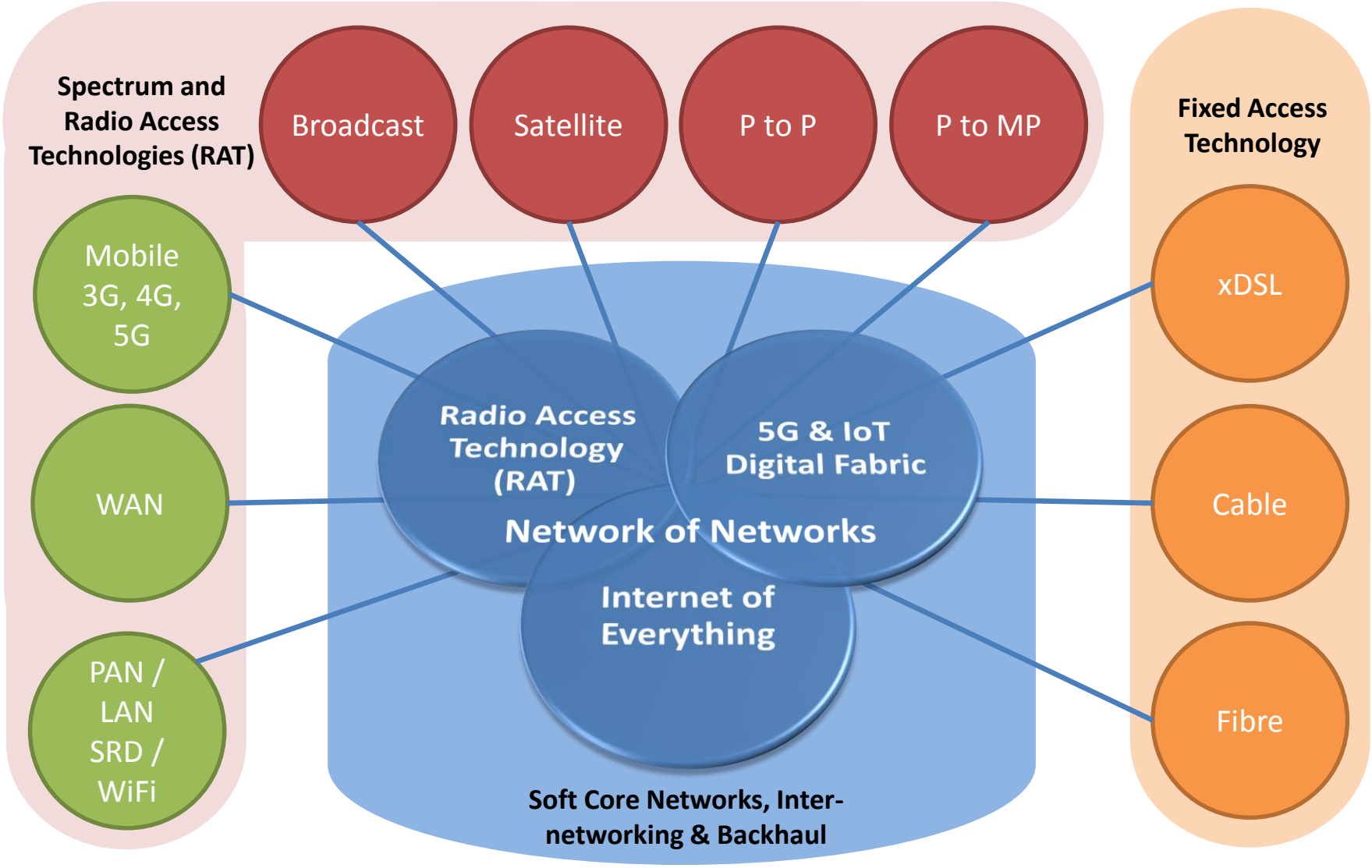
5G paper recommendations

Challenge	Notes	Recommendations
UK capability and current projects	Bring together existing research and activities	Create 5G & IoT innovation network Test beds and trials, enabling 5G Digital Fabric and technology validation Create UK eco-system to develop leading position for international 5G standards activity
Network infrastructure, topology and 5G digital fabric	Leveraging new and existing network infrastructure – enabling network of networks	
Radio technology evolution	Air-Interfaces and antennas	
Spectrum engineering	Co-existence and interference, global economies of scale	
	Enhanced radio planning. 3D, mapping and terrain	
Data processing, data handling	Data, Control and User plane - Big Data enabled networks, addressing the 3 V's = Volume, Velocity and Variety	
Socio Economic challenges	Technical use case validation. Health & Social care, energy and transportation	

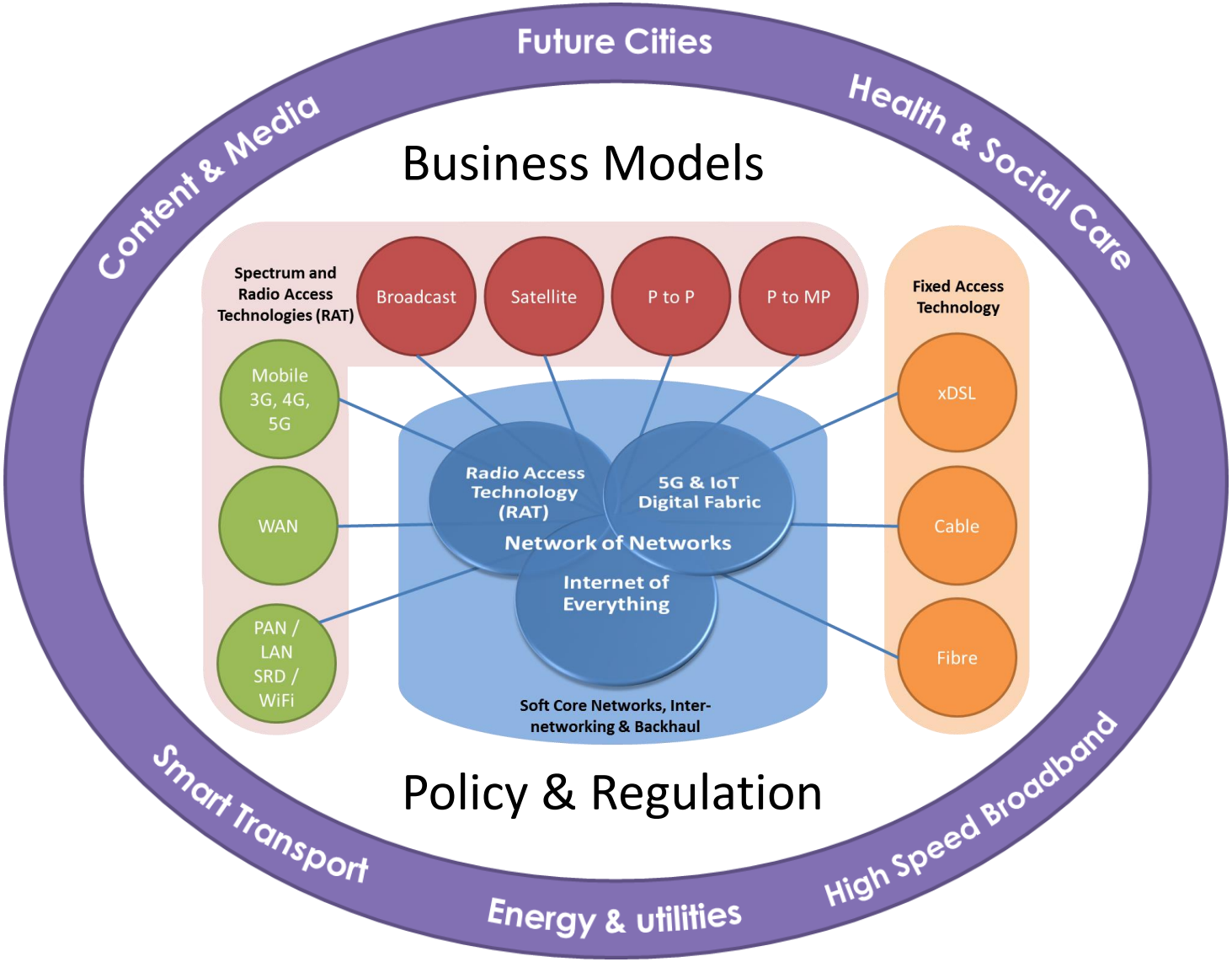
Key Service features provided by each generation of Mobile Networks

1G	Phone Service. Mobility to Voice Services (analogue)
2G	Phone Service. Digital GSM + Added Security through Digital encryption
2.5G	Phone Service 2G + limited data. Short Message Entity + Packet Services
3G	Phone Services + data + new services and Apps
4G	Previous G's plus: Packet Service Only + Higher throughput (Data Centric Architecture)
5G	Previous G's plus: Greater Consistency & Flexibility in QoS / QoE, transparent to user. Ultra-Dense Connectivity and Capacity, perception of near 100% COVERAGE in all areas

5G & IoT, scope and evolution



5G & IoT, scope and evolution



Stakeholders in Fixed / Mobile / IoT eco-system

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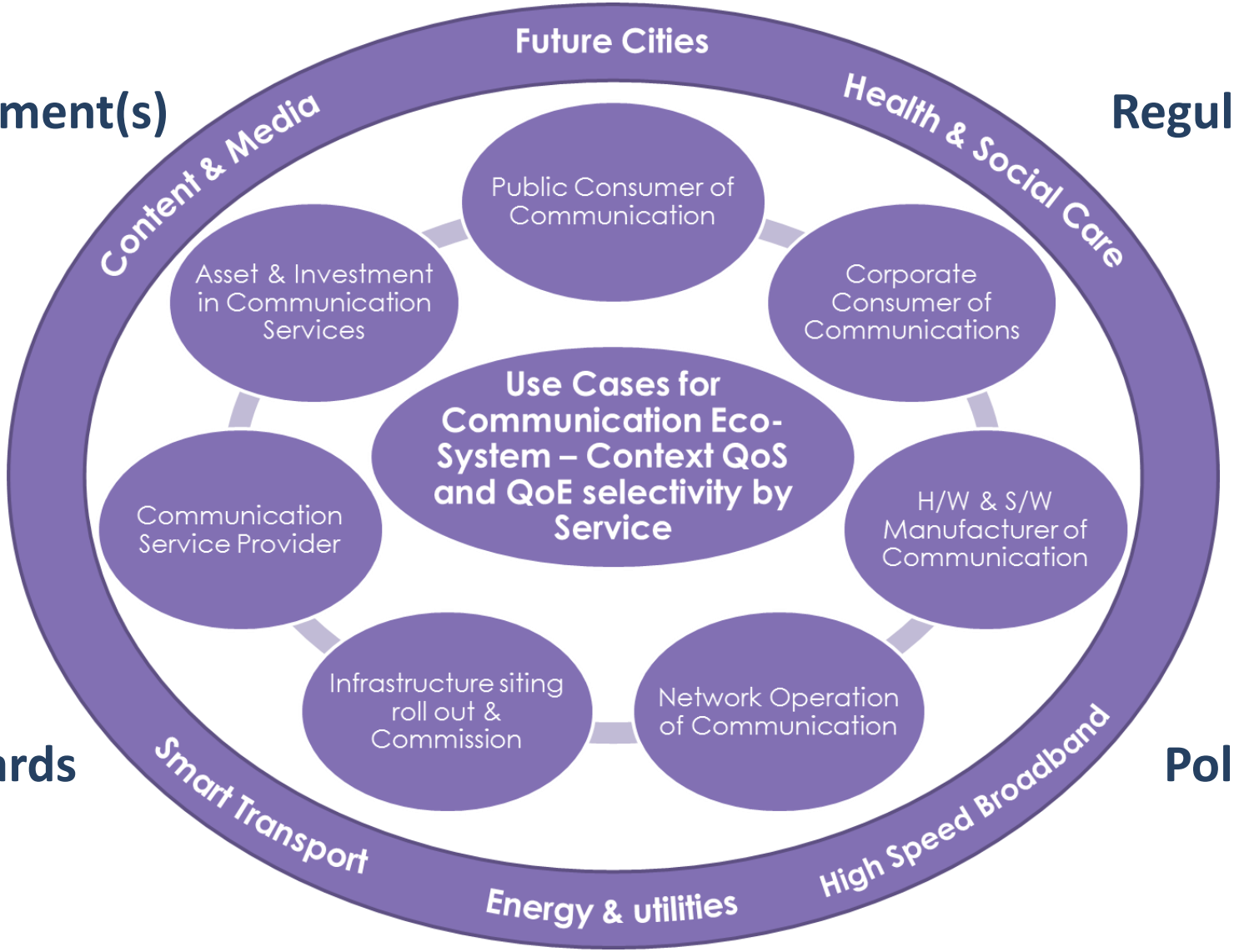

5G vision, seamless services with perception of sufficient bandwidth and coverage in any context

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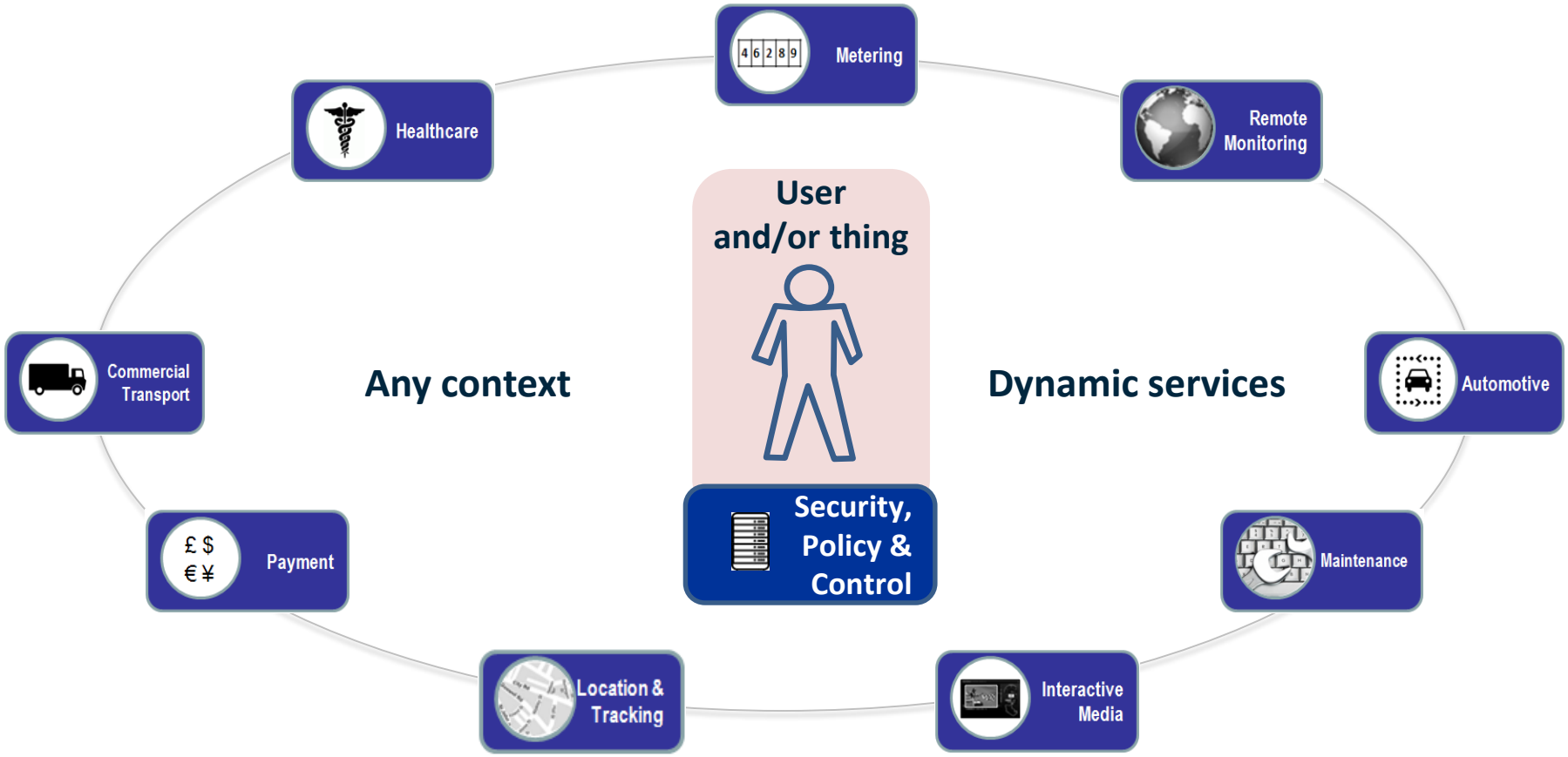

Next generation services enabled, abstracted complexity

5G uses cases in context

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Busy Son & Carer

Transport control

Office

Public Transport

Outpatients appointment

Hospital

Planning required due to disabilities, accessibility, weather and air quality

Weather & Air Quality

Elderly Father with Multiple Long Term Conditions + professional care

Home

Car

Utilities, telehealth & telecare

5G uses cases in context, major incident

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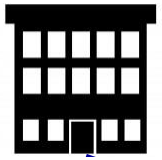
Transport control

Busy Son & Carer



Office

Public Transport

Emergency Services

Hospital

Major Incident

Taxi

Emergency Services

Emergency ervices Control Centre

Major Event

Weather & Air Quality

Elderly Father with Multiple Long Term Conditions + professional care

Home

Car

Utilities, telehealth & telecare

Emergency Services

5G uses cases in context

Network of Networks – dynamically operating across boundaries

5G assets – Intelligent Radio Capacity, focused on incident

Not necessarily 5G air interface… e.g. could be combination of WiFi, 3G, 4G, 5G, Satellite etc.

5G example use cases - combined to deal with an emergency incident generated through traffic accident in a congested city	*Smart Transport / Cities*	*Health & Social Care*	*Content & Media*
	IoT enabled eco-system, covering connected car, traffic control and route planning. From collision detection and avoidance to prevent incident through to linking and interacting with city infrastructure	**Emergency response, patient data on site, low latency remote diagnostics, remote clinician / medical / robotic operation**	**Higher resolution / increased video usage on site - users, emergency services and local businesses**
1. 1-10Gbps connections to end points in the field (i.e. not theoretical maximum)	●●	●●●	●●●
2. 1 millisecond end-to-end round trip delay (latency)	●●●	●●●	●●●
3. 1000x bandwidth per unit area	●●●	●●●	●●●
4. 10-100x number of connected devices	●●●	●●●	●●
5. (Perception of) 99.999% availability	●●●	●●●	●●●
6. (Perception of) 100% coverage	●●●	●●●	●●●
7. 90% reduction in network energy usage	●●●	●●●	●●●
8. Up to ten year battery life for low-power, machine-type devices	●●●	●●●	N/A
9. Network of Networks - to achieve requirements of 1 to 8 listed above, operating seamlessly together.	●●●		

Key to table:		
	●●●	High level functionality of 5G required. Not achievable using current technology, requires 5G RAT and 5G Digital Fabric
	●●	Achievable using current technology, but requires significant network of networks cooperation not achievable today
	●	Can be achieved using current technology and networks

Trials and test beds chronological evolution

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Technology Building Blocks

Systems, integration and interoperability

Network of networks and Digital Fabric

Service and Apps, Socio-economic challenges

Technology PUSH – Trials and Test Beds

Technology PULL – Trials and Test Beds

Health & Social Care

Key themes

- Debating the results of **WRC'15** - Is 700MHz going to be available for Public Safety, by what means, and by when?
- What is the roadmap for **PPDR 4G?**
- Will 4G transition to **5G**? Do we have to start again? What new benefits will 5G bring for Public Safety?
- The increasing deluge of **Social Media**, and Information Exchange for Emergency Management: What are the challenges from a social, legal and ethical perspective?
- Key challenges for the security and resilience of next generation **mobile broadband for PPDR**

Energy & Utilities

Transport

Smart Communities

Buildings, Rural, Cities……

Questions?

Contact information

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Send me an email if you wish to added as a WTIC Network Member.

Become a full member see, www.wtic.org.uk