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5G HUDDLE 2016

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On 26 & 27 April, the Wireless World Research Forum (WWRF) hosted its 3rd Annual 5G Huddle, organised by Forum Europe, bringing together a variety of key stakeholders to identify the requirements to bring 5G to fruition. After a successful event in October 2015 in Copenhagen, this year's event returned to London, and organisation was aided by various sponsors including Cambridge Wireless, TechUK, University of Surrey 5G Innovation Centre, Institute for Communication Systems and the Commonwealth Telecommunications Organisation.

Keynote presentations

Following introductory remarks from **Nigel Jefferies** (Chairman, WWRF) four keynote presentations were made. The first, from **Raj Sivalingam** (Executive Director, Telecoms and UK Spectrum Policy Forum, techUK; replacing Julian David, CEO) introduced techUK and its role as the trade association for the digital technology industry in the UK, aiming to enable the next generation connectivity market for its members. Raj observed that momentum is building in the technology, standards and networks that will form the basis for 5G. Nevertheless Raj pointed out the importance of cultivating the markets that will make up the 5G use case and of building collaborative relationships between those developing technologies and the industries that will use them.

Raj Gawera (Chair, Cambridge Wireless; VP and Managing Director of Samsung Cambridge and

Samsung Aalborg), followed with an introduction to Cambridge Wireless which started in the 2000s as a response to the question of what 3G technology could be used for in practice. Raj said that whilst 5G was evolving on many fronts, a question we should be considering is how can it be made to be truly revolutionary/disruptive, rather than the evolutionary progression that previous generations of mobile technology have followed.

In a video presentation the Secretary General of the ITU, **Houlin Zhao** set out some of the ongoing collaborations between WWRF and the ITU on the formation and development of International Mobile Telecommunications. He explained the ITU's vision for 5G and noted that the ITU-R has now defined performance requirements and evaluation criteria for 5G, ahead of consideration of spectrum issues at WRC-19. Houlin noted that 11 bands have now been identified to be considered as potential candidates for IMT for consideration at the WRC-2019. The Secretary General highlighted that IMT is the enabler for new connected devices (cars, wearable devices, augmented reality, smart energy management, connected health, emergency communications, mobile education) as well as future generations of mobile internet and mobile broadband, and will be a cornerstone in achieving the goals for the UN's 2030 sustainability agenda.

Philip Marnick (Group Director, Spectrum, Ofcom; Chair, RSPG) followed. Philip pointed out that there is a perception of 5G as the solution to many problems, and this is the challenge that members of the WWRF have to meet or manage the expectations on 5G. He noted that pre-standardised expectations have differed

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from reality on each generation of mobile technology once standardised, and expectations continue to evolve (e.g. many connected car uses require connectivity everywhere). Philip also asked “how do we ensure 5G services reach all users?”. There is an expectation that coverage will be everywhere and always available. In reality this would be a feeling of ‘infinite capacity’ by users and devices. However, ensuring that coverage reaches the rural populations and does not only address ‘ultra-dense’ connectivity environments is a key challenge.

Philip suggested that a diverse range of spectrum bands will cater for heterogeneous networks in 5G and that there are other challenges to overcome when providing ubiquitous coverage, particularly with mmWave, such as providing power and backhaul to all of the necessary sites. Coexistence with existing systems using mmWave bands would also be a challenge with new systems expected to be launched in 2018 – 2020. The UK is taking a stance within international discussions ahead of WRC-19 that globally harmonised bands should be identified for 5G, in bands where at least 1GHz of bandwidth is available. Promising candidate bands include 31.8-33.4GHz and 66-76GHz, where current worldwide usage is currently low.

Julius Knapp, (Chief, Office of Engineering & Technology, FCC) gave an overview of the actions that were being taken to introduce 5G in the US. The US-approach, treating 5G as a national priority for early infrastructure implementation, was described as one that aimed to create opportunities for industry to innovate and develop new services. The FCC has

issued a Notice of Proposed Rule Making (NPRM) setting out how the FCC would like to make available new bands for 5G, with flexible use. Julius discussed the characteristics of the 28GHz, 37GHz, 39GHz and 64-71GHz bands which are of most interest to the FCC. Julius explained that FCC was intending to act this summer to provide a foundation for the 5G industry to act upon.

Raj Gawera (Chairman, Cambridge Wireless; VP and Managing Director of Samsung Cambridge and Samsung Aalborg) returned to the stage to explain how the development of IEEE standards fitted in to a 5G world. Raj explained that WiFi faced a number of challenges that are not present in cellular. Raj outlined the development of the 802.11ax standard and also some of the results of Samsung’s research in the mmWave, for example on testing mobility, indoor penetration and antennae technologies such as beamforming. Raj also pointed delegates to the white paper on 5G that Samsung has recently published setting out its vision for 5G’s requirements and capabilities.

Providing the spectrum to fuel the 5G ecosystem

The second session of the day aimed to address the challenge of providing sufficient spectrum in appropriate frequencies to enable 5G to realise its potential, and was moderated by **Janette Stewart** from Analysys Mason. The session started with a presentation from **Christian Rousseau** (Transport Policy Delegate Director, Renault) outlining the requirements that the automotive sector had. Christian outlined four

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exemplar use cases and their technical requirements in terms of throughput, latency, duration of service and importantly reliability:

- **High density platooning (a convoy of vehicles controlled from the lead vehicle)**
- **See-through sensoring (the information from sensors in one vehicle are shared with adjacent vehicles)**
- **Teleoperated driving (remotely controlled vehicles), and**
- **High definition map updates for highly automated driving.**

Christian pointed out that it was unclear to the automotive industry how the telecoms industry approaches safety critical reliability requirements that the automotive industry has for some of the exemplar use cases. He also highlighted the importance of dealing with privacy protection, a recurring theme throughout the conference. Christian finished by asking if 5G will come soon enough, pointing out the long duration of the planning cycle: if semi-autonomous vehicles are to be launched by 2020 then the communication technologies that will enable that are required very soon since those cars are already in development (with a typical development cycle for cars being six years i.e. cars to be launched in 2020 are planned from 2014).

Darko Ratkaj (Senior Project Manager, Technology & Innovation, EBU) followed with a discussion of the requirements that the audiovisual media sector has for future connectivity and the possible roles of 5G. Darko outlined the audiovisual media value chain and how different attributes of 5G corresponded to

different parts of the value chain. Some attributes were highlighted as important throughout the value chain (cost-efficiency, flexibility and interoperability for example). Darko asked delegates if 5G would be an additional platform; a unified telecommunications platform with broadcast remaining separate; or a better, unified telecommunications and audiovisual platform. Darko pointed out that this raised questions about the coexistence of different technologies in the future. Two priorities for the AV community were a desire to:

- **leverage investment in existing technology and infrastructure**
- **'agree on technology, compete on services' to avoid fragmenting the market, which is an approach that the media industry has used to date**

Finally, delegates were invited to consider the EBU's white paper on AV services and 5G.

This was followed by a panel discussion with contributions from engineers and policy makers regarding the role that they were playing in providing the right spectrum for 5G. There was consensus that spectrum would be available and that indeed in many jurisdictions technological neutrality on the part of operators meant that spectrum already existed in which 5G could be deployed with more becoming available. There was broad agreement in favour of global harmonisation if possible; however, there is some divergence of opinions for and against different candidate bands. Panel members highlighted the importance of making trade-offs between users different requirements and costs as well as the imperative that 5G will need to accommodate some

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novel use cases that have not yet been identified. The discussion also highlighted that 5G development to date has focussed on maximising throughput and identified bands accordingly, whereas it now seems to be becoming clear that the latency and reliability requirements are the key requirements to address some use cases. Achieving highly reliable, ubiquitous coverage would be challenging using mmWave bands and hence other solutions such as re-farming sub-1GHz bands would be necessary. It was noted that the question of how long 'legacy' 2G and 3G networks would remain in the market post-2020 requires some further consideration.

Plotting the path to 2020 and beyond

In the afternoon session on **Day 1**, discussions focussed on the transition to 5G and how to enable the investment in networks needed to achieve a widespread adoption. **Stuart Revell** (5G Innovation Centre, University of Surrey) opened the session with some early predictions about the take-up of 5G suggesting that based on trends in past technologies although we will see 5G trials and early launches from 2018 it will not peak in adoption until 2039. Stuart pointed out that in the past we have underestimated demand as consistently once a platform was in place people have innovated and provided novel services built on it.

Stuart suggested that in the past the telecoms industry pushed technology and users then found applications after launch. In contrast, there are uses and requirements for 5G that have been identified

upfront and the challenge is now for industry to work better with the users ('verticals') to align developments and timeframes. One major issue to resolve is that currently the mobile internet – like the internet itself - is a 'best efforts' service which may not meet the reliability requirements that many 5G use cases have.

Andy Sutton (Andy Sutton, Principal Network Architect, BT UK, 5GIC & ETSI ISG NGP Chairman) followed with a presentation on how next generation mobile network architectures and end-to-end internet protocols might be developed to better serve a 5G world. Andy described some of the challenges in developing new protocols that would meet the requirements of 5G users (such as ultra-low latency required for connected vehicles) and the difficulties in transitioning to new more efficient protocols whilst retaining backward compatibility with current networks. Andy also suggested the use of application bits per second per Hertz as an alternative way of considering spectral efficiency that takes account of overheads allowing the industry to be driven by the actual data transfer rates available to applications and services.

Takehiro Nakamura (Executive Director, NTT DOCOMO) gave the last presentation of the session outlining NTT's 5G deployment plan. NTT is targeting deployment to start in urban areas and key Olympic venues before the start of the Tokyo 2020 Olympics. NTT envisages that this would be followed by a phased approach to deploy 5G+, with additional features, in the early 2020s. NTT is planning large scale system trials next year, following successful lab tests over the past year which had achieved 22Gbit/s peak speeds for a two UEs, >50Mbit/s for 24 simultaneous UEs

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and over 2Gbit/s for a single UE in a mobility trial (60kph). Takehiro explained bands of preference for 5G including 4.4-4.99GHz which is available in Japan and in China; and 27.5-29.5GHz – considered a good candidate with only limited existing use in Japan currently. The panel discussion generated considerable debate about the relative rates of progress towards 5G in different markets and the tension between meeting the requirements expressed by verticals and the time required to establish standards. Bernard Barani (Deputy Head of Unit, Dir E, Network Technologies, European Commission) pointed out that there were many technical hurdles that remained unresolved and that verticals and telecoms operators still need to work more closely together. Bernard explained that facilitating this discussion is an area the EC is actively working on and there was consensus from the panel and contributions from the floor on the need to improve the discussion between the telecommunications community and industry verticals.

Delivering a robust and secure 5G network

David Francis (Chief Security Officer, Huawei Europe) opened the session, presenting Huawei's viewpoint on 5G network and data security issues. He outlined how 5G would see communications technologies becoming more integrated into the internet therefore opening up additional attack surfaces which were new to telecom firms but with which hackers are already well versed. David explained how the important issues of security and privacy were both intertwined and fundamental to the uses of 5G. David explained this as a social

challenge as much as a technological one due to the differing security profile required for different use cases and the importance of maintaining users trust in all parts of the 5G ecosystem.

Dr Anand Prasad (Chief Advanced Technologist, Executive Specialist, NEC Corporation; Chairman of 3GPP SA3) gave the next presentation describing the work that 3GPP has begun on developing security standards for 5G. Anand explained some of the new challenges that 5G would present as a result of networks becoming more open and modular; with the increase in virtualisation and cloud services. Referring to some elements of David Francis' presentation, Anand highlighted the different levels of protection required by different uses as a result of their security requirements but also other constraints (e.g. limited battery life or processor power on some IoT devices). Anand also pointed out the difficulties presented in securing new systems whilst retaining interoperability with the existing networks.

Steve Babbage (Distinguished Engineer, Vodafone; Chair, ETSI SAGE (Security Algorithms Group of Experts); and co-lead, NGMN 5G security stream) gave a presentation outlining the vulnerabilities in existing 2G, 3G and 4G systems and the potential improvements that could be made in 5G. Steve proposed a method of cryptographic key exchange that could be used when short response times were not required, highlighting that performance constraints on security (such as call set up time, fast cell handover, battery life, high availability requirements) should allow for flexibility in security protocols between use cases and 'network slices'. Steve also suggested that 5G should move

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towards giving the device more control over security rather than the network.

This was followed by a presentation by **Marcel Belingue** (Commonwealth Telecommunications Organisation) outlining how the CTO is working to promote and develop cybersecurity amongst its member organisations. Marcel highlighted some of the particular challenges in its member countries as coming about due to many only just launching 3G and 4G in many cases; many of the states being small; and competing priorities for investment.

Martin Adolph (Study Group Counsellor, ITU-T Study Group 12, ITU) gave the last talk of the day on non-radio aspects of 5G. Martin outlined the ITU's role as a UN organisation, working closely with other UN organisations aligned with the industry verticals (e.g. WHO for connected health) and its role in defining the requirements and standards for 5G including non-radio elements. He explained that the ITU has identified a number of key gaps in the IMT-2020 standards that need to be addressed. Security was one area in which contributions are sought but also network architecture, end to end QoS, network softwarisation, information centric networking and fronthaul/backhaul optimisation.

A glimpse into the future. What will 5G mean for me?

Day 2 of the conference was opened by a presentation from **Mark Swarbrick** (Head, Telecommunications Markets and Regulatory Policy, Department for Culture, Media and Sport, UK Government) on the DCMS view of 5G in the future. Mark stressed that the UK government

saw 5G as being at the heart of the UK's future digital economy and society. The UK Government has invested heavily in enabling digital infrastructure and is now carrying out a wide ranging digital strategy review on next generation infrastructure priorities (due to be published later this year). Mark highlighted the research work being done by UK and European universities and industry and noted that the DCMS will continue to encourage this. He finished by noting the importance that no-one was left behind in the 5G future and the need for policymakers to understand 5G's true capabilities sooner rather than later so that they are not misled by hype.

Sarah Weller (Managing Director, Mubaloo) gave a vision of a 5G future from the perspective of a software/application developer. Sarah explained that users were coming to expect services that were always on and always available, not just faster. Users (commercial and consumer) were becoming more reliant on these services which in turn needed to be more reliable. Sarah suggested that digital PA's (such as Cortana, Siri, Alexa) are likely to become ever more important to users. These kinds of services require 5G network characteristics in order to be able to proactively prompt users with information they had not necessarily realised they needed or to effectively present thin clients to users. For example, constant connections to multiple devices and sensors to monitor and respond would require characteristics that 4G network cannot currently deliver.

Paul Copping (Smart Cities Advisor, Digital Greenwich) outlined the projects being carried out in the Royal Borough of Greenwich as a testbed for smart

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city technologies as part of its Smart City Strategy , including:

- **Adult social care – as a service broker which may develop in the future into integration of public and private social care packages**
- **Waste management – route planning and sensors so that refuse is collected only when bins are full**
- **Connected and autonomous vehicles – 3 separate projects in the Borough**
- **Connected homes – monitoring energy use, maintenance requirements and interaction with other services**

Paul stressed that it was not the cities' role to direct the development of 5G technology but to work out how citizens will interact with the services that they will enable, and how to deploy them together to enable 'smart' delivery such as identified above.

This was followed by a presentation from **Adrian Grilli** (Technical Advisor, European Utilities Telecom Council) on what 5G will mean for utilities. Adrian set the scene by explaining that the electricity and utility industries are very conservative due to the high reliability and resilience requirements that they operate under. He also explained that existing electricity grids are not designed to accommodate distributed generation and are therefore looking to new solutions for the connectivity that is required. Adrian asked what delivery models future 5G networks would take (i.e. licensed, licence exempt, multiple networks, single infrastructure, shared/private etc.). The utilities industry has a strong preference for private networks as public and unlicensed networks impose constraints that inhibit the availability and reliability requirements they

have. The EUTC's proposals for spectrum that would be suitable for smart grid purpose include, UHF spectrum (400MHz) and in the L-band.

Phillippa Biggs (Coordinator, Broadband Commission for Digital Development, ITU) gave the final presentation of the session explaining the role that 5G could have in the developing world. Phillippa highlighted the accelerating pace of take-up of new technology whilst the separation between launches and time to peak adoption has remained the same. She outlined that 5G is part of a wider issue about bridging the digital divide and connecting those who are currently unconnected. Phillippa highlighted the need to develop credible commercial business cases for 5G deployments to happen in the most optimal way.

The presentations were followed by a panel discussion which asked whether ambitions by users for 5G were too high, or not high enough. There was some debate about the need to understand, and perhaps map, existing infrastructure in order to develop anything new. Resilience and latency emerged as important differences to 4G capabilities

The 5G Testbed: interactive workshops and demonstrations

In the final session 5GIC, **Rohde & Schwarz**, Huawei and WINGS ICT solutions demonstrated some of their latest research into the technologies and applications that will make up 5G. This included:

- **Dr Mir Ghoraihi demonstrated 5GIC's work to test a 5G massive MIMO system with an ambition to test a distributed massive MIMO system on the University of Surrey campus.**

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- Alexander Nährung and Mark Bailey from Rhode & Schwarz demonstrated their work in channel modelling and the development of tools to analyse the signal quality of millimetre waves which will support researchers considering the characteristics of 5G candidate bands
- Lei Lu, Huawei, presented a new SCMA (Sparse Code Multiple Access) based air interface that could offer improvements in spectral efficiency and latency that could support 5G
- Andreas Georgakopoulos explained some of the work being carried out as part of the 'SPEED 5G' project to understand the Benefits of cognitive RRM/MAC functionality to undertake dynamic channel assignment for efficne use of spectrum resources.

Nigel Jefferies (Chairman, WWRF) concluded the conference thanking speakers and participants for some productive discussion. He suggested that the conference brought out the need for continued efforts in building collaboration and bridges between all stakeholders and that the WWRF would continue its efforts to support this.



This report was written by **Analysys Mason** and published by **Forum Europe**.

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