THE 5G HUDDLE - Towards a global 5G vision

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EXECUTIVE SUMMARY

The 5G Huddle was organised by The Wireless World Research Forum (WWRF) and TechUK to bring industry leaders from Asia, Europe and America to London and share views on the vision for, and emerging development of, 5G. One of the main messages from speakers was that 5G could be the mobile communications platform to deliver the era of ubiquitous communications involving man and machine. Whilst there is growing consensus about the potential for 5G, its technical requirements and the need for global standardisation, there is less clarity about the business case. Many in the industry believe that 5G services will roll out around 2020. However, following on the heels of 4G deployment, a major challenge for 5G will be cost and returns on investment. As such, 5G also has the potential to cause major disruptions to the mobile market. In line with other areas of communications and the Internet, 5G will also need to address important security and privacy concerns.

Critical to 5G success will be the development of a single global standard, Huawei Senior Standards Manager and Wireless World Research Forum Chairman Nigel Jefferies said in setting the scene. The main effort so far has been on research, but that will shift into standardization after the World Radio Conference in 2015, and be followed by product development. The European Commission set up the 5G Public-Private Partnership (5GPPP) with industry to drive investment and research, and efforts are also under way in Japan, China, Korea and the US, and WWRF provides a unique global forum for all involved to share their visions, plans and concerns.

TechUK is very keen to take the opportunity for the UK to position itself as a partner of choice to all those in the world looking to move on 5G, said CEO Julian David, moderator of the introductory session. Part of the job of techUK, which represents the high-tech industry "from chips to clicks," is to talk to stakeholders, particularly governments, about what is needed to secure the digital future, he said. A big piece of that is digital infrastructure and 5G. For techUK the 5G starting point is customer experience: 5G should be able to provide consistency across the coverage area and quality of suitable levels for the diverse range of applications.

"We are in for exciting times," as International Mobile Telecommunication (IMT) enables new trends in communications systems, ITU Secretary General Hamadoun Touré said in a video address. The exponential growth in data traffic means that 5G will have to support a variety of applications and environments, lower costs, offer more robust systems and higher levels of security, and make more efficient use of spectrum.

5G will make the Internet of Things (IoT) possible, the Right Honourable David Willetts MP, former minister for universities and science, said in a keynote presentation. The IoT is an opportunity for the UK once more to be at the cutting edge of technological development and to play a key role in 5G standard-setting, he said.

The UK is looking to lead on 5G in several ways, Simon Towler, Department for Culture, Media and Sport deputy director, head of telecommunications policy, said in a keynote address. The first challenge is to understand what 5G actually is, and the UK and other governments are "grappling with a set of fairly broad requirements" at this point. To serve the IoT, networks will have to be more extensive and have greater capacity. In addition to the technological developments and the standards that underpin them, there are questions about how the technologies will be deployed and how investments will be made. And if the capacity of wireless networks is to be expanded, more spectrum and better spectrum management will be needed. The most powerful thing government can do is to bring people together, Towler said. Collaboration is "the key watchword" to enable 5G development.

5G "is more than just cellular," it's "always sufficient," Prof. Rahim Tafazolli, director of the Centre for Communications Systems Research, University of Surrey, said in a keynote presentation. The technology will "set a new paradigm of thinking," moving the world from mobile systems based on 2G. Tafazolli said he expects 5G to be commercially available by 2020-2021, driven by the IoT. The technology should promote spectral and energy efficiency, lower latencies and end-user quality of experience (QoE), Tafazolli said. "My plea to the ITU: don't set 5G at higher speed."

The first panel, chaired by UK Spectrum Policy Forum Chair Jim Norton, considered the potential services, applications and opportunities 5G and a future mobile and wireless communications system could deliver in 2020 and beyond. 5GPPP Chair Werner Mohr outlined ongoing research projects in the EU and internationally, saying consensus for global standards is building at an early stage. He predicted that 5G will be a combination of existing and evolving systems, coupled with new, revolutionary technology.

We will see a "tectonic shift" in who will be the final service client, said Prof. Mischa Dohler, head of the Centre for Telecommunications Research in the Department of Informatics, King's College London (KCL). Future service

opportunities will lie not with consumers but in business-to-business, he predicted. One of the most exciting ideas around 5G is the notion of the "tactile Internet" which will require not just telecommunication skills but skill-sets for remote activities such as e-health.

The collective 5G vision should be renamed the "5G Era vision" because it envisions enabling services that come from multiple infrastructures, said Chih-Lin I, chief scientist of wireless technologies, China Mobile Research Institute. China Mobile, the world's largest mobile provider, has two 5G themes: "Green" – end-to-end efficiency – and "soft" – a move from the core network to the radio access network.

Qualcomm Technologies sees 5G as enabling new services and devices, connecting new industries and empowering new user experiences, said Eduardo Esteves, vice-president, product management. 5G will become a highly adaptable system that provides the scalability and adaptability to connect everything from around 2020, he predicted.

In response to a request from Government, the UK Spectrum Policy Forum was set up by techUK in 2013 to harness the expertise of the country's spectrum-using industry and be a sounding board on the increasingly complex range of issues and decisions on spectrum – not just relating to 5G but an increasing range of terrestrial and space-based wireless applications. At a reception marking the first year of the forum, Minister of State for Culture and the Digital Economy Ed Vaizey, MP announced that the Government will be contributing £ 60k in 2014 /15 to help the Forum in undertaking underpinning studies in relation to this task. The role of the Private sector contribution is "absolutely vital" as its members hold the answers as to what is practical, desirable or risky, Vaizey said. He also announced the formation of the Future Technologies Network, which will work alongside the Forum by promoting innovation to encourage technology growth.

Day two of the conference centred on the challenges and opportunities of creating the 5G environment.

It's all about "one network, multiple industries," said Jan Färjh, Ericsson vice president, head of standardization and industry. A common network platform with dynamic and secure network "slices" allows spectrum frequencies to be used flexibly, avoids industry-specific spectrum allocation, and takes advantage of standardized network interfaces. However, 5G must balance complexity, cost, divergent nodes and relevance, he said in a keynote presentation. Defining a network too specifically could make it overly complex and too expensive to build.

The main 5G drivers are the mobile Internet and the IoT, said Shaoli Kang, system engineer, China Academy of Telecommunication Technology. She described the 5G Vision of the IMT-2020 (5G) Promotion Group, the main body fostering 5G research in China: "Information a finger away, everything in touch." China's future IMT systems will require 1350-1810 MHz more spectrum by 2020, with spectrum demand beyond that still under study.

Another panel, chaired by Arqiva Chief Technology Officer Cameron Rejali, examined ways policy makers and industry can build a 5G infrastructure. The European Commission considers 5G not only as "4G plus 1" but as a revolutionary way to use networks as building blocks for a networked society, said Thibaut Kleiner, head of unit, network technologies, DG CONNECT. One key EU message is that 5G networks must have minimum guaranteed performance, because QoE and latency are game-changers for the digital society, he said. The Commission believes that the role of government is to invest in research, such as through the 5GPPP, and to deal with spectrum issues.

The number of mobile standards is decreasing over time, said Lee Hyeon Woo, chair of Korea's 5G Forum global alliance committee. The time gap from R&D to standards to deployment is also getting shorter, making pre-standardization collaboration more important.

From Huawei's perspective, 5G must expand services beyond mobile broadband to the vertical market such as the IoT and device-to-device communications, said Huawei Fellow Peiying Zhu. The technology poses an unprecedented performance challenge because it must stretch in three dimensions—speed, links and latency. Re-architected 5G networks must include no-cell virtual radio access networks, be software-defined, simple and service-aware, and be able to monetize services, he said. There should be a standardized air interface framework for all applications.

Any 5G network must lower the net cost of service access for consumers, said Avanti Director, Regulatory & Business Development Kumar Singarajah. 5G should enable converged service delivery via multiple networks, including satellites.

The question is how operators can retain their legacy networks and still have a more flexible, efficient service-oriented system that maximizes return on investment, said Telefonica UK Head of Network Strategy Nektaria Efthymiou. Operators can do all of the things 5G might do on their existing networks, but they need something that will converge everything and provide consistent, seamless connectivity. Industry also needs the flexibility to enable new business models and support multiple technologies to optimize ROI. Some changes in physical infrastructure will also be needed to allow networks to deploy 5G quickly, and there will have to be a social and economic structure to drive demand for

5G services.

5G technologies must give users uniform experience of Gbps speed, low latency and massive connectivity, while being green and cost-effective, said Howard Benn, head of standards and industrial affairs at the Samsung Electronics Research Institute. Technologies that are moving toward addressing those problems include millimetre wave systems, device-to-device and advanced small cells.

Another panel, chaired by Martin Koyabe, head of the Commonwealth Telecommunications Organisation research & consultancy division, dealt with standardisation and regulatory challenges. Philip Marnick, Ofcom group director, spectrum policy group, called in a keynote address for broader engagement on 5G issues. 3G had a clear mobile vision, but 5G is something new, he said. Standards bodies should be "wider," and include a broader range of stakeholders than just the mobile industry.

NTT DOCOMO Executive Director Takehiro Nakamura, leader of the Association of Radio Industries and Businesses 2020 and Beyond Ad Hoc, said the road to 5G will be a radio access network that satisfies all the identified for 2020 and beyond, and consists of new radio access technologies and Enhanced IMT-Advanced.

The timing of 5G deployment is where "I get a bit of an uneasy feeling," said ETSI Chief Technology Officer Adrian Scrase. The year 2020 seems to be "an immoveable date" but is it realistic? he asked. ETSI's role in 5G could be to build a community of interest in standardization.

Asok Chatterjee, executive director, standards of the Telecommunications Standards Development Society India, said his country, although a newcomer to the 5G discussion, wants to work with other global standards bodies. "We don't have any chips on our shoulders and are ready to jump on the 5G band-wagon," he said.

Several issues will shape 5G, said Kent Rochford, co-director of the US National Institute of Standards and Technology/National Telecommunications and Information Administration Center for Advanced Communication. The key attribute for 5G will be sharing technologies so the network can be used as efficiently as possible, he said. That will require spectrum regulation, technical standards and measurements standards, he said.

The ITU's IMT-Advanced process of establishing requirements and then evaluating them is also likely to be used for 5G standards, said Colin Langtry, chief of the radiocommunications study groups department. Investigation of the main elements of 5G is already well under way in the ITU, he said.

Panellists also discussed how current 4G business models might evolve and move to 5G, in a session moderated by Analysys Mason Principal Janette Stewart.

4G service is excellent, so a 5th generation must offer something new or fix something that is not working, said GSMA Senior Director of Technology Dan Warren. The only issue now is coverage, which is a business, not a technical, issue. The business model for 5G must be driven by services we understand, such as health monitoring or connected cars, he said. The business case for 5G must justify itself.

Ramjee Prasad, founding chairman, Global ICT Standardisation Forum for India, described that organisation's "WISDOM" (Wireless Innovation System for Dynamic Operating Megacommunications) vision for 5G standardisation. Among other things, he said, it could enable "Human Bond Communication" using all five senses.

5G will be built on 4.5G attributes such as carrier aggregation and LTE plus Wi-Fi, said Alcatel-Lucent Architecture Strategy Director, Wireless CTO Office Alistair Urie. Alcatel-Lucent believes 5G will rely on 4G LTE but will add multiple services on a single air interface. He urged operators to adopt 4.5G technologies and "stop investing in 3G."

5G could severely disrupt markets and business, said London Futurists Chair David Wood. Industry must be able to see these "steamrollers" – such as a privacy backlash from 5G services and products and unemployment due to technological advances – coming and have the agility and strength to turn them to their advantage.

The 5G concept is much clearer now than it was a year ago, Nigel Jefferies said in summing up the conference. He noted the importance of having global standards, and the distinct visions various regions of the world have about what 5G should be. There is some consistency about the demand for 5G; the fact that 4G rollout and the opportunity to exploit the associated commercial returns should be allowed to proceed; the need for new spectrum and innovative new ways of using spectrum; and the timing of 5G deployment.

The technical requirements for 5G globally are converging, but what hasn't converged is agreement on the business case, Tafazolli said. Most stakeholders probably agree that 5G is more than just a mobile cellular generation system and that it is very different from earlier versions. Most speakers also agreed, among other things, that speed is not a

differentiator between 5G and earlier generations, but giving the end-user better QoE is, he noted.

Frank Fitzek, principal investigator, communications and storage, Dresden 5G Lab, said 5G will not be a singular cellular standard but must be approached from a holistic perspective. The 5G Lab is investigating four tracks: wireless networks, silicon systems, the mobile edge cloud that will follow individual users through the network, and tactile Internet applications.