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From: Prof Mischa Dohler
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To: Digital Communications Infrastructure Strategy Team
Department for Culture, Media and Sport

1 October 2014

Re: Digital Communications Infrastructure Strategy Consultation

Dear Ed Vaizey, Lord Deighton
and Digital Comms Infrastructure Strategy Team,

The "Digital Communications Infrastructure Strategy" consultation document is very insightful and timely. It makes an informative read even to those skilled in the digital arts. What follows are the responses to some (not all!) of the posed questions. Whilst I have responded in a personal capacity, based on constant interactions with colleagues, these views largely reflect the opinion of the Centre for Telecommunications Research and the Department of Informatics at King's College London.

"Generally, we overestimate what we can do over the next 5 years; and underestimate what we can do over the next 10 years."

Some minor comments on the document:

- Paragraph 2.18 should be written in past tense since we are already in 2014;
- 2.23: NFV is a feature and not a technology;
- 3.23 small typo "will remains".

Introduction

Q1 Views are sought on:
a) Is this an appropriate role for Government?
Yes, generally, the government can help the digital uptake in the roles mentioned in the document. However, the government ought to understand that a simple "networking" of stakeholders does not suffice to get the business rolling. The government could play a role model as a customer, as an investor to lower CAPEX to the businesses, or as a more aggressive mediator to the regulations being issued by the EU.

b) What other high level principles the Government might adopt?
Networking stakeholders and providing subsidies to lower CAPEX for large infrastructure endeavours is well accomplished to date by the UK government. More coherent working principles ought to be establish for being a "role customer" of/for the digital ecosystem; and also for influencing more EU regulations (see more below).

c) What resources do you consider the Government should aim to deploy to effectively manage its role?
Possibly, a CIO should be appointed (again), along with a qualified team with members addressing governmental, company, startups needs. Since a lot of policy work influences the digital uptake, this team ought to be decoupled from political cycles to ensure continuity of the digital agenda.

Section 1

Q2 What potential opportunities are there for Government to leverage its combined buying power to support policy objectives?
An obvious opportunity is that the government can impose quotas on specific requirements in its procurement procedures. Examples are: a mix of large, small, and start up companies to underpin a minimum level of innovation; appoint a team overseeing the implementation of "smart procurement" in the sense that tenders are not only awarded on price/requirements alone but also on a degree of "smartness" or ability to meet future needs which have not been specified in the tender documentation; etc.

Q3 If migration to IPV6 is required, are there any barriers to that migration and if so how might these be addressed?
There are no barriers, no.

Section 2 - What might future demand look like?

Q4 Is an ongoing disparity of provision of broadband services inevitable? If so should this be addressed and how might this be done most effectively?
The market typically decides which technologies/services are being adopted. The disparity is thus a result of natural competition. It can however be throttled by increasing the minimum requirements on core KPIs, such as throughput, availability, etc.

Q5 How symmetrical will digital communications networks have to be in the future? Will this differ across user types? What implications does this have for fixed and wireless broadband provision?
Traffic today is already completely symmetric, i.e. forward and reverse streams have the same peaks. However, they are not typically correlated today. In the future, the symmetry will remain whilst the correlation of the peaks will also increase. The direct implication is that we need to work on higher peak rate systems (both wired and wireless) but also more intelligent cashing approaches which allow to smoothen the peak and thus lower CAPEX.

Q6 Which countries should be our benchmarks on communications infrastructure to ensure that businesses remain in the UK and continue to invest?
US, Germany, South Korea.

Q7 What metrics do you think should or will become relevant in comparing network performance in different countries? What metrics should most appropriately be used as the basis to set objectives for government policy?

As a metric, peak rates and peak-to-average-ratio are interesting because they force the development of both high rate systems but also ensures a high utilization thereof (thus forcing intelligence to be implemented quickly). Another metric could be "degree of accountability", i.e. how easy is it for the consumer to hold providers accountable for outages, failures, etc.

Section 3 - Scenarios

Scenario 1

Q8 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree what alternative scenario do you envisage?

I believe that this scenario is extremely conservative. I will therefore not respond to the questions 8-12 outlined here and rather respond below in the context of Scenario 3.

Q9 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far will it be a direct consequence of the level of demand?

Q10 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?

Q11 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect any of the scenarios and in what way?

Q12 How likely is any unforeseen disruption to this scenario and what area might it occur?

Scenario 2

Q13 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree what alternative scenario do you envisage?

I believe that this scenario is fairly conservative. I will therefore not respond to the questions 13-17 outlined here and rather respond below in the context of Scenario 3.

Q14 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far will it be a direct consequence of the level of demand?

Q15 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?

Q16 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect any of the scenarios and in what way?

Q17 How likely is any unforeseen disruption to this scenario and what area might it occur?

Scenario 3

Q18 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree what alternative scenario do you envisage?

I generally agree with the outlined scenario which seems the most likely for the next years. Notably, all points mentioned under 3.36 – 3.41 have featured in one form or another in next generation wired or wireless broadband design efforts.

Q19 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far will it be a direct consequence of the level of demand?
Most technologies have actually evolved irrespective of the demand, i.e. in most instances the demand was there but the technology not offered (or at a reasonable cost). That trend is indeed unlikely to change.

Q20 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?
Yes, there is an important technology emerging which has not been mentioned at all but which will heavily impact requirements on the infrastructure of the future, both from a technical as well as regulatory point of view. Notably, I am talking about the emerging concept of the Tactile Internet. In contrast to the prior Internets, i.e. the original Internet, the Mobile Internet and the Internet of Things which are mainly information delivery networks, the Tactile Internet is a skillset delivery network. That is, a skill originating at some point in the UK can be applied in real-time remotely to any other point in the UK or the world. Applications range from remote surgery, remote air craft servicing, etc. From a technology point of view, it involves robotics, big data, telecoms, artificial intelligence, just to name a few. The digital delivery networks need to be of highest resilience, low round-trip delays, and high rate – well beyond anything the current 5G vision outlines. And, because it will likely involve the control of infrastructures of national importance, they may need to be 100% designed and owned by national industries thus potentially giving the UK a competitive edge.

Q21 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect any of the scenarios and in what way?
The shortage of raw materials will likely make a higher impact than the availability of energy.

Q22 How likely is any unforeseen disruption to this scenario and what area might it occur?
As said above, it will happen in the area of the Tactile Internet, applied initially to heavy B2B markets. Also, video-driven machine-to-machine traffic – an emerging area which has not been touched upon either – may further increase the required bandwidths. Furthermore, there might be a disruption (in the positive sense) because our community is currently working on providing rates in the region of Terabits per second; it is not commercial yet but within reach.

<u>General</u>
Q23 Are there factors, for example technical or unrelated to the regulatory framework, that could create bottlenecks and delay future infrastructure deployment in the UK in this timeframe, that would result in demand not being met or the UK not being seen as a leading digital nation?
The rollout of an infrastructure is – in essence – a real estate issue to start with. Therefore, real estate developments (prices, regulations, etc) may create a notable bottleneck. Furthermore, medical findings – such as certain wireless causing certain types of cancer – may suddenly put further rollouts on hold.

Q24 Do you expect commercial providers to deliver future infrastructure and meet demand on a purely commercial basis, or is some form of public intervention likely? If public intervention is likely how might that work with the commercial provision of infrastructure? What form might that intervention take?
To meet infrastructure needs at this scale (Scenario 3) without government support is unthinkable. It starts with the need for stronger supporting R&D in the areas of 5G, ultra broadband, smart cities, etc, so as to remain competitive – given there is barely any R&D culture left in UK companies. Furthermore, the CAPEX required is likely beyond the reach of any of the players so a national fond, which ought to be paid back over the years, would be a great help.

Q25 Which current or draft legislation might prevent or facilitate the emergence of any of the scenarios?
I am not sure here but if there is a legislation preventing governmental CAPEX support, then this could be a barrier.

Q26 Do you have views on which scenario (or combination of scenarios) is most likely and should influence the development of future strategy?
The most likely and interesting one is Scenario 3. Pay attention to the statement of the "cloud at the edge": This is very important as traditional cloud players like, Amazon (and most of them are US based), will need its cloud components at the edge of the network. This, however, will force them to lease cloud real estate from operators. Thereby, the operators get into the actual data value chain, and thus potentially a lot of money can be generated with that.

Section 4 Competition and regulation
Q27 How might efficient investment in communications infrastructure be supported, for example by changes in the regulatory framework?
Currently, the infrastructure providers are entirely decoupled from the service providers. Possibly, more regulatory work on the value chain is needed to make sure that some of the money generated over the networks flows back into the network developments.
Furthermore, to get the full potential of the mobile network, the Core Network ought to be deregulated so that more innovation can happen there and power SMEs the same way as the Internet economy.
Furthermore, one may consider stronger regulation on seamless integration, authentication, billing of all technologies in offered bundles; this, in turn, will force large companies to engage their IEEE & 3GPP efforts.

Q28 Are there any further measures necessary to incentivise the rollout of future mobile infrastructure in currently underserved areas?
I am not skilled in these arts but maybe some deregulations/regulations on the air space are needed to support easier drone-supported rollouts in the future.

Q29 Is there a role for a revised USO or USC to ensure that minimum consumer demand requirements are met and to reduce the potential for a new digital divide? What might this look like?

Q30 In terms of supporting future innovation and long-term investment in infrastructure, what areas of broadcasting regulation may have served its purpose by 2025 -2030 (or indeed earlier). What future technical developments may also have longer term implications for regulation and wider public policy?

Q31 Are there changes to the EU Framework that the UK might seek to encourage more competition in UK markets?
Yes, notably most regulations done by BEREC to date which is mainly for human use of electronics. I am currently in discussions with BEREC on the impact of regulations onto machine-to-machine communications (which impacts the Tactile Internet uptake, among others). There are currently some issues which mainly pertain to Service Level Agreement frameworks which cannot be extended to machines.

Q32 Should Government seek changes to the European Framework which put more reliance on competition law and how might this be done?

Q33 In what ways can you see competition driving technological change in the UK in the future?

Q34 How can the regulatory framework keep up to date with new business models and changes in technology?
Best is to regulate service features rather than technology features – this allows the technology to evolve quicker.

Q35 Are there any changes to legislation other than the Communications Act that would incentivise the provision of communications infrastructure?

Q36 Would there be benefits to investment from a focus on broadband only services? Are there any barriers to the emergence and adoption of broadband only services, whilst still providing necessary access to emergency services?

Section 5 – Facilitating and Encouraging Investment
Q37 How might copper access networks evolve over time alongside other access technologies? Is there a role for policymakers in helping manage any transition from copper to other access networks?
Q38 Views are sought on whether there are any additional actions the Government should consider to ensure:
a) That the provision of all areas of the UK's digital communications infrastructure remains competitive in order to ensure that the UK can take full advantage of growth opportunities in the Digital Age;
b) Aside from legislation and adapting the regulatory framework in the broad sense which other actions should the Government take to encourage investment in communications infrastructure?
c) That potential investment in the provision of digital communications infrastructure offers a suitable risk and reward profile to ensure that they can be financed by the private sector

Q39 Views are sought on:
a) The case for the UK to invest to gain 'early mover advantage';
There is a strong case in investing in any technologies which will eventually power the Tactile Internet, mainly because this is of national interest.

b) What areas in particular the UK should aim to see investment;
Tactile Internet developments, which starts with investment in 5G.

c) Are there any actions not covered elsewhere in this report that the government should consider to ensure digital communications infrastructure is in place before it is needed and such that it helps generate need.
I personally believe that the field of robotics/drones will play an intricate role in the rollout and deployment of the digital information infrastructure. Maybe more time is needed to understand the impact.

Q40 How can we maximise the current R&D and innovation UK landscape to help take advantage of the opportunities provided by future technologies? What needs to be done by Government and its agencies, and industry to tackle any gaps?
The UK is very strong in research, and now – with the support of Innovate UK – in startups and innovation. The traditional "development" departments of large companies are long gone. The government maybe could help more in bringing small companies meaningfully into large companies.

Q41 In which future communications technologies do you consider the UK has, or could achieve, an international leadership position?
Tactile Internet, because it has all technology constituents, it has very strong vertical industries, and a very strong servicing industry which could then be exported internationally.

Q42 What more might government and industry do to exploit future technologies, associated new applications and emerging business models?

Q43 What role might local bodies have in facilitating the future delivery of digital communications infrastructure?

Q44 How can council's maximise the digital communications infrastructure in their local area to support their work on economic regeneration?

If you require any further information, please, do not hesitate to contact me or call me on my mobile +44 7873 252 444.

Sincerely,

Prof Mischa Dohler