THE 'INFINITE BANDWIDTH, ZERO LATENCY' PROJECT: INVENTING A DIGITAL FUTURE

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ABSTRACT

Policymakers around the world are promoting the development and roll out of superfast or next generation broadband networks. Rather less attention is given to how these networks might be used. This paper describes the approach developed in the 'Infinite Bandwidth, Zero Latency' project to engage diverse stakeholders in the generation of ideas for future applications, and forming consortia around selected ideas to develop them, to date, to the stage of feasibility study proposals. The project is based around the Imagine/Triple Task method of participative engagement.

KEYWORDS

Next generation networks, futurescaping, Imagine/Triple Task, broadband

1. INTRODUCTION

There has been a strong policy push in many countries for 'Next Generation' (NG) communications networks, though rather less policy thought appears to have been given to potentially new applications they might enable. The 'Infinite Bandwidth, Zero Latency' (IBZL) is a thought experiment devised to support the development of such novel applications. IBZL has been developed by researchers and practitioners at The Open University, Manchester Digital and University Centre Milton Keynes as a way of exploring this potential, building research and development links with industry and academic partners. This paper reports on the process and outcomes to date of the IBZL project. It extends our earlier account (Bell & Walker, forthcoming) of what we have now termed IBZL 'Phase 1' scoping activities to report on subsequent phases that have moved from the generation of ideas to collaborative research and development proposals.

IBZL is a process and the result of joint work with Manchester Digital, a trade association of digital companies in Manchester and the North West of England. Manchester City Council has a long track record of supporting and championing the digital sector as an important aspect of its economic and social development dating back to the late 1980s and a need to develop alternatives to the city's older manufacturing base which was decimated in the early 1980s (Agar *et al*, 2002). IBZL represents a novel mechanism for engaging industrial, community and academic partners in and around the digital industry sector in identifying areas for mutual interest and developing these to proposal stage. The outcomes to date identify specific areas of work for partners in building novel and useful applications of NG networks.

2. BACKGROUND

There is no universally agreed definition of what qualifies a network to be considered 'next generation'. However, three elements are usually considered essential. Firstly, NG networks provide a significant increase in the transmission speeds, particularly for the domestic or small-business end-user. Speeds cited vary widely, but recent use of the term in the UK varies from 25 Mbps to over 200 Mbps. The 'Digital Britain' report (Dept. of Business, Innovation and Skills:54] refers to 'next generation service up to' 40 Mbps, and more recently ministers have referred to 50 Mbps and faster (INCA, 2010). To put this in context, in early 2010, Google (Google, 2010) announced a plan for experimental community networks operating at 100 Gbps. Secondly, and in contrast with ADSL technologies, it is generally assumed that NG networks will offer a step-change in upload as well as download speeds, to reflect the demands of user-generated content. For some, NG bandwidth should be symmetrical, though others take a more relaxed view ([e.g. OFCOM (2009)). Thirdly (OFCOM, 2009) NG networks are widely taken to offer improved quality of service (QoS), meaning not only service reliability and availability, but also indicators of network performance including latency (the time taken for data packets to travel from source to destination), jitter (the variation in latency among data packets) and data loss (the loss of data packets due to network congestion). Latency, jitter and data loss are important aspects of the usability of emerging /improving applications such as internet telephony or video.

There is a strong technological determinist flavour to many discussions of NG policy, often citing their 'disruptive' nature. There is also a strong policy emphasis of the importance of these networks to future economic and social development, in the industrialised world at least. There has, though, been surprisingly little consideration of how these networks will be used beyond rather vague assertions that innovative new services will be developed, particularly in the fields of entertainment, education or healthcare. There appears to be a widespread assumption of 'build it and they will come'; the mere existence of NG networks will bring innovative (even disruptive) applications into existence.

This state of affairs is unsatisfactory for two broad reasons. Firstly, the evidence from the roll out of earlier generations of broadband network is mixed. The then predicted evolution of innovative content industries did not emerge (Cawley & Preston, 2007). While the rapid establishment of user generated content and social network applications of the last 10 years certainly built on the growth of broadband networks, it seems to have relied at least as much on the always-on nature of network connections, and increasingly their wireless ubiquity as it does on increased transmission speeds. Secondly, the most immediate widely available examples of next generation applications are multichannel TV services with increasingly high definition and 3D extensions. This vision of next generation networks places the emphasis on professional, commercial content production under the control of multinational media corporations. Outside rather limited geographic locations (such as Hollywood, Bollywood and London), these will offer limited opportunities for economic development, and arguably even fewer opportunities for democratic and popular expression. In part, therefore, IBZL is an attempt to argue for an alternative networked future.

Some, though, are now turning their attention more systematically towards the complexity of how new applications might take advantage of these networks (e.g. Middleton, 2010; Shin, 2010). The IBZL project aims to contribute to these discussions.

The IBZL project started in early 2010 as a thought experiment. It was organised by The Open University's Faculty of Mathematics, Computing and Technology and Manchester Digital, a trade association for companies in the digital industries and Manchester and the North West of England, as a way of addressing this apparent gap in policymaking. IBZL does not actually predict a world of infinite bandwidth or zero latency; rather these ideas were used as devices to encourage participants to consider what might become feasible in a world where network bandwidth and latency ceased to be limiting factors - to dream dreams without limit. The initial workshop was organised to address the question 'What genuinely innovative applications are enabled by next generation networks'? The success of the first workshop led to the development of a programme to identify candidate projects and consortia from among workshop participants and support their development through to feasibility and project implementation stage.

The remainder of this paper is structured as follows: we outline the 4-phase IBZL 'curriculum', introducing some of the concepts that have emerged from our work to date; we discuss the achievements and limitations of the approach; finally we outline the planned next steps in the development of IBZL and the ideas it has generated.

3. IBZL – INVENTING NETWORKED FUTURES

The IBZL project has developed a 4-phase intervention to explore novel applications of next generation networks.

Phase 1:. The first phase involves invited workshop participants in envisaging a future of effectively unlimited bandwidth and zero latency.

Phase 2: In the second phase, the outputs of the phase 1 workshop are analysed as themes and "candidate projects" are re-presented to the participants in a subsequent 'Phase 2' workshop. The Phase 2 workshop identified clusters of participants interested in developing outline proposals for workable projects.
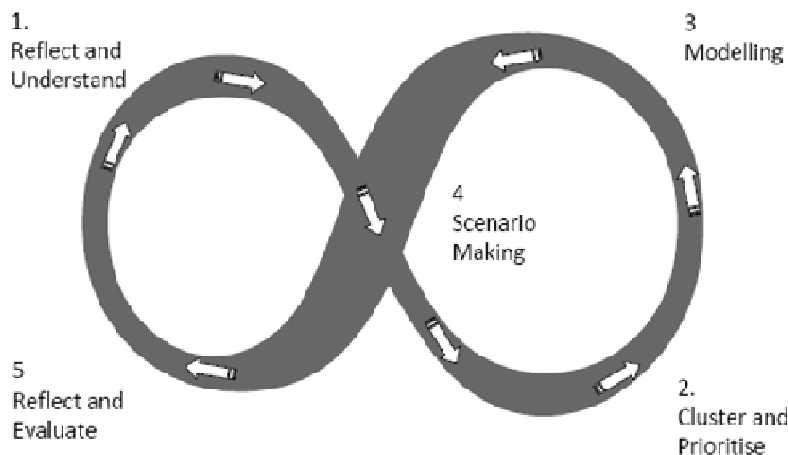
Phase 3: In Phase 3, the outline proposals have been developed in to proposals for feasibility study-stage work that might be presented to appropriate research or commercial funders..

Phase 4. This phase will involve the management and conduct of these proposals by clusters within a wider IBZL network. The approach and outcome of each phase is described in more detail below.

3.1   Phase 1: scoping

During the first phase, we sought to generate innovative ideas about how next generation networks might be used through 'futurescaping' workshops. These one-day workshops brought together a range of participants from academic, public, private and third sector backgrounds. Participants were selected by the workshop organizers to bring a range of technological, commercial, service and social perspectives to the issues addressed (for more detail on the selection of workshop participants, see Bell & Walker, 2011). The workshops took a participatory engagement approach using the 'Imagine/Triple Task Method'(I/TT Method see Fig 1.) (Bell & Morse, 2010a). Considerable thought was given both to the individuals that were invited and the mix of backgrounds and other attributes that they might bring to the workshop.

Fig 1: Imagine/Triple Task method schematic

In the workshops participants were allocated to working groups of four or five, in such a way as to maintain a diversity of backgrounds and perspectives in each. Each working group worked through four steps over the course of the day: reviewing the current situation; prioritising issues; envisaging future options; and producing a forward plan. During the workshops, participants made extensive use of participative diagramming using rich pictures (Checkland, 1984; Bell & Morse 2010b) as an unthreatening but revealing way for groups to share ideas. Each working group clustered and prioritised the ideas ('opportunities' and

'dreams') they generated in the reviewing phase, using a 'matrix of achievability and excitement'. This allowed groups to identify exciting ideas that might also be achievable 'Systems of Challenge' (SoC). These then formed the basis for preliminary forward plans produced by each group, naming the challenge/scenario, outlining what it will do, and what it will transform.

Participants in the two Phase 1 workshops identified 25 named ideas as outputs, supplemented by ideas from a shorter workshop held at a conference of the Women's Engineering Society (November 2010). By way of illustration, these included: '*intelligent matchmaking*' concerned with optimising complex networked relations of products, people and organisations; '*latency mapping*', concerned with the 'geography' created by variable latency relationships between network locations and hence the kinds of applications that would be feasible between particular places; and '*stealth shepherd*' which brought together ideas of robots/drones representing people in the physical world, for example in shepherding. More widely, the 25 ideas could broadly be clustered under the headings of (advanced) digital resource management, telepresence, resource sharing and the changing relationship between the internet and material world.

For a fuller account of the process and outputs of the IBZL phase 1 workshops, see Bell & Walker (forthcoming).

3.2   Phase 2: selection

The second IBZL phase aimed to refine the ideas from the Phase 1 workshops and identify both potentially viable proposals for future research and development projects, and also consortia of participants willing and able to progress them. It comprised two sets of activities – firstly, organising the outcomes from the Phase 1 workshops, and secondly presenting these to participants in a Phase 2 workshop for validation and as the basis for identifying future collaborative projects.

3.2.1 Organising outputs

To organise the outcomes, we (the authors) collaboratively identified, disaggregated and reclustered what we understood to be the underlying ideas in the Phase 1 working groups' outputs. We identified themes, some of which recurred in several working groups' presentations of ideas, and clustered them under three sets of headings. These are summarised below; space does not permit a more comprehensive account here.

'*Creating ordered chaos*' (theme 'A') concepts are concerned primarily with the two themes of the transition to, and desired nature of, an 'IBZL world'. The issues they addressed were primarily with policies, business models and associated cultural shifts in the development of NG. At a more abstract level, these Phase 1 outputs can be read as a concern with the wider 'theory' of an IBZL world. So, at a tactical level, suggestions for candidate projects included 'latency mapping' as outlined above, as a way of monitoring and evaluating issues associated with differential levels of latency between locations, and "green impact" similarly was concerned with evaluating the environmental consequences of alternative models of network configurations, ownership and sharing approaches. These activities would inform the development, and immediate consequences, of building NG infrastructures, contributing to a wider concern with policy development support for pilot projects and beyond.

'*Intelligence in the network*' (theme 'B') emerged as a collection of themes concerned with the management and control of information in an NG context. The relationship between digital information and information overload is not new (e.g. Hiltz & Turoff, 1985 or even Bush, 1945). In the IBZL setting, we can envisage the availability of even greater amounts of information, in more complex forms, being moved around at greater speed. NG networks may, however, make it feasible to develop new interfaces and informational metaphors to navigate and control this information. For example, the use of social networks and the distributed knowledge they represent may be harnessed in more sophisticated ways and the power relations inherent in informational imbalances between many customers and suppliers may be inverted. Wider concerns about the control of digital personal information in an IBZL world ('Me and my data') were reflected in discussions in the IBZL workshops. A third issue relating to the content of networks was possibility, given enough bandwidth and as importantly, lower latency to develop genuinely distributed 'cloud' computing applications sharing processor capacity and other resources as an alternative to the centralised data-centre based 'cloud' services currently available.

'*Space of flows*' (theme 'C') draws on Castells' (1996) terminology to refer to the reconfiguration of various digital and physical/material spaces that may be associated with NG network applications. Digitally,

the abundance of bandwidth and reduced latency might allow for widespread use of more immersive telepresence applications pointed to, for example, by the kind of video wall technologies explored at Bell Labs during the 1980s (Fish et al, 1990) that aimed to support informal, unscheduled communication. Such applications could have importance both in the workplace and in the home, where social isolation among an ageing population is likely to be a growing problem. NG networks may also be instrumental in reconfiguring the boundaries between digital and physical spaces, for example through the use of 'real avatars' which represent people in the physical world at a distance, for example as remote controlled 'bots'.

3.2.2   Towards proposals

In Phase 2, participants in the Phase 1 workshops were invited to a day-long 'development meeting' to identify potential projects and consortia that would be willing and able to develop them. The workshop was attended by 14 participants and a further 10 participants indicated that, while they were unable to participate in this meeting, they were keen nonetheless to remain involved in the wider project. The preceding analysis of the outputs of the earlier workshops was presented back to participants, firstly, as a way of validating our interpretation, and secondly (and more significantly) to act as the basis for participants to identify the areas in which they were most interested. Participants were asked to identify areas in which they were interested to develop project ideas towards the outline proposal stage. Importantly, for our purposes the meaning of 'candidate projects' was understood broadly to include the differing practices and institutions from which participants came; a 'project proposal' might be instantiated as a research funding proposal (for academic participants) or a business idea/plan (for business participants). As in the Phase 1 workshops, the I/TT method was used to focus the working groups in two rounds of refining their ideas and moving towards an outline proposal.. The primary means to achieve this is consentful sign posting. The groups were not coerced or 'told' what to do, rather they were encouraged to attempt to fill-in certain criteria, accepted by all those at the event to be necessary for a sustainable project.

Three groups emerged, self-selected from this process, corresponding to the three high level groups (A), (B) and (C) identified above. Given the nature of the conversations around the process of identifying clusters of interest we have interpreted this as validating our analysis of the phase 1 workshop outcomes (though given the data we have, it would be hard to refute definitively an alternative interpretation that we effectively 'led the witnesses'). Each group successfully identified specific areas of interest and began to develop outline project/feasibility proposals as outlined briefly below.

Phase 3: elaboration

By the end of the Phase 2 development meeting, three consortia had coalesced around candidate projects which have formed the basis of ongoing work, in two cases feasibility proposal stage (to external funding bodies) and one is in the process thereof.

Theme group A concerned itself with the substantive issues emerging from the phase 1 workshops centred on the challenges posed by an IBZL world to prevailing social, political, cultural and economic norms. The group recognised the need for a significant volume of theoretical work to describe the IBZL world. However, it was felt that this ought to be accompanied by a parallel but connected stream of activity to specifically raise questions and stimulate debate at the national/international policy level. A particular motivation was the shared opinion that a 'policy vacuum' was a more likely rate limiter towards an effective and just IBZL world than technological constraints. The group opted to establish a *Think Tank* to catalyse this process with a small initial membership comprising academics of various disciplines, technology consultants and social entrepreneurs. The group has committed to collaborate for an initial pilot phase in order to develop some preliminary outputs and to test the viability of the *Think Tank* in this guise. The concept has already stimulated considerable interest among regional, national and European policy makers and, alongside the production of its initial policy papers, the group has begun to explore options for the longer term sustainability of the *IBZL Think Tank*.

Theme group B developed a proposal for peer-resource sharing combining technological innovation with a novel business model. Peer-to-peer networks like Skype provide valuable services by using a 'freemium' model to create a big network. A peer-to-peer storage network that uses the spare capacity of many thousands or millions of internet users is a cloud application that is now becoming feasible because of the spread of next generation networks and the falling cost of disk space. Using encryption and a high degree of data dispersal,

together with sophisticated models to match applications with the latency, availability and trust relationship between peers, such a network could offer very high data security and resilience. The proposal aims to overcome barriers to commercialisation of a peer-to-peer-cloud through a further innovation: the use of a co-operative business model to offer commercial data hosting services and reward users who commit storage and guarantee availability with a 'dividend'.

Theme group C has submitted a proposal to trial 'real avatars', such as robots or drones, that can exploit widely available low latency networks to represent people in the material rather than the digital world. The proposal aims to study their viability in a real world, 'living lab' (Schumacher & Feurstein, 2007) setting in a rural area in the north of England. The study will engage local people in assessing whether they can offer opportunities for people otherwise unable (for example because of disability or physical distance) remotely to share in outdoor activities such as hill walking or educational field trips through their control of a 'real avatar'. The study aims to: identify the potential services the avatar could offer; carry out market research amongst potential beneficiaries; assess the equipment, management and running costs; assess the legal framework and any constraints (for example relating to privacy and surveillance drones); identify network quality of service issues and how they would affect the range of the avatar and the quality of the experience.

4. DISCUSSION

Whilst the IBZL Project Team does not wish to over-claim outputs for the application of the I/TT Method in this context, nevertheless certain overlapping themes emerge.

4.1   Process

The IBZL four phase model has emerged as an evolved response to group dynamic. The I/TT method was adopted from the outset but this adoption has also required adaptation in order to meet the emergent themes of the IBZL context. To some extent this was necessary. As a non-prescriptive piece of research and development, the workshops could never be pre-programmed and, the emergent proto-projects which stakeholders decided to work on, developed their own momentum and provided the opportunity for methodological responses.

The approach has been successful to the extent that, at the time of writing, two proposals for feasibility studies have been submitted. The precise path of these developments will inevitably depend on the success of the feasibility proposals. The proposal for a 'think tank' has been favourably received by local and national policymakers, and is the subject of ongoing development. From a methodological perspective, the *Think Tank* is perhaps better thought of as development of the IBZL process rather than as an outcome. It provides an opportunity (and one which was recognized by workshop participants) to engage with wider social, economic and policy issues in a more systematic way than is possible within the confines of a 1-day workshop.

Implicit in the original project formulation the IBZL approach may provide a method for engage academic researchers with other stakeholders in the identification of areas for collaborative research and development. While, in IBZL, we have concentrated on issues associated with NG networks, there is no obvious reason why the approach could not be adopted in other fields, for example low carbon technologies. Importantly our method provides a way of engaging not only academic and industrial participants, but also (and central to the process) non-industrial stakeholders including users, user representatives, policy makers and small/micro enterprises in defining the scope and direction of collaborations. In a situation where (in the UK at least) there is increasing pressure on universities to demonstrate their engagement with the 'users' of research it provieds tools such as this are likely to be of growing significance.

4.2   Outcomes

Outcomes often associated with ideas that have been around for a while (e.g. information overload, privacy, digital equity) but that take on new forms/become more feasible in an NG context

It is too early to evaluate the outcomes of the process in any detail; to the extent that it has generated plausible ideas for project proposals, this can be taken as confirmation that it has some value. Evaluation of

longer-term outcomes will present a challenge, since the success of the outcomes will be the result of a wide range of factors, of which the quality of ideas and consortia initiated during IBZL will be only one. We can, though, make two initial observations about the type of ideas which have emerged.

Firstly, and unsurprisingly, the ideas that reached the status of 'candidate project' inputs to the Phase 2 event all involved the combination of NG networks with other, concurrent innovations and trends. These include open architectures, the internet of things and the semantic web and (more prosaically, 'linked data').

Secondly, and as noted above, several of the outputs reflect longstanding promises of technological pundits and researchers (as in the examples of telepresence or robots mentioned above). It is certainly quite plausible that NG networks will finally render such applications viable. Alternatively, they may reflect longstanding ideas from the history of the future which are this time being projected by workshop participants on to NG.

Thirdly, networked applications are inherently social as much as technological, innovations. By definition, they involve the engagement of participants often operating in very different economic, social, physical and cultural contexts. The conventional 'lab' may help to evaluate some aspects of technical feasibility, but they are poor at providing opportunities for social evaluation. We have begun discussions with three 'living labs' (Schumacher & Fernstein, 2007) (fortunately for us, both Manchester and Milton Keynes, have active 'living labs' and are members of the European Network of Living Labs). These provide strong opportunities as locations in which we the IBZL process can be used to generate ideas through the engagement of citizens in the process from phase 1 on. The also provide ideal locations for 'real world' trialling of networked applications rather than simply demonstrators. The proposal for a feasibility study for applications of 'real avatars' mentioned above is an opportunity to explore the social, economic and technology issues *'in vivo'* in the Alston Cybermoor Living Lab.

4.3   Next steps

At the time of writing, two proposals for feasibility studies have been submitted[1]. The precise path of these developments will depend on the success of the feasibility proposals. The proposal for a 'think tank' has been favourably received by local and national policymakers and is the subject of active development.

Reminiscent of Conan Doyle's dog that didn't bark, none of the ideas from the IBZL work to date have addressed specifically educational applications. This is interesting for two reasons. Firstly, given the number of educators involved in the workshops (and particularly educators from The Open University with its particular commitment to learning technologies in distance education) we might have expected a wide range of educational ideas. Secondly, education is frequently used by policy makers as one of three major application areas (with telehealth and entertainment) that will flourish on NG networks. Consequently, we are planning a set of IBZL phases 1 and 2 workshops bringing together technologists and educators specifically to explore educational possibilities.

A third set of workshops has been scheduled for late 2011.

Aligned with the material steps of the IBZL project is the continuing evolution of the IBZL model. An area which has not been developed effectively as yet is that of evaluation. The IBZL team is working on a self-recording evaluatory method called BECM (Being, Engaging, Contextualising and Managing). It is in plan that in future IBZL events facilitators and stakeholder groups will evaluate their own process and outcomes by use of the BECM criteria.

5. CONCLUSION

To date, we have used the IBZL approach successfully to engage over 40 people from a range of backgrounds in generating 25 named output ideas. Comfortably over half of these participants have either been engaged in the second phase or indicated that they would like to be. Three consortia have been formed

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[1] Since this paper was submitted, funding has been approved for a feasibility study into the potential use of 'real avatars'/robots in tourism and agriculture in rural northern England. The outcomes of this project will be reported separately.

to date to take on specific ideas to their next stage of development. The outcomes of the work of these consortia will be reported later.

One area for improvement in future IBZL workshop activities is the reporting and recording of the work of the working groups within the workshop format, to allow both for a clearer link to subsequent developments and to support systematic evaluation..

So far, we have not attempted define the kind of applications that can be developed. We are exploring whether the approach we have developed can be successfully used to address more specific NG problems (such as educational applications) as part of a significant extension of the IBZL approach in science, technology, engineering and mathematics (known in UK higher education policy circles as 'STEM' subjects) education and engagement..

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