Vision of Personal Broadband

Communications Futures Programme, Broadband Working Group
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I.   Executive Summary

This short document is intended to outline the vision of "personal broadband" (later refered to in the paper as PBB) a term loosely defined as "Personal Broadband is a set of capabilities and interfaces that allow users (or their agents) to select the connections that best meet their needs within a particular context." The vision is not specific to any particular service, "consumption device" or purpose, but rather defines enablers and interfaces which make it possible to offer a variety of services tailored for end-users serving both business and personal needs.

The vision is not constructed as an abstract exercise. Instead, the goal is to recognise the existing limitations and investments made by various industries and more fully utilise them. As such a significant part of the vision is its ability to easily tap into legacy systems and networks.

Some illustrative examples of Personal Broadband are described, including "Being Best Connected", "Find me a printer" for a roaming corporate user, "On the road with 'my' music or video library", "Mobile Office" and "Best connection for what I need to do".

While this vision recognises existing limitations, it does not try to identify specific barriers that need to be overcome to fulfil the vision. Some generic categories of barriers are identified, but the tasks of identifying specific barriers and how to overcome them are left as next steps for follow on work.

II.   Document History

Draft Version 0.1: Initial Draft by Hossein Moiin following discussions with Andrew Lippman.

Draft Version 0.2: Incorporating comments from Andrew Lippman, Dirk Trossen, and Sharon Eisner Gillett and making some editorial modifications.

Draft Version 0.31: updated by Dan Dahle incorporating collective discussions of the group from Hossein Moiin's presentations.

Draft Version 0.4: same as version 0.31 with revised structure moving section 3 to an appendix in order to more quickly get the reader to the subject.

Draft Version 0.5: further comments incorporated after 5 October Broadband Working Group meeting review.

III. Context

The communication industry is going through fundamental change. This change can be attributed to the decoupling of service from its delivery channel and "consumption device" (end user devices designed to deliver and consume information). While this trend has been around for some time, recently it has gained additional momentum in liberalised economies as all information and communication are becoming digital and there is a proliferation of access channels and consumption devices as well as entertainment and communication services. This new inter-industry dynamics has led to a battle among previously separate markets and industries of media, computing, electronic device manufacturers, and telecommunications.

As different industries try to capture a share of the communication market they put in place mechanisms that allow connectivity to various services. Today "access everywhere" is becoming a reality in major areas of the world. This notion of universal access is led by a strong demand by an increasingly mobile and busy workforce and population with a strong desire to have access to their information, transactional, communication and entertainment services within their context but regardless of their location. The demand has been met by end customers cobbling together a variety of providers who offer bits and pieces of this universal access. As these different providers (for example, wired and wireless telephony operators) try to meet this demand, they develop different approaches and networks to offer similar services to the end users. As an example consider the near future scenario depicted in Figure 1. In this case there are a number of channels available to the consumer for his or her most commonly used services such as telephony or Internet access where the best solution depends on the particular context of the end user. These services can be provided over a variety of fixed channels (e.g., cable, xDSL, or Fiber) as well as a number of wireless channels (e.g., Wi-Fi™, UMTS, or WiMAX™) with very different characteristics. The difference in characteristics arise from a number of differences in networks including but not limited to:

1. Support for mobility,
2. Coverage (and ability to hand-over application sessions),
3. Cost of deployment, upgrades and maintenance (and therefore, price for access),
4. Bandwidth (guaranteed, average and peak), and
5. Quality of service – latency, guaranteed delivery, etc.

Access Everywhere
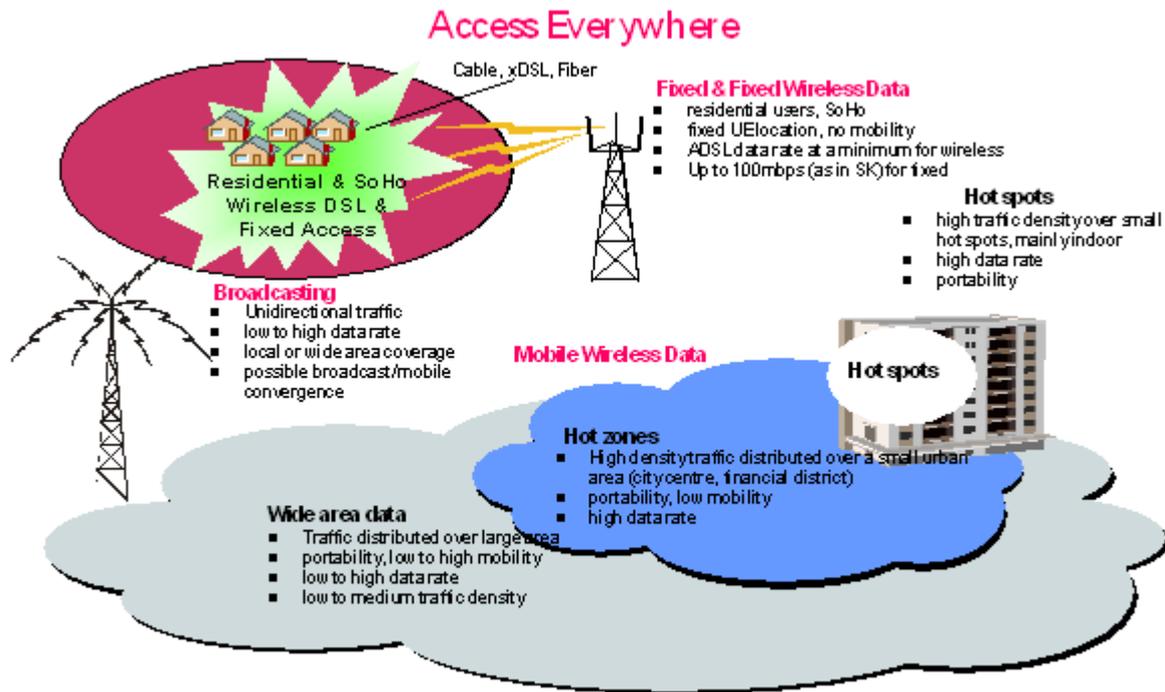
Figure 1

As an example of differences in characteristics consider that an xDSL channel does not support mobility, has point coverage, and it is very expensive to build (when including the price of laying cable), but inexpensive to maintain and upgrade with bandwidths ranging from few hundred thousand bits per second to a millions per second. xDSL also has Quality of Service (QoS) capabilities for Internet protocol (IP) traffic. In contrast, a GPRS channel supports mobility at speeds of up to 300 Km/hour, is moderately expensive to build (excluding the license cost), operate and upgrade, and has a maximum bandwidth of 128 Kbits/sec with guaranteed QoS for synchronous communication. As can be seen, there is a wide difference of characteristics between these two networks and yet in many cases, they both can be used to provide the same service depending on the personal context of the user of that service. With the growth and proliferation of these and other similar networks, it seems that (broadband) access to services will become available in a ubiquitous manner in the near future.

It is the increased availability of connectivity choice, however, that raises the potential for this "access everywhere" to become in fact "personal", i.e., to become a form of access that is tailored to the need of the end-user depending on the user's context. This type of access is the motivation for defining "personal broadband".

Definition: Personal Broadband (PBB) is a set of capabilities and interfaces that allow users (or their agents) to select the connections that best meet their needs within a particular context.

The rationale for PBB success builds on the observation that many of the technology based success stories of the past owe their success, to some significant degree, to the fact that they were "personal". The personal nature of these services either was the key that provided them with success and/or increased their successful adoption. The key question of interest, therefore, is: Can broadband service become more successful by "going personal"?

Examples of past personal technology successes include mobile telephony, Instant Messaging, VHS (and DVD), Personal Music Players (starting with Sony's Walkman and evolving to Apple's iPod™), Personal Digital Assistants, Laptop computers, web-based email access and storage and even search engines on the Internet. Each of these services have either created new markets or quickly outperformed competition from existing markets and industries. One mights say they are "moving from 'high technology' to 'my technology'".

For example, globally mobile telephony in 2004 generated more revenue (and had more customers) than its much more established fixed-line counterpart despite its relatively large price differential. As another example consider that despite their typically lower performance and higher cost, this year there will be more laptop computers sold than desktop machines. DVD (and VHS) sales now account for more than 66% of a movie's total intake. The success of personal music players (iPod accounting for more than 60% of revenue and profits of Apple) and search engine company Google (the most spectacular IPO in recent memory, post bubble and for a company that was only 5 years old) provide significant proof. Similarly, cable and satellite television with expanded channel availability (being more personal) is now a larger industry than public broadcast television. Other potential candidates for personalization success include programme-on-demand (such as VOD) and personal video recorders (such as TiVo™). These services will customise the consumption of a well-known and already popular service to an individual enabling commercial success through the offering of customized services.

Studying the past success and failure stories helps us to identify the common characteristics that define a personal service and help us to determine if broadband is a good candidate for going personal. It appears that successful personal services share a number of common characteristics. These include:

a. Inherently useful
b. Conducive infrastructure (technology must be ready and available for the mass market)
c. Availability of suitable content
d. Availability of suitable consumption devices and user interface
e. Attractive business model (for the required members of the value chain <u>and</u> must be attractive to the user of PBB)

Let us consider, as an example, mobile telephony. When first introduced, mobile telephony allowed mobile subscribers to call other subscribers (mobile or fixed) while they were on the move through a familiar consumption device model, i.e. the telephone. This is an inherently useful service as it extends the consumption of a basic service (telecommunication) to a new context. Furthermore, many mobile operators (at least outside of US) were spun-off from fixed line operators who had a ready made an attractive business model to extend their networks to this new mode of consumption.

Assuming that the above correctly identifies the characteristics of a successful personal service, and assuming that broadband will benefit from "going personal", we can now add more texture a vision of PBB that has the above-mentioned characteristics.

IV. Vision

We should point out that most (if not all) of the past success stories of personal services were application specific (in the case of mobile telephony it was voice followed by messaging). Broadband, on the other hand, is an infrastructure service; therefore, at first it is not clear how such a service can become personal, as it is not tied to any specific application or consumption device. The definition of PBB allows it to be independent of any particular service without precluding any service.

As defined above, PBB will enhance the personal nature of applications and services that are accessed through it and by doing so PBB extends the virtuous cycle of broadband. Therefore, while the services accessed via PBB will have all five characteristics of personal services identified earlier, PBB may only have some of them. Specifically, PBB must be based on a solid infrastructure (realising the "access everywhere" goal) with an appropriate business model (PBB service providers must be financially successful to provide on-going services) offering an inherently useful service (e.g. "best access" to remote information).

Services running on a PBB connection can be classified as:

1. Personal Services: User selected (and possibly subscribed) services usable by an individual user. The list of personal services is kept by the "network" and maybe managed and altered by the user, or the network.
2. Group or Team Services: Services aimed for usage by a defined group such as secretary functionality. An administrator creates a team. He or she also manages the group membership (addition, deletion, and alteration of group members and their access rights) and configures the service.
3. Enterprise Services: Services aimed at enterprise customers with higher security and trust models than those for groups.
4. Network Services: Traditional (i.e., PSTN like) services defined by the network as well as new services being defined such as IP multimedia services (IMS).
5. Vertical Services: Specific services targeted at particular segments or applications (such as on-demand-video or commercial inventory and ordering applications). Such services may also utilise dedicated networks and consumption devices.

Figure 2 depicts the key ingredients of the PBB vision. In this figure a communication service is decomposed into consumption, services & application, and channel ingredients. Given that the aim of PBB is to

provide "best access" to a range of applications being run on a range of devices and accessed through a number of networks, flexible access for PBB is of core importance. PBB must be open to, and in fact encourage and support, diversity in each of these areas. The implementation of PBB requires a number of key functionalities to support any user on any device accessing any application via any access method or network (assuming suitability of context and appropriate authentication, authorization and accounting). Therefore, the PBB definition includes the set of functionalities, which allow a user of communication services to access those services in an optimal manner via any network on any device.
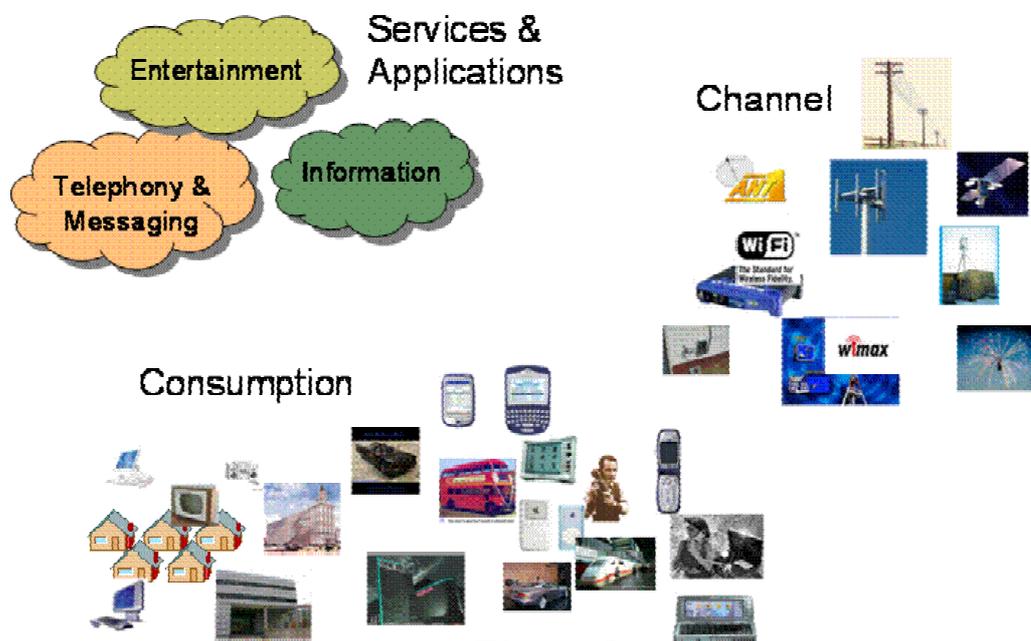
Figure 2

The illustration of PBB ingredients, as depicted in Figure 2, allows various access technologies, applications and devices to be integrated within a common framework. This implies a framework to solve problems of interoperability among diverse technologies; however, the vision is incomplete unless it puts the user (possibly via his or her agent) at the centre and allows him or her choice of connectivity. This element of choice must have explicit functions that support this choice embedded within the architecture of PBB which will be addressed in follow on work after this paper.

The inclusion of choice, as depicted in Figure 3, emphasizes the range and importance in the vision of personal broadband and its usefulness and value across multiple user contexts throughout their day. .
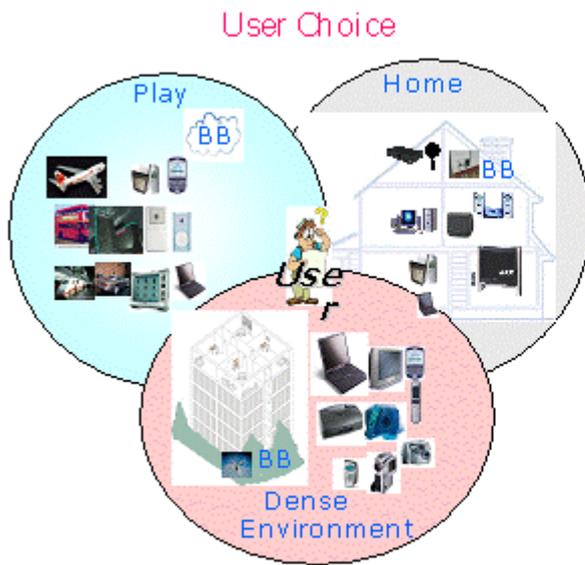
Figure 3
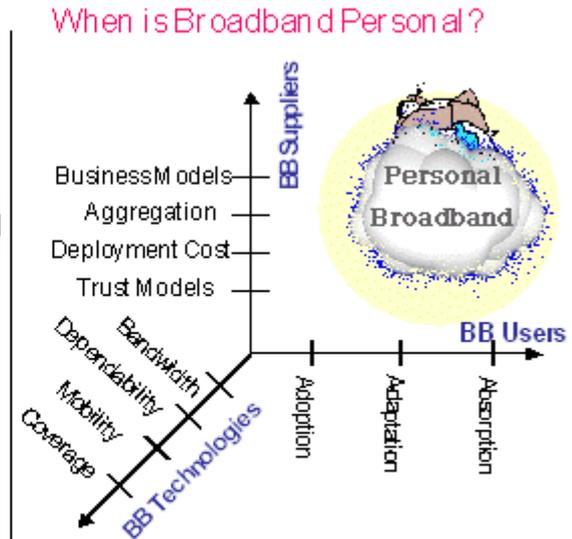
Figure 4

Fulfilling the vision of PBB depends to a large extent on the personal applications that use this infrastructure and their usage by the end users. The users of such applications will go through a process that leads the applications, and therefore, the infrastructure that supports them, to first be adopted, then adapted to, and finally absorbed. This process defines a progression signalling when broadband has been personalised. In addition, there are a number of technology and business barriers which must be overcome to allow this process to happen. Some of the dimensions and balancing trade offs of these barriers are indicated in Figure 4, but their detailed definition and enumeration along with approaches to overcoming them will be dealt with in a future paper.

V.   Sample Use Cases and New Possibilities

Ultimately it is the usage in daily life enabled by the PBB Vision that creates value for the user and new opportunities for providers of services. Here are a few scenarios intended as indicators of what PBB might grow up to be:

"Being best connected" – as a user is walking through a retail mall they see an item that reminds of a companion item they would like. They take out their PBB device, select their best connectivity method from the variety of connection options, based on their own preferences for service provider, bandwidth, cost, etc. (note that the selection process could be automated) and search the item in a mall directory to find related products and outlets for purchase in the mall. During this search, they may go to a manufacturer's interactive site where there may be a different connectivity preference, e.g. high bandwidth for video streaming or lower latency for instant response. Having satisfied themselves with their research the could proceed with the order of their selected product and pick it up at the prefered store location in the mall.

"Find me a printer" – a mobile user is at visiting at a corporate office and needs to print a document, however the selection of the printer used cannot be based on network identity at the user's base office location. Part of the PBB Vision is the service to locate local resources, like a printer, with the desired attributes nearest the current location of the user. More broadly, this aspect of the PBB vision aims at enabling users to discover any networked resources within a certain proximity, independent of the chosen connectivity for the user as well the networked resource.

"On the road with 'my' music or video library" – with the advent of personal entertainment devices such as Apple's iPod™ or Sony's PSP™ users increasingly can take their music or video preferences with them. Even so, the libraries of play lists can easily exceed the local storage and a roaming user may want to get "outside in" access to their complete libraries of music, videos, games, photo albums, etc., including recent updates other family members may have made.

"Mobile Office" – a knowledge worker is expecting an important call from a client however she also would like to join a good friend for lunch that has a rare visit in town. The PBB vision enables her to join her friend and still be connected with her office via a secure broadband to corporate network services with virtual presence. Her phone calls are automatically forwarded to her PBB device and she has full access to all the required records and resources of her office.

"Best Connection for what I need to do" – John has a consumer broadband service at home for his family to enjoy and utilize for school and personal

interests. However, when he works from home he often has needs for better access to support voice, collaboration and video capabilities that enhance his productivity, just like in the office. The PBB vision allows the corporate user to control and manage dynamic upgrades in network access on the company's IT account for his professional use while he still has his own independent choice of service level for he and his family's personal use. This concept could likewise extend to the retail world where a merchant might upgrade a qualified customer's access capabilities to fully utilize their retail web site investment.

New Possibilities
New Access Provider: Mobile Pico-Operator may offer a high bandwidth bridge to WLAN or "3G" through a "meshed" set of their service subscribers by lending access rights through their subscribers to other parties. In return, the meshed subscriber "hosts" are rewarded by the service provider with discounts or special offers.

Direct-Link: Account at "MGM" can access and deliver entertainment products through a number of distribution channels both at home and while out and about. One example may be a pay-per-view customer accessing their viewing rights at a friends house for a special viewing event.

Borrowing Bits: Lending access rights to family members in the mall using a PBB device as a "mobile gateway" for connected access (i.e. extending network utility to local activities)

VI.   Summary and Next Steps

In this paper we have described a vision of future personal broadband capabilities that not only provides pervasive connectivity, but choice of providers, user devices and seamless services across those choices. Figure 5 provides a summary of the attributes, capabilities and interfaces described by the PBB Vision. Some of these attributes and capabilities are becoming available today and others will take longer to realise. To date there has been considerable discussion, but not yet agreement, on the architectures of networks and services required to fulfill this vision.

Personal Broadband is a set of capabilities and interfaces that allow users (or their agents) to select the connection that best meet their needs within their particular context

Attributes	Capabilities	Interfaces
· Focused on providing the most suitable connection as defined by the *user* · Enhances the personal nature of applications and content accessed through it · Compatible with commercial and non-commercial access service relations which can be long or short-lived (ad hoc) · Compatible with existing investments · Can be realised as a service, or offered as a product, by one or more service providers	· Ubiquitous: available "everywhere" and "always-on" · Provides options to users to choose from among multiple providers · Provides flexible treatment of user's information (e.g., their identities or how much of their profile information is to be "passed-on") · Maintains the integrity of content as it passes through the network · Provides dependable (trustworthy) access to applications and content from any device	· *Open* to applications and devices · No particular device or application is assumed · Focused on layers 1 to 3 of ISO stack (Physical, Data Link, and Network) · Defined to support higher level functionality required for realisation of PBB · Allows for explicit passing of contextual information from user to application and vice versa

Personal Broadband will be realised through complementary devices, core and access networks, applications and content, and the required supporting infrastructure working in concert

Figure 5

The next steps to develop the underpinnings of the PBB Vision will include identifying the barriers that might exist for the creation of PBB and what steps need to be taken to resolve those barriers. We envision three broad categories that need to be addressed:

1. Supplier side business issues: the barriers in this group include trust models among various providers (commercial, non-commercial and ad-hoc), risk management by the providers, economic viability of deploying such capabilities, appropriate business models for the identified players including roaming agreements with flexible value exchange, and the role of aggregation.

2. Technical issues: the barriers in this group include the availability of the appropriate supporting infrastructure (always on, bandwidth, latency, coverage, and support for mobile or nomadic use), scalability and dependability of proposed interfaces and functions, and security and privacy concerns of the valud chain from users to sourcing suppliers. Furthermore, as mentioned in the previous section, a suitable technical architecture needs to be developed for PBB based on the vision and its associated business architecture. This technical architecture, although focused on layers 1 to 3 within our work, will need to properly identify, address and support dependencies to higher layer functionality including support for both synchronous and asynchronous services as well as simple and composite services. Examples for such dependencies are identity management, context processing, access network selection and QoS detection and provisioning.

3. Demand issues: what applications and devices will drive the demand so that PBB is developed and adopted? What form will the adaptation of users' lives take to the availability of PBB, and what will cause PBB to become absorbed so that it is only noticed by the users when it is absent, much like the previous absorbtion of telephony services?

Our goal in the next stage is to enumerate the barriers and to have a proposal for their removal in the follow on paper for the Personal Broadband Vision.

VII. Appendix

About the BBWG and CFP

The goal of the BroadBand Working Group (BBWG) within the Communication Futures Programme (CFP) is to promote the virtuous cycle of growing Internet usage and further investments in broadband access. The goal of the group is based on the observation that if there is growth in Internet usage then that would justify future investment in the network, which leads to the creation of innovative (and possibly bandwidth-hungry) applications and services which in turn leads to growth in the usage and so on. The approach of the group is to develop white papers identifying the barriers to the above-mentioned virtuous cycle via consensus among stakeholders across the broadband value chain. The activities of the group are driven by "small-group" teams focusing on articulating specific problems and/or approaches to solutions followed by agreement of the entire working group. The group demonstrates consensus via short white papers (such as this one) and disseminates these papers to policy and executive audiences who impact the industry.

Why write this paper?

The contribution of the BBWG can be categorised into two groups; first, there are activities, which try to ensure that the existing (or predicted) paths for growth result in a virtuous cycle. This group of activities concentrates on the economic viability of investing in infrastructure of broadband and tries to determine how a virtuous cycle can be formed. Personal Broadband (PBB), on the other hand, belongs to a second category of activities, those that extend the existing notion of broadband to include new context and usage. By adding new context and use-cases it is hoped that there will be positive economic impact so that the virtuous cycle can be extended. Therefore, the nature of PBB is to define and create new opportunities and not solve specific issues. As such it has been decided that PBB can benefit from a vision and definition so that its creation can be turned into a series of actionable tasks. This paper attempts to define the vision of PBB without going into the details of what steps are required to create it.