This briefing document serves to explain the background to the technology, and its implications, chosen for Ireland's National Broadband Scheme (NBS).

The NBS contract was awarded to Three Ireland, part of the Hutchison Whampoa group.

This document has been prepared by **IrelandOffline**, a voluntary organisation campaigning for equal access to broadband in Ireland.

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Executive Summary

The National Broadband Scheme (NBS) is a program by the Department of Communications, Energy and Natural Resources to deliver universal broadband access in Ireland by the provision of services to those areas (estimated to contain 10% of the population) where commercial operators do not reach.

The position of service provider for the NBS was put to competitive tender, a process which was won by Three Ireland, part of the Hutchison Whampoa group.

Three Ireland will serve 92% of NBS customers with a wireless offering based on I-HSPA, a 3G mobile technology. The remainder will be offered a satellite-based service.

3G internet services, due to their low speeds, high latency and unreliable service are not considered broadband by most other EU and OECD regulators, and are explicitly excluded from the OECD's broadband statistics. 3G internet is widely ermed "midband" because of this.

There have been few details about the selection process for the NBS. It has not been an open process. Many existing customers are deeply dissatisfied with the level of service currently offered by 3 Ireland and the level of customer service provided.

Three claim that the service they provide will have a 36:1 contention ratio, however 3G technology, nor any mobile system allows an Operator to limit subscriber contention, only user contention by refusing connections.

Three claim in their specifications that they will provide download speeds ranging from 1.2Mbps to 5Mbps, however an analysis of the technology and infrastructure to be installed shows that the actual download speeds will range from 86kbps to 345kbps loaded with a typical number of users and 180kbps to 6Mbps for one user only in a Mast Sector

Three plan to install 160 masts to provide their service, h owever it would 800 to 1,500 to provide a minimum download speed of 1Mbps depending on terrain

The high latency and variable speeds make 3G highly unsuitable for many common broadband uses such as VoIP, online videogames, and VPN teleworking.

Three will provide a 12GB download allowance in the €19.99 per month package. However, anyone who exceeds this allowance will be charged over €275 per GB.

About the NBS

The NBS was devised by the current government as a means of addressing the "**digital divide**". Core to this divide is the growing gap, in the quality of Internet access services, between urban areas and remote rural areas. The NBS was established to address the "last 10%" which is frequently reported as the 10% of population that don't have broadband access available to them, because such services would generally be deemed to be not commercially viable.

History of the NBS

The concept of government-subsidised broadband services for rural areas was established before the NBS by way of the Group Broadband Scheme (GBS). This scheme followed the principles of the Group Water Scheme which is responsible for local communities having their own running water. Similarly, the GBS gave funding and support to local organisations who established their own broadband service for their area. However, the GBS was plagued with delayed funding allegations, and support from telecommunications providers (telcos) faded out as promised funding became less accessible. The NBS extends these principles but sought to nationalise it and, thereby, remove local, fragmented organisations from the equation and give one Telecommunications Company or consortium, the contract to provide a service to all affected areas.

Bidding for the NBS

A bidding process was established to identify the best service provider. This was overseen by the Department of Communications, Energy and Natural Resources (DCENR), and its predecessor, the Department of Communications, Marine and Natural Resources. The outcome of this process was that 3 Ireland had beaten other contenders including established providers such as eircom and BT Ireland. The selection criteria were not made clear, nor were the criteria published.

Role of the NBS in the government's broadband-related goals

The Houses of the Oireachtas Joint Committee on Communications, Marine and Natural Resources have issued a number of reports, since their appointment in 2002, detailing recommended steps to enhance the roll-out of broadband.

Core to a number of its reports was the need for a national vision of broadband roll-out. From this came the NBS, but there are a number of initiatives to enhance broadband roll-out. These include Metropolitan Area Networks (MANs) which provide high-capacity, carrier-neutral networks around urban areas to

which operators can connect. Also, schools are allegedly to get high-speed broadband (100 Mbps, 10-15 times faster than current mid-range broadband service offerings), as well as some regulatory changes.

The NBS was created to satisfy the goal of delivering Universal broadband access; i.e. provide broadband in areas where commercial operators will not be able to reach for a variety of reasons. Most government initiatives in 2009 essentially still follow the New Connections Report published in Feb 2002 and with some additions by the DCENR Telecom Strategy Group over the course of 2003.

The report also highlighted the need to "Define broadband as a service [..] and set a target of the widespread availability of 5 Mbps connections by 2006 and with a further suggested target of 10 Mbps connections by 2008".

Specifications of the NBS

The provider, 3 Ireland, will be required to provide service that meets a minimum specification to areas identified by the DCENR. Details of this minimum specification are not published, but the Minister did say, on the 2nd of May, 2007 (Read NDP press release), that the final offering will have:

- at least 1Mbps (mega-bit) download speed
- at least 128kbps (kilo-bit) upload speed.
- at least a 10GB (giga-byte) download capacity (before caps or Acceptable Usage Policy (AUP) kicks in)
- support for Virtual Private Networks (VPN) for businesses and VoIP applications and devices for home business purposes.
- sufficiently low latency to allow standard applications such as VoIP and online gaming to be run without significant degradation of service from an end user perspective.

Since that press release, details have been scant, other than the final service offerings announced, and no reference to the technical specification they must match. There are 2 product offerings in the NBS (view 3 Ireland's NBS product details). Up to 8% of people will be offered a satellite-based offering with these specifications:

- Download speed of 1Mbps
- Upload speed of 128kbps

- Usage cap of 11GB (10GB download, 1GB upload)
- No upgrade path

The remaining majority of NBS customers will be served by a 3G, cellular-based offering with these specifications:

- Minimum download speed (for customers at the edge of a cell coverage area) of 1.2Mbps, and a maximum of 5Mbps (for customers very near the cell base station / antenna)
- Minimum upload speed of 200kbps (0.2Mbps), and a maximum of 2Mbps
- Usage cap of 15GB (12GB download, 1GB upload)
- Upgrades planned for download speeds of 2.3-10.4 Mbps and upload speeds of 1.4-4.8 Mbps by 2012

The price of either offering is fixed at €19.99 per month (plus an initial equipment fee), including VAT.

1Mbps is 1 mega-bit per second. Bits per second are a standard telco measure of data transfer rates. There are 1000kbps (kilo-bits per second) in 1Mbps. 1GB is a giga-byte (not bit!). There are 8 bits in a byte. Bits are used to measure transfer rates, and bytes used to measure data size/amount, generally. Computer storage may be measured in multiples of 1024 rather than 1000.

IrelandOffline criticisms of the NBS

Availability of Service

We in IrelandOffline do not believe that the proposed 3g service can possibly deliver the outlined specifications with the required consistency of speed for the NBS to be considered true broadband.

Coverage map

The coverage map used to determine who can, and who cannot, avail of the NBS was devised using a system of Electoral Divisions. These don't reflect real-world coverage of services (using any broadband technology). Also, the map was generated based on operator feedback, which means operators were allowed overstate their coverage to discourage NBS competition in their area. The map also does not take in to account the very significant number of people who are connected to a broadband-enabled telephone exchange (DSL) but whose line is not suitable for DSL service. Estimates range from 20% of urban lines to multiples of that in remote areas. Similarly, no allowance is made for wireless operators who cannot service vast areas because of geographic features. The map is not a true representation of those who cannot avail of broadband service.

Speed

The 3G technologies of I-HSPA which are being proposed for usage by 3 Ireland, are explained in much greater detail later in this document. To summarise, the speeds quoted are best-case scenarios, and the majority of users will not get anywhere like these speeds. Unlike other technologies, such as phone line-based (DSL) and cable-based (cable) broadband, users of 3G Internet access don't share the available bandwidth equally. The available bandwidth is determined by the number of users, the distance the user is from the cell base station / tower / antenna, and a number of other characteristics.

The quoted speeds, even the minimum speeds quoted, will not be achievable by many users. In busy areas / cells, users will achieve little more than dial-up Internet speeds. Such is the recognition, internationally, that 3G does not deliver a reliable and scalable broadband product that other EU and OECD telecommunications regulators **explicitly exclude 3G** Internet subscribers from their nation's broadband subscriber counts. 3G Internet is widely termed "**midband**" because of this. ComReg, Ireland's telecommunications regulator is one of very few regulators that do include "**midband**" subscribers in their broadband subscriber reports. The term "**midband**" is also used in the

Oireachtas Joint Committee on Communications report of 2004.

Latency

While the speed, or bandwidth, of an Internet connection determines how much data can be transferred simultaneously, the latency of a connection determines the time it takes for a given piece of data to be transferred between two Internet devices (e.g. a user's computer and a web server). The lower the latency the better, especially for time-sensitive applications like VoIP (e.g. iChat, Skype or Google Chat), on-line gaming (e.g. Games consoles such as the XBox Live, Playstation, and PC-based gaming), VPN/office access (used for teleworking/remote working) and many others.

To give an example of the effects of poor latency, if one was to make a Skype call on a DSL or cable broadband connection, it's reasonable to assume the quality would be excellent, without any delay being experienced, or any dropping of voice (short periods where the voice cannot be heard, from a fraction of a second to a small number of seconds). On a good satellite Internet access service, the latency would be much higher, and therefore a delay can be noticed from a half of a second upwards (akin to calling across the world in the 1970s!). However, on a 3G Internet connection, the latency is both higher (more noticeable delay) and much more varied (frequent drops in audible voice; voice appears broken up). Higher and variable latency also make real-time on-line gaming a near impossibility.

Selection process

There have been few details about the selection process for the NBS. It has not been an open process. Many existing customers are deeply dissatisfied with the level of service currently offered by 3 Ireland and the level of customer service provided. Was this a taken into account during the selection process? Was it purely cost of roll-out, or was any weight given to the quality of service being offered, minimum service levels, scalability, upgrade paths, and so on? If there was, why has this not been highlighted? The official scoring scheme was published on the Government eTenders site (click and select full notice) on the 30th of January 2009. Despite the fact that price element is weighted at 35% of the score the reason given there for the award is lowest price.

Value for money

While the government suggested it will target capital investment of €435m to address the digital divide, they are, in fact, spending €39M from Irish Government and €40M EU funding. The rest is part of 3's roll out. That

investment provides poor value for money of a broadband delivery platform. Any investment from any telco is to be welcomed, but IrelandOffline believe that government investment should be saved for proven, reliable, and long-term delivery of broadband, and not the stop-gap measure that is this 3G-based solution.

Forward thinking

Ireland have had numerous reports on what we should be achieving in terms of nationwide broadband roll-out, the Oireachtas Joint Committee being a higher profile example, but many come from other agencies including Forfás. All are agreed on the significance of having nationwide access to high-quality broadband as being absolutely essential for the oft touted "knowledge economy". The DCENR themselves have quoted speeds and penetration rates they wish to achieve (and have failed), but the single biggest criticism is the lack of any concrete plan to ensure anyone in Ireland can have access to high-quality broadband. The NBS is not, IrelandOffline believe, in line with a forward-thinking strategy, in this regard.

Compare the NBS to a similar initiative in Finland. The government of Finland has announced that a fast, high-quality broadband network should be made available across the whole country, reaching almost all households, businesses and public offices by 2015. A report compiled by **Harri Pursiainen**, Permanent Secretary of the Ministry of Transport and Communications recommends that the speed of the broadband should be at least 100Mbps and it would be delivered through an optic fibre network or a cable network to almost every building. Presenting the report to the government this week, Minister of Communications **Suvi Lindén** said that implementing the objective represents a historic step in the development of the information society in Finland.

Finland currently has more than 1.5 million broadband connections. According to Lindén, the widespread availability of affordable, high-quality and high-speed broadband connections has been a primary goal of the Finnish electronic communications policy. Finland's National Broadband Strategy was implemented in 2004-2007. During the first two years of the strategy period, the growth in the number of broadband connections in Finland was the fastest in the world and even in the third year it was the third fastest in Europe. Finland's broadband ranking has risen from sixth to third in Europe and from fifteenth to seventh worldwide, according to Lindén.

The Finnish government wants to ensure that the country's communications networks meet the needs of the society both now and in the future. According to Lindén, the availability of broadband connections has enabled the use and development of advanced digital content and services, playing a crucial role in

the Finnish information society development.

It's clear to see the difference in strategy, and indeed in results. While Ireland was hovering around the lower end of the broadband penetration rates of the EU and the OECD, Finland were recording record growth.

Exorbitant hidden costs

While the costs of the equipment itself are relatively affordable at €19.99, the data allowances must be kept in mind. Current allowances are 15GB (12GB download, 3GB upload).

However if you exceed this allowance you may find yourself in for a shock, a charge of 2.77c per MBit - Wholesale that equates to a wholesale cost of **€275.71** a GByte. Operators will obviously charge more than the wholesale cost

Technical Background

Except for a maximum of 8% satellite coverage, allegedly, the technology being used in the NBS is 3G "**midband**". Here's a brief technical summary of the technology involved.

Mobile internet

Mobile Internet, misleadingly called mobile "broadband", is accessed via a dongle or a mobile phone, and involves the use of 3G services. 3G technology is made possible by two complimentary technologies HSDPA and HSUPA (high speed download and upload packet access, respectively). In theory, these technologies enable mobile Internet users to access speeds of up to 7.2Mb/s download and 1.76Mb/s upload.

In practice, however, such speeds are only available in certain areas. It is likely that access to these speeds will become more wide-spread in the future. Though mobile Internet dongles, USB sticks and data cards are currently the normal way for people to access mobile broadband, 3G laptops are also becoming popular. Home users would normally require a router/firewall and wireless access point(wifi) into which the dongle is plugged into. The sharing aspects of a purely dongle based access system are unclear.

HSDPA / HSUPA

High-Speed Downlink Packet Access (HSDPA) is a protocol for mobile telephones. It is a third-generation (3G) High-Speed Packet Access technology designed to speed up network capacity and data transmission rate of cellular phones. HSDPA is associated with various Universal Mobile Telecommunications System (UMTS) networks. These include the Global System for Mobile (GSM) Communications. Current HSPA is defined in 3GPP Release 5. HSUPA is higher upload speeds with little difference in latency or download speed. The final version is in 3GPP Rel. 7 and includes HSPA+. LTE is a separate and incompatible system needing different spectrum (about 8x as much) and new modems.

Currently, HSDPA can support speeds ranging from 1.8 Mbps to 14.4 Mbps at the centre of a cell (the base station / tower / antenna). This is very poor compared to wired networks. It should be noted that these are the peak shared bandwidth for an entire sector of a mast (which usually has 3 sectors). The speed is adaptive; each time the **distance doubles the maximum speed is one quarter**. This means if someone can get only 3.6Mbps at 500m and a

second user connects at 100m from mast, if each get a fair share of traffic, the closer user will get 3.6Mbps, not 7.2Mbps and the 500m user will get 1.8Mbps. As more users connect the noise level rises reducing the range (cell breathing, cell reducing size), at about 40 users, (close to maximum number of connections for a 7.2Mbps mast) the artificial noise means only half the 7.2Mbps peak is available. Thus if the 40 users are in two groups, 20 with each of our two previous example users, the speed is 3.6Mbs / 20 = 180kbps and 1.8Mbps / 20 = 90kbps for the other 20 users at 500m. Users at 1km would likely lose the signal altogether.

I-HSPA / iHSPA / HSPA+

3 Ireland are proposing to use I-HSPA to deliver faster speeds than mentioned above, and to roll that out between now and 2012. HSDPA has a poor uplink speed, which is remedied by HSUPA. Normal HSPA systems are a protocol running on the basic Cellular 3G/UMTS basestation. I-HSPA is a proprietary Nokia version of HSPA+ in 3GPP Release 7. As such it simplifies the basestation allowing direct connection of the IP data traffic to a backhaul router. The downside is that the air interface is still CDMA and compatible with existing 3G data modems. On the 5MHz channels that 3 have it cannot deliver any extra speed, or any extra capacity, and the mobile performance of handover between basestations is poor. It may reduce latency to about 100ms+ instead of 120ms+. The queuing behaviour for congested cells is unknown at this time.

I-HSPA basically combines HSDPA and HSUPA. Without extra spectrum and new modems especially for Nokia Siemens Network's Proprietary system it can't deliver any extra speed or capacity. Performance degrades in the exact same manner as ordinary 3G where for 40 users on 7.2Mbps sector simultaneously, half the capacity is lost due to CDMA code noise, the speed is 1/80th rather than 1/40th.

Download caps

Download-aware users will have noted that mobile broadband packages generally have quite restrictive download limits from 1 GB to 15 GB, when compared to other residential broadband offerings. Reasons for the lack of "unlimited broadband" packages in mobile Internet include:

High costs - transferring data across 3G networks is more expensive than across ADSL or cable (the technologies used in the majority of home broadband connections, in Ireland.).

System overload - providers are concerned that if all users were offered unlimited downloads, the system would be overwhelmed very quickly causing lost connections and slow service across the 3G mobile network. This issue may

be the reason why mobile Internet will not overtake home broadband as the default means of connecting to the Internet until technology improves.

Advantages of mobile broadband:

- Mobility. It's convenient to access the Internet on the bus, train, park or anywhere outside your home environment.
- Wireless. You don't have to be plugged into an Ethernet connection or even be in range of a hot-spot because this technology provides you with your very own portable modem, be that a USB dongle, or mobile phone.
- Portability. Mobile modems (e.g. USB dongles) are small and discreet. Many mobile phones have a modem built in to them. This makes it easy to carry your modem with you, on the go.

Disadvantages of mobile broadband:

- Variable speeds. Users of traditional broadband offerings can expect a more constant speed, in a given location.
- Slower speeds. Speeds quoted in mobile Internet marketing are usually the absolute maximum that a minority of users will receive. Compare that to the slightly more realistic speeds advertised on wired broadband, or fixed wireless access (FWA) broadband, where speeds are more regularly achieved by a larger number of people.
- Limited download allowance. The cost of data on 3G networks means that the usage allowances are lower than similarly specified broadband packages on more traditional technologies.
- Contention cannot be controlled. The nomadic nature of 3G networks means a user (even if stationary) could move from one cell to another, seamlessly. This nomadic quality, while convenient, does make it difficult to control contention on any given cell.

Cell Breathing

Each handset or modem uses a different CDMA code sequence. This means every connection looks like noise to every other connection as they occur at the same time in the same 5MHz channel. Along the boundaries of the three sectors on a mast you would have very poor reception. This is solved by using three different 5MHz channels. However the same channel from a different Cell can interfere. Interference (noise), either background, man made, another cell, or connections within the sector reduces the available signal (Signal to Noise Ratio

= SNR). Since the upper power of the handset/modem and basestation transmitter is limited (and has to be to avoid leaking to other cells), as more connections are made, the range decreases. This means when there are 40 simultaneous connections in a sector, the range from the mast is reduced to a half, or even a quarter.

Thus the cell edges on the three sectors move (breathe) in and out as users connect in the cell, or even in nearby cells, especially if users are upstairs or on higher ground. You can't have even 75% coverage "always on connection" with 3G/HSDPA. It is not possible unless there are four times the number of masts (cells are a quarter of the size) and also adding many more 3G channels. You would need about 18 x 5MHz + 5MHx channels (N=18). Common licences have enough spectrum for just N=6 or N=9 channel reuse.

Contention on 3G Networks.

Let us assume that the 3G can enforce the 36:1 contention ratio mentioned in the NBS launch press release. We already know, from above, that it can't be enforced, but it helps explain contention. The NBS, and 3 Ireland, claim 223,000 buildings will be served by the scheme. As a rule of thumb, let's use UPC's take up figures of 20% to 30% take-up of houses passed by their cable. That is approximately 1 in every 4 houses on the UPC (ntl/Chorus) cable network that can avail of broadband do actually subscribe. Another generous assumption is that there is only 1 user per household/business.

In a basic example, if the 3G network could enforce a 36:1 contention ratio, and assume a generous maximum of 25% of people online at peak time, then the contention ratio would only be 9:1 for those users (36:1 * .2). In terms of speed, that would mean 5Mbps (the maximum speed quoted by the NBS), or 1Mbps (the minimum speed) would become a mere **555kbps** down to **111kbps**. Those speeds are for generous assumptions. For a more realistic coverage, we'd take the average (allowing for users at average distances from the centre of the cell to the edge of the cell). Using a geometric average, the expected speeds for users would be **248kbps** (sqrt(555kbps x 111kbps)).

A more in depth analysis would look at all of the 160 new masts proposed by the NBS, and assume a norm of 3 sectors per mast giving 7.2Mbps per sector, or an overall capacity of 3,456Mbps within 500m. That is, 160 masts x 3 sectors 7.2Mbps = 3,456Mbps. For distances of up to 500m from the mast, if all users were fortunate to be that close to a mast, the average speed for a similar 10,000 people (20% take up of 200,000 people with 25% of them being online simultaneously at peak time) would be **345kbps** (345Mbps total capacity / 10,000 users). If those users were further away from the cell centre, they would get around **86kbps** (bearing in mind that a good dial-up modem

connection will yield upwards of 50kbps). Again, for a more typical spread of users between the cell centre and edge, the geometric average would be **172kbps**.

Alternatively, to turn the analysis around, let's examine just what the proposed new 160 masts will give. Given we know the average mast has 3 sectors and each sector serves approximately 40 people, we know that the 160 proposed masts will serve approximately 19,200 or just 8.6% of the proposed 223,000 customers. To serve the 20% take-up rate used in our earlier calculations, at least 370 masts would be required. Quite a shortfall, already, but then take in to account cell breathing, and the nature of 3G to reduce the available capacity by 50% as it becomes more populated by active users, we can easily see that many more masts are required. An approximation of 733 masts for a minimum cell-edge speed of 50kbps, and up to **1,500 masts for a minimum speed of 256kbps** (and typical speeds of the quoted 1Mbps-5Mbps). A tally that the proposed 160 falls well short of!

Finally, it's important to remember that the above are using generous allowances for all values, and for a controlled contention of 36:1 (as proposed in the NBS). However, contention can't be controlled, short of refusing connections altogether. With the nomadic nature of 3G, users will switch between cells or sectors, depending on their signal strength. For more populated areas, this becomes harder to manage, and the available bandwidth will be affected. The more users in a cell, the less bandwidth, supported number of active users, and geographical reach. All leading to a poor experience for anyone in a populated cell that is not adjacent to a mast!