Munster Wireless Ltd.
[redacted]

Munster Wireless Ltd. response to Call for Input by DCCAE on

Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area

Introduction

Munster Wireless Ltd. is a small rural Internet Service Provider established in January 2005 in response to a need for higher internet speeds than the 56k dial up and the expensive 128k ISDN lines available at that time.

We started with a 2Mbps down 1Mbps up satellite connection with a 25:1 contention ratio as our backhaul costing €540 per month. In 2007 we connected to fiber on a MAN at the edge of our network. For a 10Mbps uncontended connection including IP transit, this worked out at €2396 per month. It was 2014 before we could get a fiber connection of 100Mbps uncontended with IP transit which worked out at €1372 per month.

We no sooner had backhaul at an affordable price when the Department invited us to a meeting to tell us to "Find a new career, there's a train coming" When it was explained to the NBP Programme directors that we were just recovering from the damage done to us by the Rural Broadband Scheme (the previous unsuccessful government intervention) and that although we weren't yet making a profit that other rural ISPs were just starting to make a profit, Mr. Mulligan asked "Why would you have a company that's not making a profit?" It appears that Mr. Mulligan is unaware of the financial condition of his employer while he oversees the squandering of billions of euro of other peoples money.

We have continued to improve our service and grow our business in areas which the Department claim it's economically unviable to do so. This is despite increasing competition from other providers using both licensed and unlicensed spectrum delivering in excess of 50Mbps and FTTH from Eir and Siro.

Current NGA

While we currently have the ability to provide NGA services to a number of clients on most of our Access Points, we will be upgrading backhaul to these sites prior to providing NGA services from them.

Uncertainty as to what qualifies as NGA according to the Department makes it impossible to decide which solution should be implemented. If unlicensed or non LTE solutions are not accepted the cost of implementation would lead to an unrealistic time-frame for Return On Investment especially if the provider is expected to compete with a state subsidised venture.

This lack of clarity as to what is acceptable by the Department as NGA may result in the Department refusing to accept certain technologies, manufacturers, or spectrum which are currently providing reliable NGA speeds.

Planned NGA

We have demonstrated our commitment to upgrading our network to meet demands at the rate which finances allow, which has resulted in our standard speed increasing five fold from when we met with Mr. Mulligan and Mr. Neary in August of 2014. At that time our standard package was 2Mbps download 1Mbps up, in 2019 it's now 10Mbps down 5Mbps up. Maintaining this rate of improvement, we will have

speeds of 50 Mbps as standard in 5 years, we would however expect our standard package in 5 years to be over 100Mbps.

This improvement will be funded from generated income as have the improvements made since our meeting with the Department in August 2014. We do not intend to seek external financing as the intervention of the Department creates too much uncertainty to allow for suitably accurate projections.

All of our sites have the potential to deliver NGA services with commercially available equipment to the premises in the attached database.. The equipment used and the order in which access points are upgraded will partly depend on:

- The response of the Department to the submissions received by them from the other indigenous rural ISPs in this "consultation".
- The availability and cost of backhaul upgrades to existing access points.
- Existing competition in serviced areas.
- Emerging commercially available technologies.

NBP Problems

The Plan

All engagement by the Department with the small established providers has been a "box checking" exercise. The Department has been consistently dismissive and adversarial in their dealings with existing rural ISPs. The current "consultation" invitation of the 30th of July, giving just 18 working days to reply during peak holiday season, demonstrates a desire to limit the quantity and quality of submissions of small operators.

The fundamental change of the plan from connecting villages with wholesale access to connecting every premises has multiplied the cost of the project while reducing competition in supply without addressing the fundamental problem of affordable, accessible backhaul for all ISPs.

The absence from the current plan of the provision of wholesale affordable, accessible backhaul puts all existing small operators at a disadvantage and will lead to a monopoly in the provision of rural broadband which will have the effect of higher base prices to the reseller. This will have the knock on effect of higher costs to the consumer putting rural online business at a disadvantage when competing internationally.

The Department's approach has, from the outset, distorted the market and reduced the rate of investment and development by the smaller established providers by choosing a business model which would be competing with them.

Despite the Department having spent in excess of €20 million on consultants[1], they have refused to consider the submissions of the small providers who have been developing solutions required to deliver broadband services in an economically viable way to areas deemed economically unviable to do so.

Eir stand to make up to €1billion for the lease of poles and ducts to the NBI over the 25 year term of the contract[2] while claiming that they can deliver the project in the current model for €1billion. Eir can certainly deliver the project for €1billion less than NBI as they will not be leasing their own infrastructure from themselves.

Eir's practice of leaving a few unconnected premises at the end of their fiber spurs will, under the current plan, force the leasing of their infrastructure and the duplication of infrastructure, to connect premises which could be connected much more economically by Eir.

Business Model
The business model chosen is in our opinion the least appropriate. The five options are:

- Bottom-up (or local community) model
  This would, in our opinion, be the best solution for last mile connectivity. It would depend on affordable accessible backhaul and it would be especially suited to clusters of premises which are not commercially attractive.

- Private design, build and operate (DBO) model
  This is the model which has been chosen by the Department and which we believe to be the least appropriate model to address the problems of providing a scalable open access network which is cost effective and encourages competition.

- Public outsourcing model
  This is the model which we believe would be best suited to utilising the ESB infrastructure.

- Joint venture
  This model would enable County Councils to provide ducting or dark fiber to strategic Points of Presence from which they would have a recurring income.

- Public design, build and operate (DBO) model
  This model would require extensive coordination between state bodies in a timely manner which is not a characteristic of the state and although it would have the potential, if implemented and managed correctly, to provide a substantial recurring income for the state it would in our opinion be unviable based on their track record.

Encroachment
Most of the proposed intervention area is currently served by WISP's (Wireless Internet Service Providers) many of whom are already providing reliable NGA speeds. Those that are not, can quickly ramp up speeds and backhaul if required with relatively small investment.

The fact that the Department wishes to reimburse NBI where they fail to stifle development by the incumbents of their network demonstrates the contempt for the existing indigenous providers and the service which they have provided and continue to provide.

Mapping
Mapping is key to finding the most economical solution to the problem. The fact that the current map does not show the true availability of services of reliable 30+ Mbps demonstrates that the Department has not engaged proactively with the stakeholders.

The fact that the existing providers are expected to fund the mapping project from their own resources will inevitably result in incomplete information as not all providers will engage. The fact that the Department has spent tens of millions of euro on consultants to get, what can at best be described as dubious advice, while failing to fund the relatively inexpensive mapping of infrastructure of existing stakeholders demonstrates a reluctance by the Department to get a true picture of the current state of the industry and it's resources.

Proposed Solutions

Our suggestions for a solution to the problem of providing an open access network to provide scalable broadband to every premises in rural Ireland which is much more cost effective to the tax payer are:

- Utilising the current ESB infrastructure to bring fiber to strategic Points Of Presence (ducted to nodes which are a safe distance from the electricity network). Utilising the current ESB infrastructure would ensure that the network remained in state ownership and would continue to generate income for the state.

- The development of a subterranean duct network built and owned by the County Councils with roll-out prioritised to bring ducting to existing Points Of Presence.

  If a network such as this were developed with a joined up thinking approach which incorporated the development of walk and cycle ways, ground penetrating radar surveys and mapping of services, protocols for placement of services, notification and access to road openings to interested undertakers etc., it would improve the economic viability of the County Councils while simultaneously improving the safety and quality of life of rural dwellers.

  This would require that international best practice be implemented where possible in the design and that the costs of road openings, duct, darkfiber or backhaul/connection services be regulated to be economically attractive to statutory undertakers which could include gas, community heating, water etc. The extra utilities could be included at the same time at minimal cost or shared expense.

  Funding might also be augmented from other sources e.g. rural development, road safety, active health funds etc.

Conclusion

The same problems as identified by the industry in submissions dated the 27th of August 2015 which is attached are still the problems of today.

Backhaul:
The Department has failed to encourage adequate affordable backhaul and indeed by insisting that Enet not implement price reductions until the Department released the Analysys Mason report and then withholding the release of the report until the 13th of February 2019, the evening before Enet's appearance at the Public Accounts Committee, kept the cost of government controlled backhaul artificially high.

Spectrum:
Failure to legislate to provide licence protected spectrum for public interest services makes it more difficult for wireless providers to provide optimal services economically. The refusal of Comreg to accept responsibility for the enforcement of section 12 of the Radio Telegraphy Act 1926 in the unlicensed spectrum or to engage with providers operating in unlicensed spectrum to develop a protocol for dealing with issues of interference adds to these difficulties.

Suggestions:
We suggest that the Department scrap the current plan, change the administrators and engage proactively with the existing providers to develop a solution which is cost effective, scalable, fair and equitable. The new administrators should read "The Broadband State Aid Rules Explained"[3] and see what has been done by the Department for Digital, Culture, Media and Sport with the "Gigabit Broadband Voucher Scheme"[4] and the B4RN project[5] in the UK.

THE PLAN IS WRONG
THE BUSINESS MODEL IS WRONG
THE MAPPING IS WRONG
THE MONEY IS WRONG

[redacted]
Munster Wireless Ltd.

[1] https://www.irishtimes.com/business/technology/consultants-paid-lavishly-for-wrong-advice-on-broadband-1.3998019
[2] https://www.irishtimes.com/news/politics/eir-may-get-1bn-from-broadband-rollout-1.3884175
[3] https://ec.europa.eu/regional_policy/sources/conferences/state-aid/broadband_rulesexplained.pdf
[4] https://gigabitvoucher.culture.gov.uk/
[5] https://b4rn.org.uk/

[redacted]

From: [redacted]
Sent: 30 August 2019 11:44
To: NBP Mapping
Subject: Submission on the Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area
Attachments: eir IFN announcement – Galway Data.docx

Follow Up Flag: Follow up
Flag Status: Completed

Categories: [redacted] is dealing with this

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

I wish to replace my previous submission on this consultation process with the following updated submission.

To Whom it concerns,
I would like to make the following submission on the Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area.

Galway County has a mix of both urban to Rural landscapes, but a common tread between these environments is the lack of fibre Broadband access via a FTTH (Fibre to the Home) service.

For the purpose of this submission, the Next Generation Access (NGA) networks which is now referrer to is presumed to be a mix of Fibre to the home (FTTH) service and Fibre to the Cabinet (FTTC) powered services, as Information provided by wireless & Mobile service providers on coverage can differ from what is available on the ground due to the topography of the surrounding landscape and can differ from Eircode to Eircode, I believe any discussion around these technologies should be between the service providers and the Department of Communications, Climate Action & Environment.

Areas in three towns in County Galway currently have a FTTH service, Tuam (Virgin Media), Oranmore (Siro) and Loughrea(ISP unknown, service delivered through MANs network), **not all areas** of these towns have been supplied with this service. I am sure that Virgin media, Siro and eNet would be able to provide you with their current coverage maps for these three towns if they have not already done so as part of this consultation process, if required I can request a current coverage map from these providers.

Siro have indicated plans to provide a FTTH service in Bearna, this is proposed and the extent of the area to be covered by SIRO is not finalised, a coverage map could be requested from SIRO, if they have not already provided this information to you as part of this consultation process, if required I can request a proposed current coverage map from Siro.

Eir have recently stated (copy of press release attached for County Galway attached) that they wish to install FTTH in the following towns in County Galway.
Athenry (MANs Town)
Ballinasloe (MANs Town)
Barna
Clifden (MANs Town)
Gort (MANs Town)
Loughrea (MANs Town)

Oranmore
Portumna
Tuam
I have no details of the areas with in these towns they propose to cover, maybe this information can be sought from Eir, along with a commitment to the Department of Communications, Climate Action & Environment for the delivery of this service, otherwise outside sections of Tuam, Oranmore & Loughrea already mentioned, there is no currently agreed plan for the delivery of a FTTH service to these towns.

Eir have also state that their program will service any population centre with over 1000 people (press release attached), can a commitment be obtained from Eir to the Department of Communications, Climate Action & Environment for the delivery of this service, if not, there is no current agreed plan for the delivery of FTTH service to these towns/villages townlands that have been deemed to be commercially viable.

Attached is the press release by Eir on their proposed works/program, please note the number of caveats attached to their press release around the delivery of such a program.

For all towns/villages and townlands shown as commercially viable (Blue) on the NBP map for County Galway, there is **no agreed** program for delivery of FTTH networks in these areas. (excluding the extents of Galway City(Galway City Council to advise) and areas of Oranmore, Tuam and Loughrea as previously detailed)

From reviewing the Consultation Map, I note locations marked in the Commercial areas with red dots, do they denote Eircode's whom have failed in a bids to access NGA network (speeds above 30 mb/s download and 6 mb/s upload), Eir have stated in a promotional document that on their traditional **networks** based on copper wire technologies the best/maximum speed consumers could have achieved was 24 mb/s.

VDSL (eVSDL) and other boosting technologies are also mention by EIR, as ways of delivering speeds above 30 mb/s download and 6 mb/s upload.

The age, integrity of traditional copper based networks and the distance away from the exchange would I assume have to be considered when determining if these areas could be serviced with the minimum speed required.

There may be larger business, financial institutes and schools etc. in these towns/villages that a supplier could have provided a fibre or a VDSL (eVSDL) connection to in the past.

How widely available are these products/services in these commercial areas and if large numbers of people where to seek this services, would the infrastructure be capable of supporting the minimum speed required. (above 30 mb/s download and 6 mb/s upload) ?

Information on Eircode's **unsuccessfully** seeking access to high speed networks in commercial areas have been relayed to the Department of Communications via the dedicated email address, I have also raised awareness of the consultation process on Galway County Councils Web site, so that concerned members of the public can make direct submissions.

I acknowledge the importance of this process to define the intervention areas to be covered under the NBP, and if I can be of further assistance in this process , please do not hesitate to contact me, my contact details are below.

Regards

[redacted]

Broadband Officer

Galway County Council
Mobile [redacted]
Telephone No. [redacted]
Email [redacted]

##
##########
Is é Proofpoint, Arna Óstáil do Comhairle Contae na Gaillimhe, a rinne an teachtaireacht ríomhphoist seo a scanadh agus a ghlanadh ó thaobh ábhair de. **Tá míle fáilte roimh chomhfhreagras i nGaeilge nó i mBéarla**. Tá eolas atá príobháideach agus rúnda sa ríomhphost seo agus in aon iatán a ghabhann leis agus is don seolaí amháin é. Mura seolaí thú,níl tú údaraithe an ríomhphost nó aon iatán a ghabhann leis a léamh, a chó ;ipe&aac ute;il ná a úsáid. Má tá an ríomhphost seo faighte agat trí dhearmad, cuir an seoltóir ar an eolas trí ríomhphost a sheoladh ar ais agus scrios ansin é le do thoil. Má tá an ríomhphost seo ag teastáil uait i bhformáid eile téigh i dteagmháil leis an duine a sheol chugat é.

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##
####### ####

Gaillimh - Phríomhchathair Chultúir na hEorpa 2020

Galway - **European** Capital of Culture 2020

Galway2020.ie

eir – IFN announcement (Galway Data)

In February eir launched "Ireland's Fibre Network" – a €500m investment in fixed network fibre for 180 towns.

Within five years every town with more than 1,000 premises, totalling 1.4 million premises nationwide, will have a Fibre to the Home network capable of speeds up to 10 Gb/s, or 10,000 Mb/s.

The investment will follow the completion in June this year of eir's FTTH roll-out to 335,000 rural premises, at a cost of €250 million to eir and with no public subsidy. This summer eir will have invested more than €600m in fibre broadband, delivering high-speed fibre broadband to more than 80% of the premises in Ireland or 1.9 million homes and businesses across the country.

This is the next stage in eir's ambitious €1bn investment programme, with a €150 million investment programme in its mobile network already underway, allowing eir to deliver 4G voice and data coverage across more than 99% of Ireland within two years, on the most expansive 4G mobile network in the world. The investment will also see the roll out of 5G services in 2019, delivering the most technologically advanced mobile data services across Ireland's cities.

The following towns in Galway will benefit from this new investment:

- Athenry
- Ballinasloe
- Ballymoneen
- Barna
- Clifden
- Galway
- Gort
- Loughrea
- Mervue
- Oranmore
- Portumna
- Shantalla
- Tuam

It should be noted that this is a five year investment programme which is still being mapped out so there are currently no specifics on when each town will be done. There will be no Commitment Agreement with DCCAE on this deployment so there will be no obligations to publish timeframes for delivery, as per 300K, outside of our normal regulatory obligations.

[redacted]

From: [redacted]
Sent: 20 September 2019 15:19
To: NBP Mapping
Subject: Sligo mapping issues

Follow Up Flag: Follow up
Flag Status: Completed

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Hi there,

Some issues in relation to high-speed broadband availability and the map;

The following Eircodes in [redacted] Co. Sligo, can't get high speed broadband despite being in the 300k area:

[redacted] - Map says yes, Eir application says no high speed available
- Map says yes, Eir application says no high speed available (now purple on map)

Orders/Connection issues;

[redacted] - Issue in relation to install at [redacted] Sligo. A customer within the 300k area is being told that there aren't enough ports left for her to get fibre unless some of her neighbours disconnect.
[redacted] - Issue in relation to install at [redacted] Sligo. Customer last on the line within 300k is being told that the connection can't be made because of a tree needing trimming.

Regards,
[redacted],
Broadband Officer,
Sligo County Council.

[redacted]

[redacted]

From: [redacted] >
Sent: 14 August 2019 16:37
To: NBP Mapping
Subject: Submission on the Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area
Attachments: eir IFN announcement – Galway Data.docx; Xerox Scan_14082019121111.pdf

Follow Up Flag: Follow up
Flag Status: Completed

Categories: [redacted] is dealing with this

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To Whom it concerns,

I would like to make the following submission on the Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area.

Galway County has a mix of both urban to Rural landscapes, but a common tread between these environments is the lack of fibre Broadband access or FTTH (Fibre to the Home or as it is now referred to as Next Generation Access (NGA) networks)

The Next generation access your referrer to is presumed to be a Fibre to the home service, as Information provided by wireless service providers on coverage can differ from what is available on the ground due to the topography of the surrounding landscape and can differ from Eircode to Eircode, I believe any discussion around this technology should be between the service provider and the Department of Communications, Climate Action & Environment.

Areas in three towns in County Galway Currently have a Next Generation Access (NGA) networks) service, Tuam (Virgin Media), Oranmore (Siro) and Loughrea(ISP unknown, service delivered through MANs network), not all areas of these towns have been supplied with a NGA service. I am sure that Virgin media, Siro and eNet would be able to provide you with their current coverage maps for these three towns if they have not already done so as part of the consultation process, if required I can request a current coverage map from these providers.

Siro have indicated plans to provide a NGA service in Bearna, again this is proposed and the extent of the area to be covered by SIRO is not finalised, a coverage map could be requested from SIRO, if they have not already provided this information to you as part of this consultation process, if required I can request a proposed current coverage map from Siro.

Eir have recently stated that they wish to install NGA in the following towns in County Galway.
Athenry (MANs Town)
Ballinasloe (MANs Town)
Barna
Clifden (MANs Town)
Gort (MANs Town)
Loughrea (MANs Town)
Oranmore
Portumna
Tuam

I have no details of the areas with in these towns they will cover, maybe this information can be sought along with a commitment to the Department of Communications, Climate Action & Environment for the delivery of this service, otherwise there is no currently agreed plan for the delivery of NGA service to these towns.

Eir have also state that their program will service any population centre with over 1000 people (press release attached), can a commitment be obtained from Eir to the Department of Communications, Climate Action & Environment for the delivery of this service, otherwise there is no current agreed plan for the delivery of NGA service to these towns/villages townlands that have been deemed to be commercially viable.

Attached is the press release by Eir on their proposed works/program, please note the number of caveats attached to their release around the delivery of such a program.

The following towns/villages townlands are shown in commercially viable areas of the NBP map . But I have no details of an agreed program for delivery or scope of works for the provision of FTTH/NGA networks in these areas. Their maybe other townlands deemed Commercially Viable in County Galway that I have not listed, but they too would not have NGA network or a current agreed plan for delivery of same.

Athenry
Ballinasloe
Portumna
Gort
Kinvarra
Loughrea (areas not covered by ISP, through MANs operated by eNet)
Tuam (areas not covered by Virgin Media)
Oranmore (areas not covered by SIRO)
Ardrahan
Kilcolgan
Craughwell
Rinville East/West
Loughrea
Carnmore Cross
Athenry
Baile Chlair
Turlough More
Monivea
Kilconnell
Aughrim
Ballinasloe
Kiltormer
Laurencetown
Bearna (areas that will not be covered by SIRO proposed network)
Baile Na hAbhann
An Spideal
Maigh Cuilinn
An CarnMor Thior/ An CarnMor Thair / Carn more
Ballymoneen/Lisheenavalla/Cregcarragh
Leacht Seoirse/ an Ruan Mor/ An Leith cheathru Mhor
An Sian Rua / An Spideal Thoir
Both Chuanna Thoir / Chuanna Thiar
Coill Rua Thiar / An Cnoc
Cor Na Ron/ An Cartur Leathan
Creathru an Loistreain/ Drimcong
Gortnamona East/West
Gortnagroagh

Oughterard
Corr Na Mona/Dubhachta/An Charraigh Thiar/Tir an Fhia
An Fhairche
Cnoc Na nEan
Headford
Carrowreagh (Dunmore by)/Clashaganny
Killaloonty/Kilmore (Clare by)/ Killeelaun
Ballyconneely
Sraith/Salach
Castlehacket/Caltragh)ed Killower)
Leenaun
Letterfrack
Clifden town/ Cloghaunard/fakeeragh/letterdeen/tullyvoheen/ardbera
Couravoughil/Killymongaun
An Gort Mor/An Turloch/Glinn Chatha
Casla
Leitir Mor
Tir an Fhia/ An Maimin
An Cheathru Rua
Clonbern
Barnaderg
Mountbellew Bridge
Moylough
Ahascragh
New Grove
Ballygar
Glennamaddy
Williamstown
Ballymoe
Dunmore
nextwork.

Due to GDPR concerns I do not wish to send on information on individual Eircode's for a consultation process, information received was by way of information request, and not for a consultation process, so I have raised awareness of the consultation process on Galway County Councils Web site, so that concerned members of the public can make direct submissions.
But I can relay that the vast majority of towns, considered commercially viable **Do not** have NGA at present (please see aforementioned list).
From reviewing the Consultation Map, I note from the location marked on the Commercial areas with red dots, do they denote Eircode's whom have failed in bids to access NGA network, Eir have stated in promotional document (extract attached) that where **Fibre to the cabinet network** exist the best/maximum speed consumers could have achieved was 24 mbs, this is why their NGA program is proposed to bring fibre from the cabinets to the homes.

So if the aspiration of the NBP is to deliver a broadband service with speeds of over 24 MB/s to consumers then all areas mention above, with the exception of section of Tuam, Oranmore and Loughrea at present do not have access to NGA networks.

There may be larger business and financial institutes and schools etc. in these towns that a supplier could have provided a fibre connection to in the past, but from my knowledge this would not be standard practice for domestic connections and SME's, this service would not be accessible to all at present.

I acknowledge the importance of this process to define the intervention areas to be covered under the NBP, and if I can be of further assistance in this process , please do not hesitate to contact me, my contact details are below.

Regards

[redacted]
Broadband Officer
Galway County Council
Mobile [redacted]
Telephone No. [redacted]
Email [redacted]

##
##########
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##
####### ####

Gaillimh - Phríomhchathair Chultúir na hEorpa 2020

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Galway2020.ie

eir – IFN announcement (Galway Data)

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Ballinasloe
Ballymoneen
Barna
Clifden
Galway
Gort
Loughrea
Mervue
Oranmore
Portumna
Shantalla
Tuam

It should be noted that this is a five year investment programme which is still being mapped out so there are currently no specifics on when each town will be done. There will be no Commitment Agreement with DCCAE on this deployment so there will be no obligations to publish timeframes for delivery, as per 300K, outside of our normal regulatory obligations.

eircom

NETWORK FOR A NATION

eircom's Next Generation Access (NGA) Network boosting broadband speeds for homes and businesses

eircom's fixed line network is made up of two parts: an access network that's traditionally been made of copper cable and a core network of high-speed fibre optic cable.

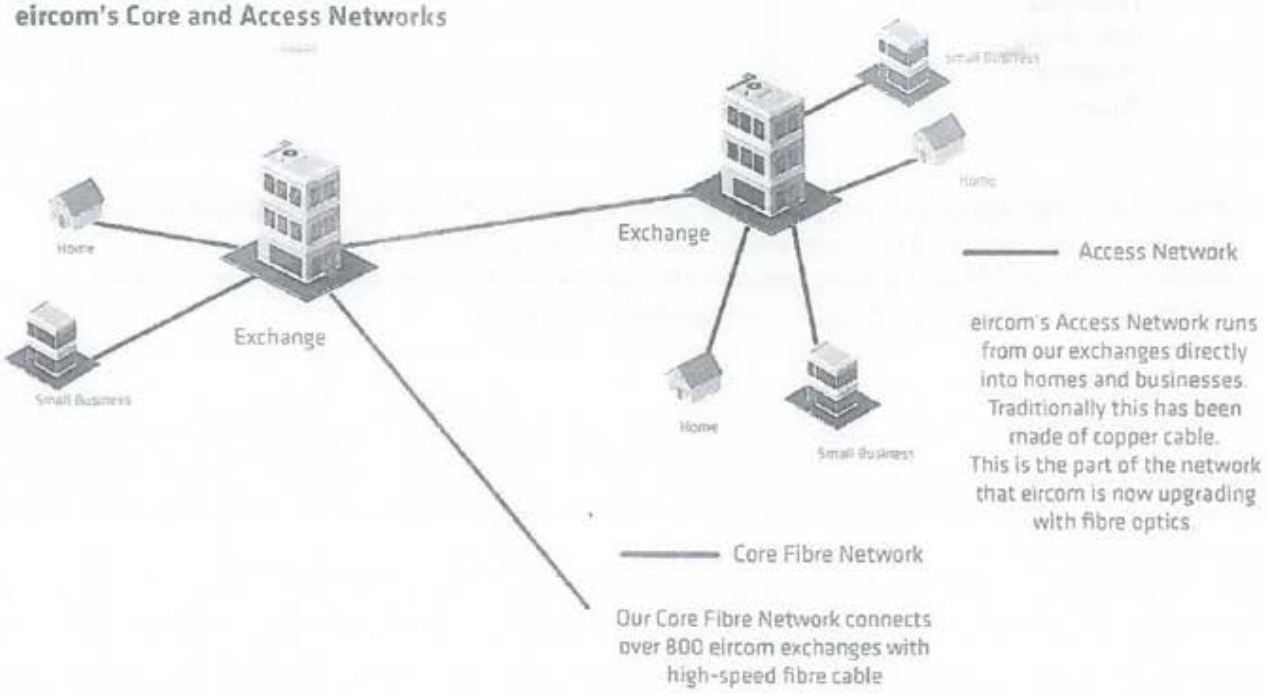
eircom's Access Network runs from each exchange directly into homes and small businesses. Access networks have traditionally been made of lower speed copper cable. This meant our fixed line "DSL" broadband speeds were limited to a maximum of 24Mb/s.

Next Generation Access (NGA) involves significantly boosting broadband speeds by rolling out new fibre based technologies from local exchanges to homes and small businesses, replacing lower speed copper cable.

eircom's Next Generation Access rollout in Galway uses three technologies to improve broadband speeds – Fibre to the Cabinet (FTTC), Exchange launched VDSL (eVDSL) - both of which boost broadband speeds to up to 100Mb/s for connected premises – and Fibre to the Home (FTTH) which boosts broadband speeds to up to 1,000Mb/s.

You can learn more about how these technologies work in **Section 1.6.**

eircom's Core and Access Networks



[redacted]

From: [redacted]
Sent: 17 September 2019 12:16
To: Broadband
Subject: FW: Eircode's in areas considered commercially viable under NBP for Service delivery in Co. Galway whom can't access NGA

Follow Up Flag: Follow up
Flag Status: Completed

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hello,

Eircode [redacted] is in the blue area of NBP map and considered commercial viable. There is currently no FTTH available to this address, they state they have poor levels of connectivity.
Eircode [redacted] is in the blue area of NBP map and considered commercial viable. There is currently no FTTH available to this address, they state they have poor levels of connectivity.
Eircode [redacted] is in the blue area of NBP map and considered commercial viable. There is currently no FTTH available to this address, they state they have poor levels of connectivity.
Eircode [redacted] is in the blue area of NBP map and considered commercial viable. There is currently no FTTH available to this address, they state they have poor levels of connectivity.

There is no doubt similar situations throughout the county, this information is based on my contact with member of the public.

Regards

[redacted]
Broadband Officer
Galway County Council
Mobile [redacted]
Telephone No. [redacted]
Emai [redacted]

##
##########
Is é Proofpoint, Arna Óstáil do Comhairle Contae na Gaillimhe, a rinne an teachtaireacht ríomhphoist seo a scanadh agus a ghlanadh ó thaobh ábhair de. **Tá míle fáilte roimh chomhfhreagras i nGaeilge nó i mBéarla**. Tá eolas atá príobháideach agus rúnda sa ríomhphost seo agus in aon iatán a ghabhann leis agus is don seolaí amháin é. Mura seolaí thú,níl tú údaraithe an ríomhphost nó aon iatán a ghabhann leis a léamh, a chó ;ipe&aac ute;il ná a úsáid. Má tá an ríomhphost seo faighte agat trí dhearmad, cuir an seoltóir ar an eolas trí ríomhphost a sheoladh ar ais agus scrios ansin é le do thoil. Má tá an ríomhphost seo ag teastáil uait i bhformáid eile téigh i dteagmháil leis an duine a sheol chugat é.

This e-mail message has been scanned for content and cleared by Proofpoint Hosted for Galway County Council. **Correspondence is welcome in Irish or in English**. This e-mail and any attachment contains information which is private and confidential and is intended for the addressee only. If you are not an addressee, you are not authorised to read, copy or use the e-mail or any attachment. If you have received this e-mail in error, please notify the sender by return e-mail and then destroy it. If you need this email in an alternative format please contact the sender.
##
####### ####

Gaillimh - Phríomhchathair Chultúir na hEorpa 2020

Galway - European Capital of Culture 2020

Galway2020.ie

[redacted]

From: [redacted]
Sent: 26 August 2019 10:47
To: Broadband
Subject: Broadband

Follow Up Flag: Follow up
Flag Status: Completed

Categories: [redacted]

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hello

Eircode [redacted] is in the blue area of NBP map and considered commercial viable.

There is currently no FTTH available to this address, only FTTC.

Regards

[redacted]
Broadband Officer
Galway County Council
Mobile [redacted]
Telephone No. [redacted]
Email [redacted]

##
##########
Is é Proofpoint, Arna Óstáil do Comhairle Contae na Gaillimhe, a rinne an teachtaireacht ríomhphoist seo a scanadh agus a ghlanadh ó thaobh ábhair de. **Tá míle fáilte roimh chomhfhreagras i nGaeilge nó i mBéarla**. Tá eolas atá príobháideach agus rúnda sa ríomhphost seo agus in aon iatán a ghabhann leis agus is don seolaí amháin é. Mura seolaí thú,nil tú údaraithe an ríomhphost nó aon iatán a ghabhann leis a léamh, a chó ;ipe&aac ute;il ná a úsáid. Má tá an ríomhphost seo faighte agat trí dhearmad, cuir an seoltóir ar an eolas trí ríomhphost a sheoladh ar ais agus scrios ansin é le do thoil. Má tá an ríomhphost seo ag teastáil uait i bhformáid eile téigh i dteagmháil leis an duine a sheol chugat é.

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##
####### ####

Gaillimh - Phríomhchathair Chultúir na hEorpa 2020

Galway - European Capital of Culture 2020

Net1.ie
Wireless, Fibre & Home Phone

Consultation on Conclusion of the NBP Mapping Exercise for the Intervention Area

SUBMISSION BY ADELPHI NET1 LTD OF [redacted]

[redacted]

30/09/2019

1. Introduction to Adelphi Net1 Ltd.

Adelphi Net1 Ltd. (hereafter referred to as Net1) is an Internet Service provider based in Dundalk, Co. Louth. The company was formed in early 2003 to address the requirement for broadband internet using fixed wireless access, initially in Counties Louth and Meath. Since that time our company has enjoyed organic growth and now provides coverage across a large area from South Co. Donegal to North Co. Dublin across both sides of the border.

We have been providing many homes, SME's, large corporates and schools with quality Internet services over the years. Currently our customer base is 85% rural Fixed Wireless Access while the remaining 15% are serviced via OpenEir's VDSL and FTTH offerings.

The advances in wireless broadband technologies over the last decade have been very considerable, particularly over the last 4-5 years.

Since 2016 Net1 have been offering FWA services which exceed the NGA standards (marketed as Net1 Infinity), currently 68% of our wireless customer base has been converted to this technology) and we are rapidly extending our Infinity coverage at a rate of 2 sites per month.

Our rural FWA customers currently enjoy the same services as our urban customers on fixed services such as Internet telephony, streaming music services, streaming TV both live and on-demand, remote working, video conferencing and remote security monitoring services.

We offer our own telephony service which is delivered over VoIP and recently have begun offering a Free To Air TV service delivered over IP which is created in house

This submission contains data on our network as of 2019 Q4. Despite the fact that we are continuing to invest heavily in our network, due to the tight time constraints required in submitting this document, we are unable to include the full details of our 7 year plan

However, along with a list of what we consider the 62,465 NGA eircodes, we will also submit a list of all 133,758 eircodes currently covered by our network, which for very little capital outlay will be 100% converted to what we consider NGA spec by Q2 2021. This is part of our self-financed upgrade route which has already been budgeted for internally.

We wold like to have developed this into a 7 year plan, however the tight timelines required on this report prevented us from doing so.

2. Description of our Network

The Net1 Network peers with the Internet at the Equinix data centre in Citywest, Dublin. We currently peer with two International Tier 1 providers (GTT and Cogent) while for Irish traffic (which now accounts for 65% of traffic) we have been a long term member of INEX, the Irish Neutral Internet Exchange.

Our Network employs multi gigabit layer 2 fibre tails from GTT, OpenEir, and Enet which are currently terminated at multi locations, namely, Mount Oriel, Collon, Co. Louth, Monaghan, Co. Monaghan, Dundalk, Co. Louth, Blacklion, Co. Cavan, Killashandra, Co. Cavan and Manorhamilton, Co. Leitrim.

A map detailing the geographic coverage of our network is indicated on the below Google Map.

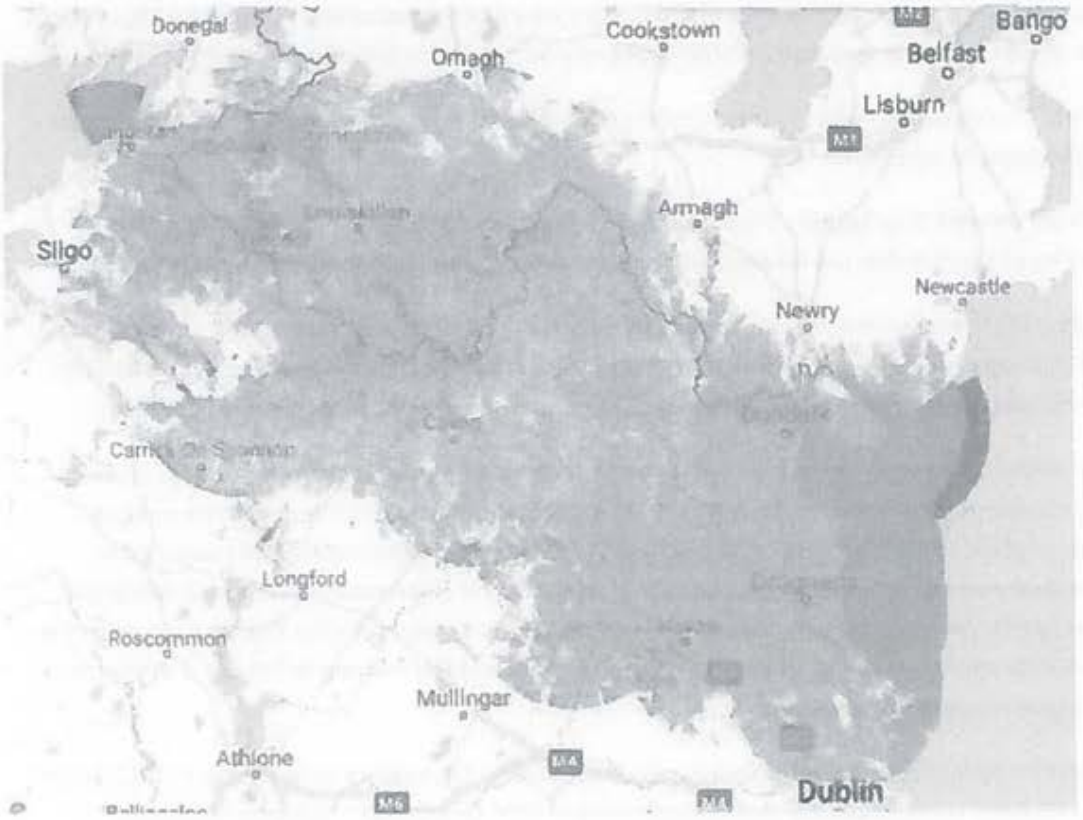

Fig 1. Net1 coverage overlay (September 2019)

2.1. Access Network

We operate a Fixed Wireless (FWA) Network in the ISM 5GHz and License Exempt 5.8GHz bands using Ethernet based data link later technologies. For our NGA Access Deployment we have chosen mostly Radwin Jet sectors and client units.

Our base stations have been deployed and upgraded from non NGA capable equipment on a fully self-funding model since 2016 and has enjoyed a high level of growth since launch.

On any given hilltop site with a 360° field of view we normally deploy 4 x 90° wide base stations. On a site with a restricted field of view we only install sectors in the directions which can provide coverage to customers.

The Radwin Jet product combines GPS Sync with beamforming technology to provide a high quality service which exceeds the speeds being obtained by many of our VDSL customers.

The RADWIN JET beamforming offers service providers a unique set of benefits; high service performance that is applicable to a wider range of customer segments, and low TCO (total cost of ownership). RADWIN JET beamforming delivers reliable connectivity in the licence-exempt 5GHz band.

RADWIN JET PtMP beamforming antennae have a very narrow beam width (8°) which imitates PtP transmission to end-users. Combined with RADWIN's air-interface capabilities (i.e. fast-ARQ, unique adaptive code-modulation, adaptive MIMO-diversity and dynamic channel bandwidth per end-user)

RADWIN JET is second-to-none in radio interference mitigation, which ensures reliable connectivity in tough congested spectrums.

RADWIN JET delivers the highest possible capacity per given distance. It supports broadband connectivity of up to 3Gbps per 4-sector site and enables 'triple-play' services with HD/4K quality.

The RADWIN JET sector antenna's high gain, achieved with beamforming technology, combined with its wide channel bandwidth support and constant transmit power in all modulations, increases the actual end-user capacity for a given distance while maximizing the distance per given capacity.

JET Beamforming enables service providers to deliver greater network capacity with less spectrum and less wireless infrastructure. RADWIN JET's ability to use only two (2) frequency channels per network, combined with high spectrum efficiency, enables it to deliver the highest capacity per available clear spectrum in unlicensed bands. A built-in GPS receiver assures TDD synchronization between all sites, minimizing self-interference and maximizing spectrum utilisation. Its superiority in spectrum efficiency and the extra distance it supports, reduces the number of towers, base stations and backhaul required per network.

RADWIN JET's dynamic bandwidth allocation (DBA) ensures a Committed Information Rate (CIR) for heavy bandwidth applications, business customers and IPTV service. JET's dynamic bandwidth management allows residential oversubscription, while maintaining overall high sector capacity without capacity reduction. RADWIN DBA guarantees that not only will the throughput not be degraded when more subscriber units are integrated into the system, but on the contrary – performance (throughput and latency) can be improved when such scenarios occur.

The DBA algorithm is responsible for allocating the radio frames to the remote radios. The purpose of this allocation is to ensure the quality of service to each of the remote unit in terms of delay and throughput and in parallel provide the maximum possible peak rate.

The pre-allocated bandwidth defines the assured capacity and delay for each radio. The DBA is responsible for assigning additional bandwidth to a radio by either using the unallocated bandwidth or re-assign "unused" downlink bandwidth between different radios.

When more subscriber units are integrated into the system, they can be defined as "Best-Effort" users, or to be assigned with "committed" resources (percentage of the sector capacity) in order to guarantee SLA under congestion. When DBA comes into action, minimum service is maintained while peak rates are granted when conditions apply.

Under no circumstances or conditions, will there be service degradation due to newly added subscribers into the sector.

At the core of the RADWIN JET is a proprietary air interface protocol that enables carrier-class wireless Ethernet services in licence-exempt bands. To ensure high quality and reliable delivery of these services, RADWIN radio systems employ several mechanisms that work together to mitigate interference:

- Automatic Adaptive Rate

- Forward Error Correction (FEC)

- Advanced Automatic Repeat Request (ARQ) Mechanism

- Non-interrupted transmission

- Orthogonal Frequency Division Multiplexing (OFDM)

- Automatic Channel Selection (ACS)

- Network Synchronisation (GPS) (TDD sync)

- Dynamic Channel Bandwidth Allocation (D-CBA)

- Smart BEAMFORMING & BEAMSTEERING (2 nd Gen)

RADWIN Jet Air 250Mbps Integrated Base Station / Beamforming Sector with built-in GPS sync

*PDF Datasheet attached "RW-5AB5-2654.pdf"

RADWIN Jet Pro 750Mbps Integrated Base Station / Beamforming Sector with built-in GPS sync

* PDF Datasheet attached "RW-5BG5-2650.pdf"

RADWIN Jet PtMP Brochure

* PDF Datasheet attached "RADWIN JET PtMP Brochure"

Explainer video on RADWIN Jet Beamforming

https://youtu.be/r6X_qZrqY_0

2.2. Backhaul Network

The Net1 backhaul network consists of Fibre POP's in strategic locations across our Network in Collon, Dundalk, Monaghan, Blacklion, Killashandra and Manorhamilton. From these sites we downlink to other sites using licensed high capacity microwave links using the Ceragon IP20 platform for long range links and the Racom Ray 2 platform for short links up to 10km.

All of these backhaul platforms support gigabit speeds to the local hilltop site.

Net1 continually monitor the performance of our backhaul network where we have maintained backup links to many of our hilltop sites should a primary link fail.

As many of these sites service corporate clients, we currently operate a 4 hour SLA throughout most of our hilltop sites should a fault occur.

This backhaul network has been designed using quality backhaul from providers with appropriate SLA's to ensure our target uptime of 99.99%

Likewise, ComReg insist that the signal paths for any new licensed microwave support a 99.99% availability before a license is issued for such equipment.

3.0. Coverage Data

Table of Location of Base stations

A list of Base stations that were used in wirelesscoverage.com WISDM LIDAR Line of Sight analysis software is attached to this submission

Location of connected Clients

Due to the time constraints this cannot currently be supplied, however Net currently have 1431 customers on our current 50Mb/s service with capability to upgrade to 100Mb/s and an additional 272 clients on our 30Mb/s plan. We do not currently hold Eircodes or Coordinates for these clients. This can be supplied at a later date if requested.
We also supply many corporate connections with uncontended speeds of up to 300Mb/s

Table of Location of Premises Passed based on High Resolution LIDAR and DSM data

Please reference file **commercially_confidential_Net1NGADetailQ42019.csv**

Please reference **shapefiles.zip**

3.1. LIDAR LOS testing and Methodology

We have engaged WirelessCoverage.com to build a Digital surface model based on high quality LIDAR / DSM data. We have supplied Wirelesscoverage.com a list of Sites and height of sectors to produce a list of premises that would be covered with clear line of sight.

Approach according to WirelessCoverage.com

The approach used for this project was designed to be as comprehensive and detailed as possible, using the best quality data and modelling tools available.

Detailed data was prepared to perform this analysis comprising of: -

- The latest EIRCODE dataset, purchased in August 2019
- A Digital Surface Model (DSM) for the whole country from Bluesky International, who have the most contemporary dataset currently available. They hold data at 1m resolution, which was scaled to 2.5m resolution using a bilinear interpolation method. Where any gaps in their coverage were identified SRTM data was used and interpolated to avoid any hard edges in the height data.
- Mast Site Data from our ISP
- WISDM Wireless Modelling system, which performs detailed line of sight tests between all properties and all tower sites. Method according to WirelessCoverage.com

Data from our ISP was collected in September 2019 and imported into WISDM. Sites were classified as Standard or NGA and we also gathered details on future planned sites. The distinction between Standard and NGA sites is based upon the quality and style of equipment currently installed at these sites, along with the backhaul feeds. Those classified as NGA are capable of connecting premises at NGA speeds of 30Mbps download.

Using WISDM, wirelesscoverage ran several coverage passes to all EIRCODE centroids: -

1. All Sites from our ISP at NGA
2. All Sites from our ISP at non-NGA

Within each pass, WISDM takes each Site within the test and performs a Wireless Line of Sight test to each property within a given radius. It is important to note that a Wireless Line of Sight Test differs from an optical test, as it takes into account the Fresnel 1 Zone around the direct (optical) path. This is a more robust means of determining line of sight. In this exercise, we discounted all properties that had more than 15% Fresnel 1 incursion, and therefore does not include properties with Near Line of Sight, which in many cases could successfully be connected.

Where a property does have Wireless Line of Sight, it is excluded from further tests within that pass, in order to avoid double-counting properties.

We then performed analysis of the coverage list from each operator with NGA coverage to identify those properties that could receive NGA service from more than one operator.

NGA Assumptions

We have taken a cautious approach to whether a site is capable of delivering NGA speeds. As such, we have taken a worst-case assumption of the type of equipment used for access points or base stations.

We considered the signal level that would be required to get the NGA modulation rates on installed fixed wireless equipment, as well as a significant fade margin. Assuming a nominal operating frequency of 5.6 GHz with regulatory compliant power output (EIRP) from a base station of 30 dBm (1 Watt) and a client receiver with 30cm antenna providing 23 dBi gain, the receive signal level (RSL) with clear line of sight would be -70.1 dBm at 7.5 km. Using Radwin Jet, and an assumed noise floor of 90 dBm, a client would connect at MCS13, providing a physical interface rate of 104 Mbps and a typical throughput rate of approximately 54 Mbps, which is safely above the NGA threshold and leaves a considerable fade margin.

Assumptions and Constraints

As with all modelling approaches to wireless coverage, there are factors which could over-state or under-state coverage. Here is a summary of the key factors as they relate to this project: -

Over-statement factors

A small percentage of the national map data used was derived from low-resolution (10 to 30m) data, which could mean in theory that potential obstructions to the wireless signal path calculations were missed. Based upon the algorithm-driven model developed by WIDSM for error calculation, we estimate an error rate of <2% over-statement.

Since the high-resolution data was produced between 2015 and 2017, it is likely that a small amount of unmanaged tree growth has occurred and that new building works will have taken place in the intervening period, which means that a small number of wireless paths may have developed obstructions that reduce their performance and in extremely rare instances, may be blocked. Based upon the algorithm-driven model developed by WIDSM for error calculation, we estimate a resultant over-statement of <1% from this.

Whilst it may be possible to receive a high-quality signal at a given property, it is possible that there is no suitable location on the property to mount a receiver due to the construction or location of the property. For example, waterside properties or those with unusual construction such as all-glass exterior can be very challenging.

Under-statement factors

In this exercise, we performed single-point line of sight tests to each EIRCODE property. It is possible that the Wireless Line of Sight to that one point may be obscured and therefore reported as no coverage, but if a receiver was mounted at a different point on the property, a connection could be established. Based upon assumptions derived from previous mapping exercises and benchmarked against WIDSM's model, we estimate an under-statement of 3-4% from this factor.

We used a watershed method for wireless line of sight calculation which allows for little or no Near Line of Sight connections. Many modern radio systems using the diversity associated with MIMO transmission allow for high quality connections to be established in Near Line of Sight operation and these have not been incorporated in the model. This is estimated to have an effect of <10%, but it is highly dependent on the technology used by the operator.

We have assumed that small 30cm dishes are used at the customer property to achieve an appropriate signal level. It is common practice to install 40cm medium dishes or larger, which have higher gain and therefore can receive a good signal at a longer range. Using larger dishes could significantly increase the overall coverage from each access point substantially.

Multi Dwelling Units (MDUs)

WISDM currently has a design constraint which means that the premises counted in coverage checks shows the same EIRCODE for all properties that have the same physical location (ie. Multi-dwelling units). This means that the coverage lists appear to have duplications. It was not possible to resolve this issue in the time available to complete the project.

LIDAR DSM Data Source coverage according to wirelesscoverage.com

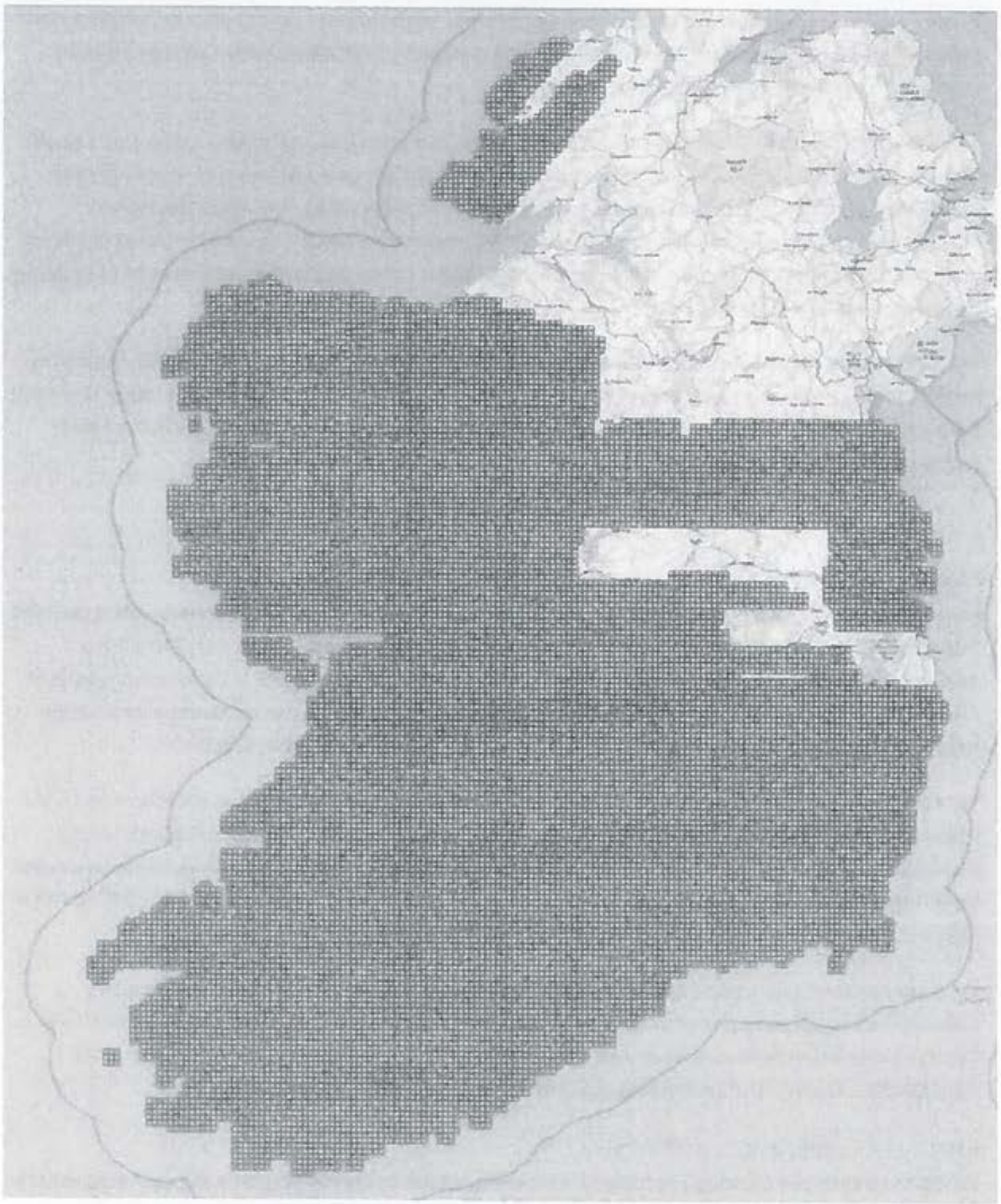

Figure 1. Map of 1m DSM Data from Bluesky International, collected between 2015 and 2017

Figure 2. Example render of DSM Data showing trees, buildings and other surface features.

Wirelesscoverage.com WISDM™ Line of Sight Engine

Highlights

Wireless coverage WISDM comprises of a family of ultra-high performance wireless planning systems developed by Boundless Networks Ltd.

WISDM WISP Edition is an interactive planning and design system built to facilitate the creation of scalable, robust and performant fixed wireless networks for Wireless IPSs. It enables the rapid creation of 'Ideal' wireless networks over very large areas of thousands of square kilometres. It is well suited to rural expanses as well as mixed and urban environments too. Once an Ideal network has been designed, the network can be fine-tuned to consider build constraints and resiliency in real time.

WISDM can also be used to analyse the coverage of an existing wireless network and perform 'what-if' tests to plan ad-hoc extensions to a network to verify potential coverage and backhaul.

Using WISDM, a predictable coverage model can be prepared in hours and **detailed coverage of individual properties** can be predicted with an extremely high level of accuracy. Site planning and acquisition is accelerated by use of the interactive planning tools, allowing rapid decisions about mast location to be made with instant coverage impact reporting.

Overview

WISDM comprises of several components and processes to complete the overall solution. At the heart of the system is a very high performance wireless Line of Sight (LoS) calculation engine. The LoS engine can calculate over 150 million wireless line of sight tests per second and can use a wide variety of terrain and surface obstruction data sets at any resolution.

Overall, WISDM WISP Edition performs the following tasks: -

1. Site Finder. This creates an 'Ideal' list of sites where masts could be located for optimum coverage for a given number of target premises passed from a target premises dataset. Target premises can be a list of all properties from a comprehensive source, such as Ordnance Survey AddressBase, or a subset of premises in say, a Government Intervention area. Assumptions can be used to set mast profiles which would include mast height and effective wireless range. For example, the Site Finder can be run with parameters which state that 20 locations could be built with 30m towers, then calculate how many 15m towers would be needed to pass a certain quantity of target premises.
2. Backhaul Modelling. The Backhaul Modeller analyses a Site Location dataset and performs line of sight tests between them to create microwave backhaul. Assumptions can be used to help plan for the style of links to be used. For example, links up to 5km can be coloured differently than links from 5km to 17km. This helps when planning a network that has optimum resilience, performance and operating costs due to the potential costs incurred to run licensed microwave links or fibre backbone.
3. Wide Area Network (WAN) Visualizer. The WAN Visualizer provides full-screen mapping to allow users to see the overall shape of a network and the distribution of different sized towers and backhaul connections between sites. The WAN Visualizer can be called from the Site Coverage and Modelling system.
4. Site Coverage and Modelling System. This is an interactive web-based tool that allows planners to review the calculated Ideal Sites and move them on a map. At each point, the user can see instantly the impact of changes to coverage of Target Premises, as well as backhaul connections to other sites.
5. Backhaul Link Capacity Planning. Backhaul links can be described in terms of capacity and latency. Client connection volumes can also be applied to sites and WISDM will predict traffic load and volumes relative to transit or fibre injection points.

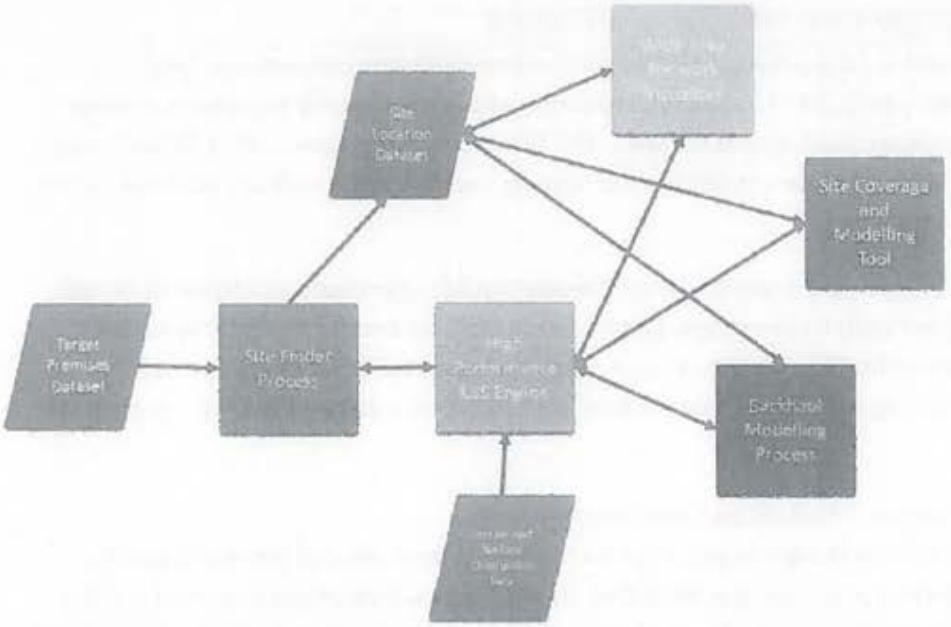

FIGURE 1 WISDM SCHEMATIC SYSTEM OVERVIEW

Wirelesscoverage.com WISDM LoS Engine

The WISDM LoS Engine is a custom-built high performance wireless propagation calculator developed in Native C and CUDA. It is a multi-threaded application, currently running on a server farm at Wireless Coverage and is accessed via a C API. This currently operates with 5,000 GPU cores to achieve around 500 million line of sight transactions per second when creating viewsheds but can be scaled further as required.

The LoS Engine has forward and reverse lookup features that are optimised to illustrate coverage from a single point, or supply from multiple points. These features are so fast that they can be operated in real time and take into consideration precision line of sight calculations as well as frequency, loss (according to ITU recommendations) and 3d antenna patterns for both transmitter and receiver.

Line of Sight Engine Technical Overview

Specific variants of the Line of Sight Engine exist for Forward (Viewshed) and Reverse (Best AP) coverage over large areas at any sample resolution. Below is an example of point to point request, but this is replicated over larger areas for the Forward and Reverse viewshed methods, where a map grid is also specified. The application uses the following parameters as input to each request via an API: -

- Site A Lat/Lon
- Site A transmitter height above ground in metres
- Site A transmitter power dBm
- Site A transmitter antenna gain in dBi
- Transmit frequency in MHz
- Scanning resolution in metres
- Site B Lat/Lon
- Site B receiver height above ground in metres
- Site B receiver antenna gain in dBi
- Percentage of first Fresnel required for partial line of sight in %
- Percentage of first Fresnel required for no line of sight in %
- Antenna Model (used for beam pattern)

The response for each request includes the following: -

- Link distance in metres
- Pass Status (Full Line of Sight, Partial Line of Sight or No Line of Sight)
- Predicted Receive Signal Strength (RSL) in dBm, assuming full Line of Sight
- Azimuth from Site A in degrees from true North
- Azimuth from Site B in degrees from true North
- Elevation from Site A in degrees
- Elevation from Site B in degrees
- Antenna Model (used for beam pattern)

- Optional link ground profile .PNG image file, illustrating the link profile and first Fresnel shape

FIGURE 12 SAMPLE LOS ENGINE INPUT AND OUTPUT

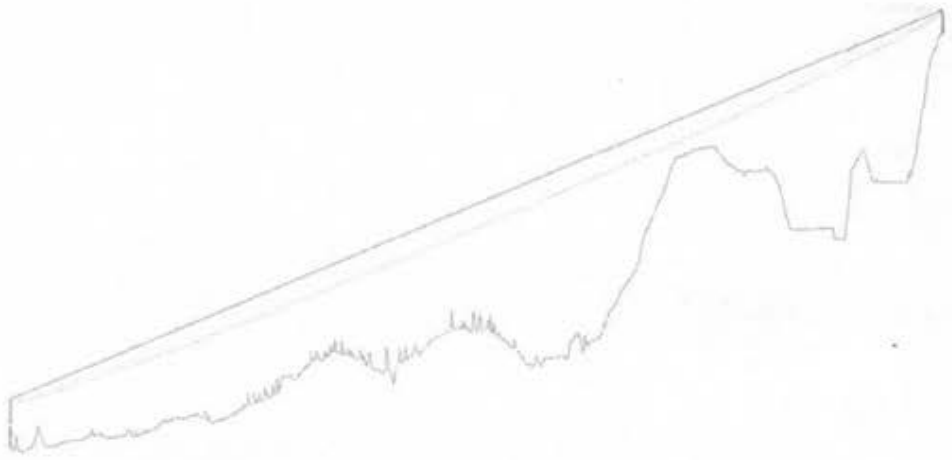

FIGURE 3 SAMPLE LOS GROUND PROFILE IMAGE

Mathematical and Technical LoS Model

A DSM elevation raster (of chosen resolution) of the target area is loaded into memory (~11GB GeoTIFF file equates to around 6,500 sq miles, imported with GDAL C library) into a flat array of 32-bit floats in a geodetic WGS84 latitude / longitude grid. This stays loaded in memory for every call of the function. A function exists to return the height in metres above sea level for any given latitude + longitude using bilinear interpolation in the grid. This allows for very fast indexed surface elevation lookups for any point in target area with high resolution.

64-bit integers are used for indexing coordinates and x87 80-bit floating-point numbers are used in coordinate calculations.

2 functions exist, geodetic_to_ecef and ecef_to_geodetic for converting between ellipsoidal WGS84 coordinates and cartesian ECEF coordinates.

geodetic_to_ecef is an implementation of Section 10.2.1 from B. Hofmann-Wellenhof, H. Lichtenegger, J. Collins' GPS - theory and practice as follows:

$$N(\phi) = \frac{a^2}{\sqrt{a^2\cos^2\phi + b^2\sin^2\phi}}$$
$$X = (N(\phi) + h)\cos\phi\cos\lambda$$
$$Y = (N(\phi) + h)\cos\phi\sin\lambda$$
$$Z = \left(\frac{b^2}{a^2}N(\phi) + h\right)\sin\phi$$

where h is height in metres; ϕ is latitude; λ is longitude; a is the Earth's equatorial radius in metres; b is the Earth's polar radius in metres; (X,Y,Z) is the cartesian ECEF coordinate.

ecef_to_geodetic is an implementation of J. Zhu's "Exact conversion of earth-centred, earth-fixed coordinates to geodetic coordinates" formula as follows:

$$
\begin{aligned}
r &= \sqrt{X^2 + Y^2} \\
E^2 &= a^2 - b^2 \\
F &= 54b^2Z^2 \\
G &= r^2 + (1 - e^2)Z^2 - e^2E^2 \\
C &= \frac{e^4Fr^2}{G^3} \\
S &= \sqrt[3]{1 + C + \sqrt{C^2 + 2C}} \\
P &= \frac{F}{3\left(S + \frac{1}{S} + 1\right)^2G^2} \\
Q &= \sqrt{1 + 2e^4P} \\
r_0 &= \frac{-(Pe^2r)}{1+Q} + \sqrt{\frac{1}{2}a^2(1 + 1/Q) - \frac{P(1-e^2)Z^2}{Q(1+Q)} - \frac{1}{2}Pr^2} \\
U &= \sqrt{(r - e^2r_0)^2 + Z^2} \\
V &= \sqrt{(r - e^2r_0)^2 + (1 - e^2)Z^2} \\
Z_0 &= \frac{b^2Z}{aV} \\
h &= U\left(1 - \frac{b^2}{aV}\right) \\
\phi &= \arctan\left(\frac{Z + e'^2Z_0}{r}\right) \\
\lambda &= \arctan2(Y, X)
\end{aligned}
$$

where (X,Y,Z) is the cartesian ECEF coordinate; h is height in metres; ϕ is latitude; λ is longitude; a is the Earth's equatorial radius in metres; b is the Earth's polar radius in metres; e is the Earth's first orbital eccentricity; e' is the Earth's second orbital eccentricity.

The 3D cartesian coordinates of each radio is found by sampling the ground elevation of the two points and adding on the mast heights, and then using geodetic_to_ecef. The accurate straight-line distance between the two radios can be found by using $\sqrt{dx^2 + dy^2 + dz^2}$

The straight line between each (x,y,z) position is divided into linear interval points at the desired scan resolution. These points are then converted back into (latitude, longitude, height) WGS84 coordinates using ecef_to_geodetic.

The surface elevation at each of these WGS84 points is sampled and the resulting coordinates + height are converted back into ECEF coordinates.

The resulting 3D ECEF coordinates should mostly be in a flat plane and represent the elevation profile of the terrain under the line between the two radios, including the curvature of the Earth. These coordinates are transformed into flat 2D coordinates by rotating them through 3 axes using transformation matrices. Once they are rotated to a flat plane against the axes, the resulting Z coordinate will be approximately zero and is discarded to produce 2D coordinates.

A 2D straight line is plotted between the two radio coordinates and perpendicular to this line, points are calculated and plotted for the first Fresnel zone and given threshold percentages within the Fresnel zone. The radius *r* in metres of the first fresnel zone is calculated using:

$$r = \sqrt{\frac{cd(t-d)}{1000000ft}}$$

Where *c* is the speed of light in ms^{-1}; *d* is the distance along the line in metres; *t* is the total distance between the two radios; *f* is the frequency in megahertz.

Intersection with the surface profile polygon and the plotted Fresnel threshold points is tested using binary search + linear interpolation.

The basic RSL *s* in decibels is calculated using:

$$l = 92.5 + 20\log_{10}\left(\frac{d}{1000}\right) + 20\log_{10}\left(\frac{f}{1000}\right)$$
$$s = p + g_1 + g_2 - l - t$$

Where *l* is the free-space path loss in decibels; *d* is the distance in metres; *f* is the frequency in megahertz; *p* is the power of the transmitter; *g1* and *g2* are the antenna gains of each antenna; *t* is the transmission line loss, assumed to be 1 decibel. Further ITU-R attenuation models are applied for appropriate bands, but not described in this document.

Conclusion

We hope that the information supplied is constructive and useful. Net1 have been a backbone of rural Internet connectivity in Ireland since 2003, and many thousands of loyal homes and small businesses rely upon our services for their day to day applications.

We pride ourselves on local based Irish technical support and knowledge of the areas we cover with our service.

We hope that this submission demonstrates our commitment to our continued focus on delivering reliable connectivity to rural Ireland.

[redacted]

(Technical Director)

30th September 2019

Response to Consultation

Nova Networks Ltd

20/09/2019

Contents

Preliminary

We regret that due to the very short space of time (comprising a series of short extensions) allowed by the Department for this Consultation and due to the very large and time consuming amount of data required to fully comply with its requirements we have been unable to address the totality required. SME FWA ISPs have written to the Department earlier this September explaining the problems that this short time-scale holiday-centred consultation has caused and seeking an extension of time appropriate to a consultation of this kind. It is most regrettable that to-date none has been forthcoming.

A1 Technical Information

1 Introduction

We have built our network around having good bandwidth with consistent and low latency, so as to support all converged IP services. We support many businesses and homes with Voice over IP VoIP telephony services. In fact our clients have a wider choice of telephony offerings with Voice over IP which helps our customers access other services and reduce cost, all of which is great for our customers.

The advances in wireless broadband technology in the past 15 years has been very considerable and particularly significant in the last 4-5 years. Those technological advances have included interference mitigation, a feature which the interference related questions in DCCAE's non upgraded 2015 Assessment Criteria by definition fails to recognise. By our company keeping up with the latest in wireless technology we have been able to deliver the benefits of reliable high speed broadband to Rural Ireland and, as a result, there is a wide variety of converged services available to our customers. In fact, more than half of our customer internet traffic is now video based, such as streaming video content from:

- RTE
- BBC iPlayer
- Apple TV
- YouTube
- Netflix
- High Resolution CCTV for our customers peace of mind and security and indeed farmers for monitoring their animals' welfare

In addition to this we support many businesses / homes with Voice over IP VoIP telephony services.

A number of our regional ISP colleagues have deployed their own IPTV distribution platforms for their ISP Customers, these operators include:

- Airwire Ltd.
- Real Broadband Ltd.
- Kerry Broadband Ltd.

They are very pleased with the results and we are actively considering collaborating with them and other operators to bring IPTV over our own high quality high speed broadband network.

We also support business users with remote working solutions through VPNs, Remote Desktop Environment and cloud-based productivity suites. Our customers report excellent results with video conferencing which allows for more remote working less commuting, less traffic congestion, reduced carbon footprint and a greater quality of life for our customers in Rural Ireland. We are delighted that our customers reap the benefits of high speed broadband in Rural Ireland today, benefits, we might add that exist at no cost to the taxpayer.

1.1Description of network Architecture

Datacentres:

1) [Redacted]

We have multiple racks in [Redacted] and our own private dark-fibre ring around the datacentre, joining our main racks to the mast racks. We have extensive infrastructure in[Redacted] with a fully redundant cloud cluster (backed up by external servers) hosting our web, OSS/CRM, email, DNS, Radius and monitoring servers. We run multiple soft-switches on the cloud cluster and VOIP billing also, along with some customer VMs.

Our network infrastructure consists of [Redacted] and [Redacted] aggregation, core and border routers/switches. We connect with the following tail providers at [Redacted] on multiple 10Gbps and 1Gbps NNI ports and use these tail providers for backhaul, enterprise customer circuits and NGA:

- Enet
- Viatel
- OpenEir
- BT
- SIRO

At [Redacted], Nova Networks Ltd avails of IP Transit on redundant BGP sessions, with transit coming from the following providers at [Redacted]:

[Redacted]

We are also peered with INEX locally.

Therefore, we have:

2 x Internet Exchanges
4 x IP Transit
5 x tail providers

giving lots of redundancy and connectivity options for backhaul and end user circuits over fibre.

We have a multi-Gbps managed circuit to [Redacted] for backhaul purposes, over dark fibre.

2) [Redacted]

We utilise fibre backhaul to link [Redacted]. We envisage upgrading [Redacted] proposed national 100Gbps backhaul ring.

At our [Redacted] POP, we have multiple border/agg routers. We peer with INEX locally. We connect with the following tail providers at [Redacted] on multiple NNI ports and use these providers for backhaul, enterprise customer circuits, NGA, cloud connectivity:

- Enet
- Viatel
- Cloud connect provider (in construction)

Core Network:

Our core network consists mainly of wireless transmission sites. From [Redacted], we have [Redacted] backhaul links, feeding 1st level sites:

[Redacted] x fibre backhauls, various capacities up to 10Gbps currently

[Redacted] x microwave backhauls (licenced bands), 400Mbps to 800Mbps currently

0 x licence-exempt wireless backhauls

All of these backhaul links are operating at under 70% utilisation and are upgraded as necessary. These 1st level sites then distribute to 2nd level and so on, mostly in a meshed, redundant topology (although there are some exceptions). Lower level sites are fed with single links where user count is small or LOS limited to parent sites.

The core network uses dynamic routing (OSPF/iBGP) to maintain routing tables and to achieve instant re-routing of traffic in the event of a link failure.

Access Network:

Our access network consists of:

- on-net fixed wireless PTMP sectors/CPEs (in both licenced and licence-exempt spectrum)
- on-net fixed wireless PTP links to enterprise customers (in both licenced and licence-exempt spectrum)
- wholesale fibre access circuits
- wholesale microwave circuits

Customer services are provided on aggregation routers at the base stations or tunnelled back to the datacentre to centralised agg routers.

1.2.Access network technology

Wholesale microwave circuits use PTP licenced microwave, mostly by [Redacted].

We minimise interference by using high gain focused antennas that have the effect of maximising the signal through accurate alignment (by a professionally trained installer) of the antenna's centre line with the base station. Utilising High gain Focused antennas has the following effects:

- Noise behind and beside the antenna minimised to a great extent.
- Minimises interference to other operators because the signal is focused on the base station (being a good neighbour)
- Minimises interference from other operators because the signal is focused on the base station (protection from noisy neighbours)
- Maximises signal to noise ratio (SNR)

A schedule of Client unit equipment deployed:

[Redacted]

1.3.Backhaul Network Technology and specification of Backhaul Technologies

Our backhaul is heavily dependent on fiber optic technology. We use high capacity FDD Links to transfer bandwidth from a fibre POH to a high site. Smaller sites use 5GHz TDD PTP links.

1.3.1 Short Range Radio Backhaul Network Technology

We make use of high frequency narrow beam links to bridge short gaps between fibre POHs and high sites. We make use of 17GHz / 24GHz / 60GHz License Exempt bands and Licenced bands for delivery of bandwidth from site to site or from Fibre POH to Site. We also deploy 5.8GHz GPS Synced Backup Backhaul to cover Extreme Weather Events that may affect Higher Frequency Links.

- We utilise 60GHz [Redacted] for links less than 1.25km delivering 2Gb/s HDX which has 4 channels available for future expansion and redundancy.
    - [Redacted]

- [Redacted] 17/17GHz 500Mbps FDD FDX Radio Link for Links up to 10km
    - [Redacted]

- [Redacted] 24GHz 1Gb/s FDX FDD Radio Link up to 6Km
    - [Redacted]

All of these connections allow for increased bandwidth for our customers, we monitor the usage and as soon as usage on any of these links are regularly and consistently over 70% we start a procurement process to upgrade the links, this is ensured that upgrades either soft or hard are implemented in time so as to keep our capacity always 30% above of Peak Demand. We monitor our usage using various SNMP graphing and Latency Testing Tools in our NMS system, [Redacted].

1.3.2 Long Range Licensed Radio Backhaul Network Technology

[Redacted]

These connections allow for increased bandwidth for our customers, we monitor the usage and as soon as usage on any of these links are regularly and consistently over 70% we start a procurement process to upgrade the links, this is ensured that upgrades either soft or hard are implemented in time so as to keep our capacity always 30% above of Peak Demand. We monitor our usage using various SNMP graphing and Latency Testing Tools in our NMS system, [Redacted].

1.3.3 Wired / Fibre Backhaul Network Technology

For sites and POPS that have 10Gb/s + Capacity we utilise the following routers to forward traffic onto High sites via the Radio Point to Point links described earlier

[Redacted]

- A Schedule of PoE Switches on base stations are outlined below.

- [Redacted]

1.3.2 Backhaul Network Technology (National, and Metro) and the specification of the Backhaul Providers

We have several Circuits from national backhaul provider partners. Our national Backhaul Providers include Openeir, BT, Enet, Viatel.

1.3.2.1 [OpenEir] Backhaul

We have 10Gb/s Ethernet WEIL Wholesale Ethernet Interconnect with OpenEir

We have checked the OpenEir Congestion Report and we have a clear upgrade path to the full 10G usage on the WSEAs and WEILs

We intend to utilise Wholesale GEA (Gepon Ethernet Access) for backup backhaul to High sites via eirs GEPON network.

All of these connections allow for increased bandwidth for our customers. We monitor our network bandwidth flows and network activity on a site by site, link by link and CPE by CPE basis using [Redacted]. Our NMS alerts us to network problems so that we usually know about and resolve them before our customers even become aware of them/call us. When our network usage on any of our links regularly and consistently exceed 70% we start a procurement process to upgrade those links and this ensures that upgrades either soft or hard are implemented in time so as to keep our capacity always 20% above of peak demand. We monitor network our usage using various SNMP graphing and latency testing tools in our NMS system as described above).

1.3.2.2 [ESBT] Telecom Backhaul

We have none currently, but plan to use ESBT in the future.

1.3.2.3 [CIX] Backhaul

[Redacted]

We have [Redacted] x 10G Link to INEX – CORK

All of these connections allow for increased bandwidth for our customers, we monitor the usage and as soon as usage on any of these links are regularly and consistently over 70% we start a procurement process to upgrade the links, this is ensured that upgrades either soft or hard are implemented in time so as to keep our capacity always 30% above of Peak Demand. We monitor our usage using various SNMP graphing and Latency Testing Tools in our NMS system.

1.3.2.4 [SIRO] Backhaul

We are about to launch services over SIRO, including backhaul, from November 2019.

1.3.2.5 [ENET] Backhaul

We utilise enet to deliver Fibre connectivity to parts of our core network outside of Dublin. Enet deliver circuits as a metro (i.e., within a single MAN) or national (from a MAN to Dublin or to another MAN) service. The circuits we utilise for our core network are National circuits providing connectivity from our Datacentre in Dublin to various core sites in our network. The enet circuits are delivered across fibre to our high site, and are terminated on a fibre patch panel.

We have multiple Enet backhaul circuits, up to 1Gbps, with various 10Gb NNIs in place allowing an upgrade path.

All of these connections allow for increased bandwidth for our customers, we monitor the usage and as soon as usage on any of these links are regularly and consistently over 70% we start a procurement process to upgrade the links, this is ensured that upgrades either soft or hard are implemented in time so as to keep our capacity always 30% above of Peak Demand. We monitor our usage using various SNMP graphing and Latency Testing Tools in our NMS system.

1.3.3 External Edge Capacity

We have an External Edge capacity of 40 GB/s

We have 10G interconnect with INEX LAN1

We have [Redacted] x 10G Fully Managed IP Transit [Redacted]

We have 10G to INEX – CORK

1.4. Design for the national backhaul network including any traffic and capacity assumptions

The backhaul network we have built has been designed around using quality backhaul from providers with an SLA that is appropriate for what are considered arterial paths for our network.

We use multiple links spread across multiple providers from Datacentres in urban population centres to provincial towns around our network. From these provincial towns we utilise our own infrastructure built with high capacity ethernet radio links to get the bandwidth up to the nearest high site. We design the radio links with adequate fade margins to achieve 99.95% availability. Where feasible we introduce redundant paths between high sites using radio links so that if there is a fibre break in one provincial town we can fail over via a number of radio links to a fibre link in another provincial town. We also plan to supplement our primary high speed backhaul connections with backup connections over gepon fiber connections as a backup of last resort.

1.5. The Specification of all types of Customer Premises Equipment which the operator (i) is using (ii) plans to use (if not already NGA). [CPE's only unless fibre]

[Redacted]

1.6. Coverage data as illustrated in the form of Polygonsed Data set

See attached.

1.6.1 Table of Location of Base stations

See attached.

1.6.1a Location of Base stations as illustrated in a MAP [Optional]

List of Base stations that were used in wirelesscoverage.com WISDM LIDAR Line of Sight analysis software.

[reference filename.csv or xls]

1.6.2 Table of Location of Premises Passed based on High Resolution LIDAR and DSM data (eircodes only or GPS coordinates) [Not both]

See attached.

1.6.4 LIDAR LOS testing and Methodology

We have engaged WirelessCoverage.com to build a Digital surface model based on high quality LIDAR / DSM data. We have supplied Wirelesscoverage.com a list of Sites and height of sectors to produce a list of premises that would be covered with clear line of sight

Approach according to WirelessCoverage.com

The approach used for this project was designed to be as comprehensive and detailed as possible, using the best quality data and modelling tools available.

Detailed data was prepared to perform this analysis comprising of: -

- The latest EIRCODE dataset, purchased in August 2019
- A Digital Surface Model (DSM) for the whole country from Bluesky International, who have the most contemporary dataset currently available. They hold data at 1m resolution, which was scaled to 2.5m resolution using a bilinear interpolation method. Where any gaps in the LIDAR/DSM coverage were identified, the following other Topographical data sources were used in the order of descending preference.
    - Open Topographic Lidar Data from the Irish Government
    - SRTM (Shuttle Radar Topography Mission)
- These data sets were blended and interpolated to avoid any hard edges in the height data. More information on the data is available in detail below. Mast Site Data from our ISP
- WISDM Wireless Modelling system, which performs detailed line of sight tests between all properties and all tower sites. Further details on the WISDM Line of Sight Engine are included in Below

Method according to WirelessCoverage.com

Data from our ISP was collected in September 2019 and imported into WISDM. Sites were classified as Standard or NGA and we also gathered details on future planned sites. The distinction between Standard and NGA sites is based upon the quality and style of equipment currently installed at these sites, along with the backhaul feeds. Those classified as NGA are capable of connecting premises at NGA speeds of 30Mbps download and 6Mbs upload.

Using WISDM, wirelesscoverage ran several coverage passes to all EIRCODE centroids: -

1. All Sites from our ISP at NGA
2. All Sites from our ISP at non-NGA

Within each pass, WISDM takes each Site within the test and performs a Wireless Line of Sight test to each property within a given radius. It is important to note that a Wireless Line of Sight Test differs from an optical test, as it takes into account the Fresnel 1 Zone around the direct (optical) path. This is a more robust means of determining line of sight. In this exercise, we discounted all properties that had more than 15% Fresnel 1 incursion, and therefore does not include properties with Near Line of Sight, which in many cases could successfully be connected.

Where a property does have Wireless Line of Sight, it is excluded from further tests within that pass, in order to avoid double-counting properties.

We then performed analysis of the coverage list from each operator with NGA coverage to identify those properties that could receive NGA service from more than one operator.

NGA Assumptions

Due the variety of equipment mounted at each site, we have taken a cautious approach to whether a site is capable of delivering NGA speeds. As such, we have taken a worst-case assumption of the type of equipment used for access points or base stations.

We considered the signal level that would be required to get the full modulation rates on the most basic of commonly installed fixed wireless equipment, as well as a significant fade margin. Assuming a nominal operating frequency of 5.7 GHz with regulatory compliant power output (EIRP) from a base station of 33 dBm (2 Watts) and a client receiver with 30cm diameter antenna providing 23 dBi gain, the receive signal level (RSL) with clear line of sight would be -70.1 dBm at 7.5 km. Using a basic radio system, such as the Ubiquiti Rocket M5 access points and associated M5 customer receiver such as NanoBeam M5 system on a 20 MHz channel, and an assumed noise floor of 90 dBm, a client would connect at MCS13, providing a physical interface rate of 104 Mbps and a typical throughput rate of approximately 54 Mbps, which is safely above the NGA threshold and leaves a considerable fade margin assuming the access point is not over-subscribed.

Assumptions and Constraints

As with all modelling approaches to wireless coverage, there are factors which could over-state or under-state coverage. Here is a summary of the key factors as they relate to this project: -

Over-statement factors

- A small percentage of the national map data used was derived from low-resolution (10 to 30m) data, which could mean that obstructions to the wireless signal path calculations were missed. We estimate an error rate of <2% over-statement.
- Since the high-resolution data was produced between 2015 and 2017, it is likely that additional tree growth and new building works will have occurred in the intervening period which means that some wireless paths are now blocked. We estimate a resultant over-statement of <1% from this.
- Whilst it may be possible to receive a high-quality signal at a given property, it is possible that there is no suitable location on the property to mount a receiver due to the construction or location of the property. For example, waterside properties or those with unusual construction such as all-glass exterior can be very challenging.

Under-statement factors

- In this exercise, we performed single-point line of sight tests to each EIRCODE property. In reality, it is possible that the Wireless Line of Sight to that one point may be obscured and therefore reported as no coverage, but if a receiver was mounted at a different point on the property, a connection could be established. We estimate an under-statement of 3-4% from this factor.
- We used a watershed method for wireless line of sight calculation which allows for little or no Near Line of Sight connections. Many modern radio systems using the diversity associated with MIMO transmission allows for high quality connections to be established in Near Line of Sight operation and these have not been incorporated in the model. This is estimated to have an effect of <10%, but it is highly dependent on the technology used by the operator.
- We have assumed that 30cm dishes are used at the customer property to achieve an appropriate signal level. It is common practice to install 40cm dishes or larger, which have higher gain and therefore can receive a good signal at a longer range. Using larger dishes could increase the coverage from each access point substantially.

Multi Dwelling Units (MDUs)

WISDM currently has a design constraint which means that the premises counted in coverage checks shows the same EIRCODE for all properties that have the same physical location (ie. Multi-dwelling units). This means that the coverage lists appear to have duplications. It was not possible to resolve this issue in the time available to complete the project.

LIDAR DSM Data Source coverage according to wirelesscoverage.com

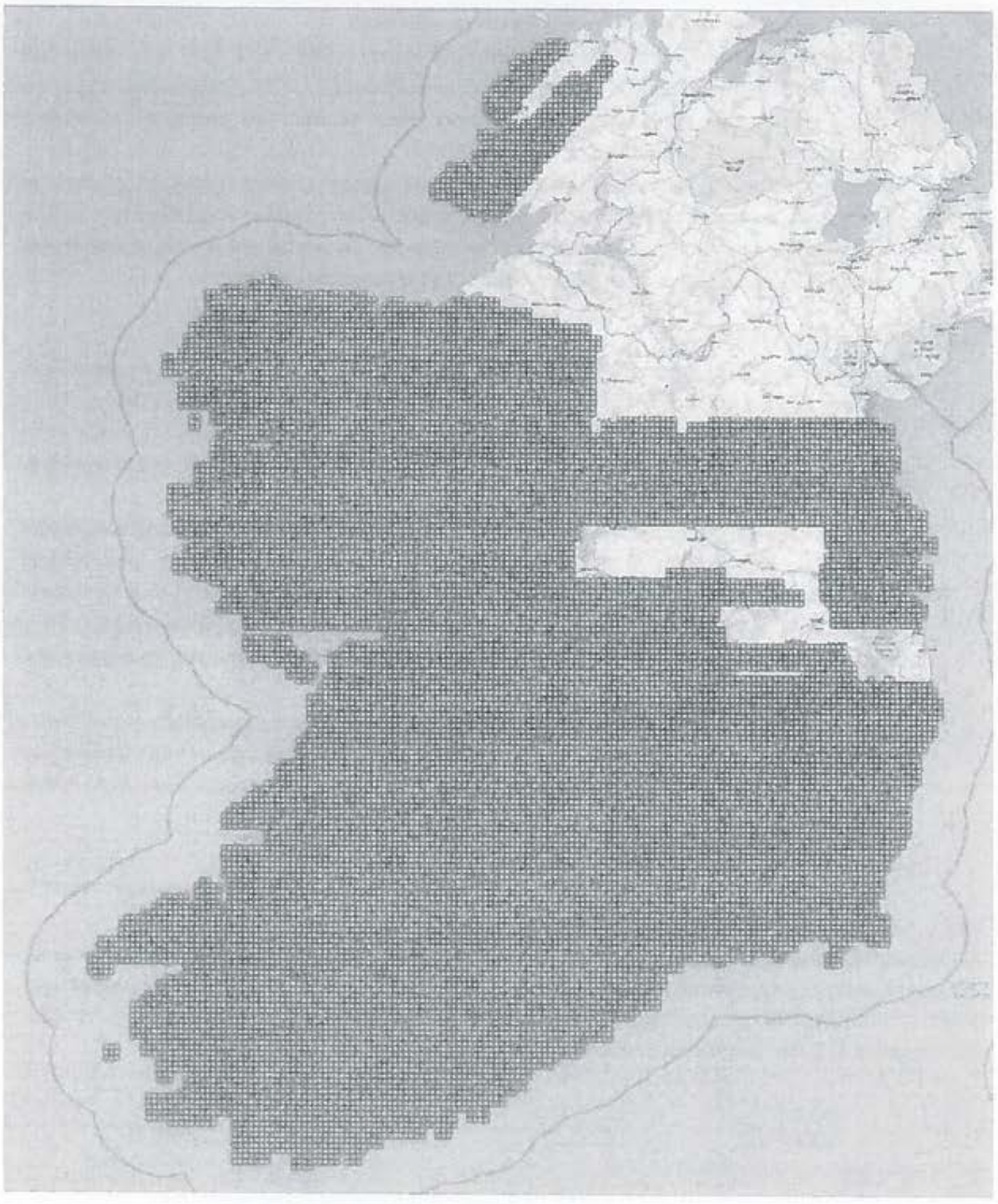

Figure 1. Map of 1m DSM Data from Bluesky International, collected between 2015 and 2017

Figure 2. Example render of DSM Data showing trees, buildings and other surface features.

Figure 3. Irish Government published Open LIDAR data areas that supplemented the proprietary LIDAR data.

Figure 4. Example of Open Topographic LIDAR data detail as published on data.gov.ie

Figure5. SRTM topographical data as captured and rendered by NASA

Wirelesscoverage.com WISDM™ Line of Sight Engine

Highlights

Wireless coverage WISDM comprises of a family of ultra-high performance wireless planning systems developed by Boundless Networks Ltd.

WISDM WISP Edition is an interactive planning and design system built to facilitate the creation of scalable, robust and performant fixed wireless networks for Wireless IPSs. It enables the rapid creation of 'Ideal' wireless networks over very large areas of thousands of square kilometres. It is well suited to rural expanses as well as mixed and urban environments too. Once an Ideal network has been designed, the network can be fine-tuned to consider build constraints and resiliency in real time.

WISDM can also be used to analyse the coverage of an existing wireless network and perform 'what-if' tests to plan ad-hoc extensions to a network to verify potential coverage and backhaul.

Using WISDM, a predictable coverage model can be prepared in hours and **detailed coverage of individual properties** can be predicted with an extremely high level of accuracy. Site planning and acquisition is accelerated by use of the interactive planning tools, allowing rapid decisions about mast location to be made with instant coverage impact reporting.

Overview

WISDM comprises of several components and processes to complete the overall solution. At the heart of the system is a very high performance wireless Line of Sight (LoS) calculation engine. The LoS engine can calculate over 150 million wireless line of sight tests per second and can use a wide variety of terrain and surface obstruction data sets at any resolution.

Overall, WISDM WISP Edition performs the following tasks: -

1. Site Finder. This creates an 'Ideal' list of sites where masts could be located for optimum coverage for a given number of target premises passed from a target premises dataset. Target premises can be a list of all properties from a comprehensive source, such as Ordnance Survey AddressBase, or a subset of premises in say, a Government Intervention area. Assumptions can be used to set mast profiles which would include mast height and effective wireless range. For example, the Site Finder can be run with parameters which state that 20 locations could be built with 30m towers, then calculate how many 15m towers would be needed to pass a certain quantity of target premises.
2. Backhaul Modelling. The Backhaul Modeller analyses a Site Location dataset and performs line of sight tests between them to create microwave backhaul. Assumptions can be used to help plan for the style of links to be used. For example, links up to 5km can be coloured differently than links from 5km to 17km. This helps when planning a network that has optimum resilience, performance and operating costs due to the potential costs incurred to run licensed microwave links or fibre backbone.
3. Wide Area Network (WAN) Visualizer. The WAN Visualizer provides full-screen mapping to allow users to see the overall shape of a network and the distribution of different sized towers and backhaul connections between sites. The WAN Visualizer can be called from the Site Coverage and Modelling system.

4. Site Coverage and Modelling System. This is an interactive web-based tool that allows planners to review the calculated Ideal Sites and move them on a map. At each point, the user can see instantly the impact of changes to coverage of Target Premises, as well as backhaul connections to other sites.
5. Backhaul Link Capacity Planning. Backhaul links can be described in terms of capacity and latency. Client connection volumes can also be applied to sites and WISDM will predict traffic load and volumes relative to transit or fibre injection points.

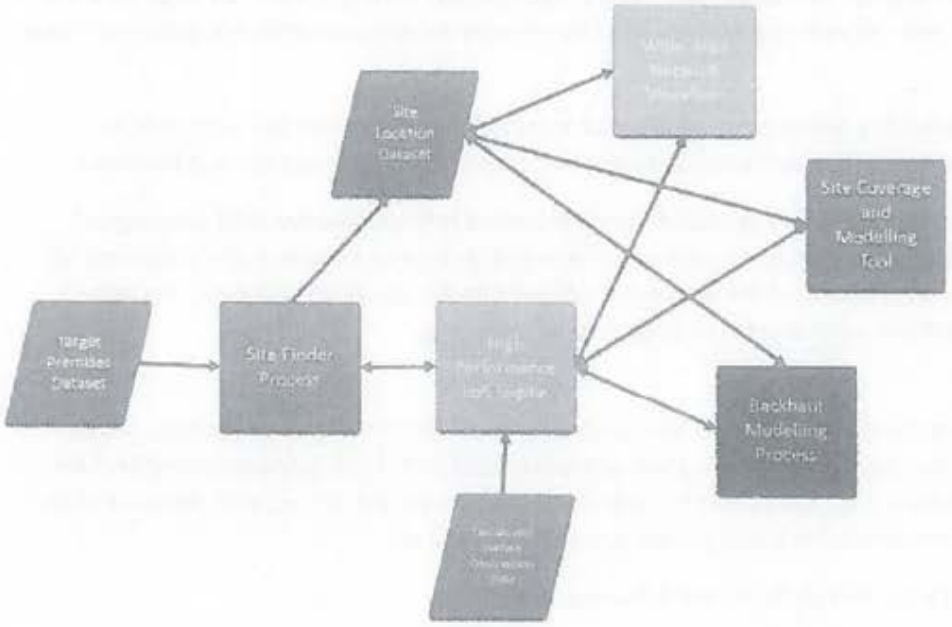

Figure 16. WISDM Schematic System Overview

Wirelesscoverage.com WISDM LoS Engine

The WISDM LoS Engine is a custom-built high-performance wireless propagation calculator developed in Native C and CUDA. It is a multi-threaded application, currently running on a server farm at Wireless Coverage and is accessed via a C API. This currently operates with 5,000 GPU cores to achieve around 500 million line of sight transactions per second when creating viewsheds but can be scaled further as required.

The LoS Engine has forward and reverse lookup features that are optimised to illustrate coverage from a single point, or supply from multiple points. These features are so fast that they can be operated in real time and take into consideration precision line of sight calculations as well as frequency, loss (according to ITU recommendations) and 3d antenna patterns for both transmitter and receiver.

Line of Sight Engine Technical Overview

Specific variants of the Line of Sight Engine exist for Forward (Viewshed) and Reverse (Best AP) coverage over large areas at any sample resolution. Below is an example of point to point request, but this is replicated over larger areas for the Forward and Reverse viewshed methods, where a map grid is also specified. The application uses the following parameters as input to each request via an API: -

- Site A Lat/Lon
- Site A transmitter height above ground in metres
- Site A transmitter power dBm
- Site A transmitter antenna gain in dBi
- Transmit frequency in MHz
- Scanning resolution in metres
- Site B Lat/Lon
- Site B receiver height above ground in metres
- Site B receiver antenna gain in dBi
- Percentage of first Fresnel required for partial line of sight in %
- Percentage of first Fresnel required for no line of sight in %
- Antenna Model (used for beam pattern)

The response for each request includes the following: -

- Link distance in metres
- Pass Status (Full Line of Sight, Partial Line of Sight or No Line of Sight)
- Predicted Receive Signal Strength (RSL) in dBm, assuming full Line of Sight
- Azimuth from Site A in degrees from true North
- Azimuth from Site B in degrees from true North
- Elevation from Site A in degrees
- Elevation from Site B in degrees
- Antenna Model (used for beam pattern)
- Optional link ground profile .PNG image file, illustrating the link profile and first Fresnel shape

Point A name: Point A
Point B name: Point B
Coordinates of A: 53.673302°, -2.664143°
Coordinates of B: 53.645783°, -2.573456°
Height of A: 20 m
Height of B: 10 m
Power: 20 dBm
Antenna gain of A: 13 dBi
Antenna gain of B: 23 dBi
RF frequency: 5825 MHz

Estimated RSSi: **-69.37 dBm**

Azimuth from A: **117.05°**

Azimuth from B: **297.05°**

Elevation from A: **1.38°**

Elevation from B: **-1.38°**

Link distance: **6734.22 m**

Figure 27 Sample LoS Engine Input and Output

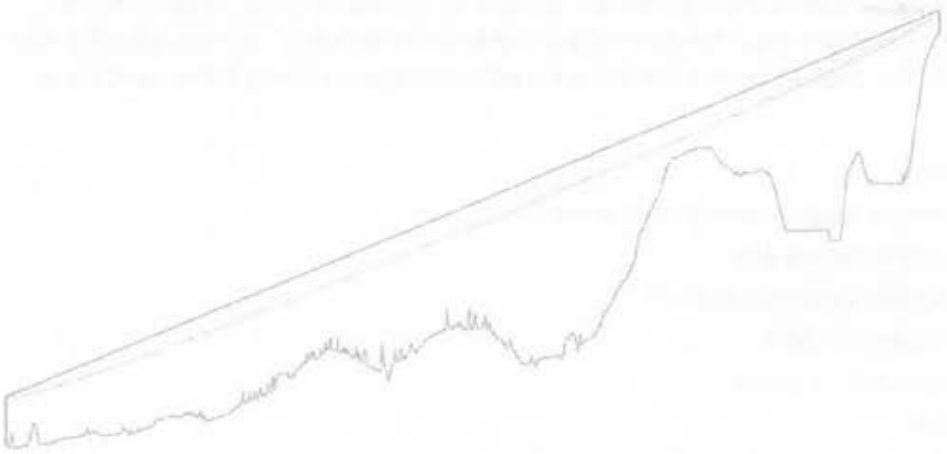

Figure 38 Sample LoS Ground Profile Image

Mathematical and Technical LoS Model

A DSM elevation raster (of chosen resolution) of the target area is loaded into memory (~11GB GeoTIFF file equates to around 6,500 sq miles, imported with GDAL C library) into a flat array of 32-bit floats in a geodetic WGS84 latitude / longitude grid. This data stays loaded in memory for every call of the function. A function exists to return the height in metres above sea level for any given latitude + longitude using bilinear interpolation in the grid. This allows for very fast indexed surface elevation lookups for any point in target area with high resolution.

64-bit integers are used for indexing coordinates and x87 80-bit floating-point numbers are used in coordinate calculations.

2 functions exist, geodetic_to_ecef and ecef_to_geodetic for converting between ellipsoidal WGS84 coordinates and cartesian ECEF coordinates.

geodetic_to_ecef is an implementation of Section 10.2.1 from B. Hofmann-Wellenhof, H. Lichtenegger, J. Collins' GPS - theory and practice as follows:

$$N(\phi) = \frac{a^2}{\sqrt{a^2\cos^2\phi + b^2\sin^2\phi}}$$
$$X = (N(\phi) + h)\cos\phi\cos\lambda$$
$$Y = (N(\phi) + h)\cos\phi\sin\lambda$$
$$Z = \left(\frac{b^2}{a^2}N(\phi) + h\right)\sin\phi$$

where h is height in metres; ϕ is latitude; λ is longitude; a is the Earth's equatorial radius in metres; b is the Earth's polar radius in metres; (X,Y,Z) is the cartesian ECEF coordinate.

ecef_to_geodetic is an implementation of J. Zhu's "Exact conversion of earth-centred, earth-fixed coordinates to geodetic coordinates" formula as follows:

$$r = \sqrt{X^2 + Y^2}$$
$$E^2 = a^2 - b^2$$
$$F = 54b^2Z^2$$
$$G = r^2 + (1 - e^2)Z^2 - e^2E^2$$
$$C = \frac{e^4Fr^2}{G^3}$$
$$S = \sqrt[3]{1 + C + \sqrt{C^2 + 2C}}$$
$$P = \frac{F}{3\left(S + \frac{1}{S} + 1\right)^2G^2}$$
$$Q = \sqrt{1 + 2e^4P}$$
$$r_0 = \frac{-(Pe^2r)}{1+Q} + \sqrt{\frac{1}{2}a^2(1 + 1/Q) - \frac{P(1 - e^2)Z^2}{Q(1+Q)} - \frac{1}{2}Pr^2}$$
$$U = \sqrt{(r - e^2r_0)^2 + Z^2}$$
$$V = \sqrt{(r - e^2r_0)^2 + (1 - e^2)Z^2}$$
$$Z_0 = \frac{b^2Z}{aV}$$
$$h = U\left(1 - \frac{b^2}{aV}\right)$$
$$\phi = \arctan\left(\frac{Z + e'^2Z_0}{r}\right)$$
$$\lambda = \arctan2(Y, X)$$

where (X,Y,Z) is the cartesian ECEF coordinate; h is height in metres; ϕ is latitude; λ is longitude; a is the Earth's equatorial radius in metres; b is the Earth's polar radius in metres; e is the Earth's first orbital eccentricity; e' is the Earth's second orbital eccentricity.

The 3D cartesian coordinates of each radio is found by sampling the ground elevation of the two points and adding on the mast heights, and then using geodetic_to_ecef. The accurate straight-line distance between the two radios can be found by using $\sqrt{dx^2 + dy^2 + dz^2}$

The straight line between each (x,y,z) position is divided into linear interval points at the desired scan resolution. These points are then converted back into (latitude, longitude, height) WGS84 coordinates using ecef_to_geodetic.

The surface elevation at each of these WGS84 points is sampled and the resulting coordinates + height are converted back into ECEF coordinates.

The resulting 3D ECEF coordinates should mostly be in a flat plane and represent the elevation profile of the terrain under the line between the two radios, including the curvature of the Earth.

These coordinates are transformed into flat 2D coordinates by rotating them through 3 axes using transformation matrices. Once they are rotated to a flat plane against the axes, the resulting Z coordinate will be approximately zero and is discarded to produce 2D coordinates.

A 2D straight line is plotted between the two radio coordinates and perpendicular to this line, points are calculated and plotted for the first Fresnel zone and given threshold percentages within the Fresnel zone. The radius r in metres of the first fresnel zone is calculated using:

$$r = \sqrt{\frac{cd(t-d)}{1000000ft}}$$

where c is the speed of light in ms^{-1}; d is the distance along the line in metres; t is the total distance between the two radios; f is the frequency in megahertz.

Intersection with the surface profile polygon and the plotted Fresnel threshold points is tested using binary search + linear interpolation.

The basic RSL s in decibels is calculated using:

$$l = 92.5 + 20\log_{10}\left(\frac{d}{1000}\right) + 20\log_{10}\left(\frac{f}{1000}\right)$$
$$s = p + g_1 + g_2 - l - t$$

where l is the free-space path loss in decibels; d is the distance in metres; f is the frequency in megahertz; p is the power of the transmitter; $g1$ and $g2$ are the antenna gains of each antenna; t is the transmission line loss, assumed to be 1 decibel. Further ITU-R attenuation models are applied for appropriate bands, but not described in this document.

Wholesale fibre circuits use either GPON (SIRO), managed ethernet or dark fibre.

On-net fixed wireless PTP to enterprise uses licenced microwave ([Redacted],[Redacted], [Redacted]) or licence-exempt from [Redacted] or [Redacted](5GHz, 17GHz, 24GHz, 60GHz)

On-net fixed wireless PTMP to enterprise uses 10.5GHz FWALA FDD microwave.

On-net fixed wireless PTMP residential uses licence exempt 5GHz, further described below.

1.2.1 Access network technology and the Specification of the access equipment

We operate in the ISM 5GHz & License Exempt 5.8GHz bands. We use Ethernet based data link layer technology. For our NGA Access Deployment we have chosen [Redacted] APs and client units. The [Redacted] APs are powered using Power over Ethernet PoE switches from [Redacted] and [Redacted] routers are used to forward customer Internet traffic inside PPPoE tunnels on a redundant layer 3 routed network.

On our Base station sites, we have deployed Sectors with the technical specifications as outlined in the following section. They have already been deployed following our network strategy which allows for self-funded organic growth and infill as a site matures and consumers become aware of the improved new service offering available to them.

On any given base station site we have deployed sufficient access points to serve the required capacity. Additional capacity is added by using additional sectors in the form of tightly focused sector antennas to maintain NGA levels of speeds that the customers are accustomed to. The tightly focused sector antennas serve to minimise external noise and facilitate frequency reuse.

As explained above, additional capacity is added on an ongoing basis to maintain the performance in line with User expectations and requirements to ensure NGA Performance during the busy hour.

A schedule of Routers used at each base station would be one or more of the following (depending on the site size:

[Redacted]

A Schedule of PoE Switches on base stations are outlined below.

[Redacted]

1.2.1 Base station Technology Deployed

In our Base stations we deploy the equipment described below to support the delivery of quality reliable internet to the customer.

A schedule of Routers used at each base station would be one or more of the following (depending on the site size:

[Redacted]

A Schedule of PoE Switches on base stations are outlined below.

[Redacted]

1.2.2 Sector Technology Deployed

We deploy sectoral transmitters according to the design and strategy outlined earlier. We utilise [Redacted] Access Points with GPS synchronisation to actively mitigate against Interference. The GPS Sync allows all sectors at a given base station site to transmit simultaneously and receive simultaneously, thereby eliminating self-interference & co-located interference. When GPS sync is combined with tight-beam horn antennae it allows an operator to reuse frequencies to increase capacity at a site. The Upload download ratio on the access network is fixed at 25% Up, 75% down. This allows for even better ratio than what is required for NGA. There are other active technologies deployed in the electronics to mitigate against interference through the use of:

- Integrated Dynamic tuneable RF filters
- Advanced digital signal processors
- Forward error correction FEC mechanisms
- Adaptive Coding Modulation (ACM)
- Transmit Power Control (TPC)
- Subscriber isolation

A schedule of the sector equipment used is outlined below:

[Redacted]

1.2.3 Client Premises Equipment(CPE) Technology Deployed.

The Client units were chosen because they had the following features to maximise performance, minimise interference:

- Maximise spectral efficiency by utilising a minimum of 2 streams MIMO (on horizontal and Vertical Polarization)
- High Gain Focused Antennas
- Maximise client performance by ensuring adequate processor specification
- Adaptive Coding Modulation (ACM)
- Forward Error Correction (FEC)
- Transmit power Control (TPC)

A2 Future Deployment Information

Due to the lack of notice, timing of the consultation period in peak holiday season, short initial consultation period and short extensions to the consultation period we have had insufficient time to present our exciting future plans for expanding our network. We will continue to grow our network and invest in new technologies in the same manner as we have done in the past. It is profoundly regrettable that the DCCAE NBP Team wilfully disregarded the best practices document on public consultations that another government department DPER had gone to the trouble of issuing on the topic of running a public consultation. Specifically DCCAE's NBP Team ignored the guidelines around giving more time for a consultation period so that smaller businesses would be given a fair opportunity to respond given the inherent constraints on resources that small business have. A copy of the DPER guidelines can be downloaded from the following url;
https://www.gov.ie/en/publication/e9b052-consultation-principles-and-guidance/

A3 Future Financial Information

The comments made in A2 are repeated here. More importantly, it is impossible for us and other similarly placed FWA operators to obtain the certainty of financing required by DCCAE's Assessment Criteria until DCCAE has accepted that we are providing NGA service and ruled our coverage area out of the currently proposed NBP .Intervention Area. By definition therefore, because the DCCAE has placed this impossibly high bar in our way, we are blocked as a result from being able to comply with DCCAE's requirements for future plans and therefore any future plans we and other existing FWA operators have can be totally disregarded by DCCAE. We cannot and do not accept that the EU's State Aid Guidelines are intended to be applied in this way.

From: [redacted]
To: NBP Mapping
Subject: [redacted]
Date: 16 September 2019 09:47:49

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

A dhuine uasail,
Rinne mé iarracht breathnú ar na léarscáil ar Chrome agus Firefox ach ní cosúil go bhfuil siad ag feidhmiú faoi láthair.

Is mian liom a chur in iúl nach bhfuil rochtain ar [redacted] ag mo sheoladh, in ainneoin roinnt mhaith iarratais a bheith déanta ina leith. Tuigtear dom go bhfuil fáil ar sa cheantar máguaird. Is é [redacted] mo sheoladh. Is é [redacted] mo circód. Tuigim go bhfuil an deacracht céanna ag mo chomharsan béal dorais.

Le dea ghuí
[redacted]
Sent from my iPhone

From: [redacted]
To: NBP Mapping
Subject: Re: National Broadband Plan
Date: 16 September 2019 11:42:20

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

A chara,
B'ábhar iontais dom freagra i mBéarla a fháil ar aighneacht i nGaeilge a sheol mé chugaibh. Tuigtear dom go bhfuil dualgas reachtúil ann cumarsáid scríofa a fhreagairt sa teanga oifigiúil céanna.
Le dea ghuí,

[redacted] aillimhe

Sent from my iPhone

On 16 Sep 2019, at 09:47, NBP Mapping <nbpmapping@dccae.gov.ie> wrote:

> ***Thank you for your response to the Department of Communications, Climate Action & Environment's public consultation, "National Broadband Plan - Conclusion of the Mapping Exercise for the Intervention Area".***
> ***Please note that this mailbox is for submissions to the consultation only. If you have a general query on the National Broadband Plan map or any other query, please use the following email address broadband@dccae.gov.ie***
>
> Disclaimer:
>
> This electronic message contains information (and may contain files), which may be privileged or confidential. The information is intended to be for the sole use of the individual(s) or entity named above. If you are not the intended recipient be aware that any disclosure, copying, distribution or use of the contents of this information and or files is prohibited. If you have received this electronic message in error, please notify the sender immediately. This is also to certify that this mail has been scanned for viruses.
>
> Tá eolas sa teachtaireacht leictreonach seo (agus b'fhéidir sa chomhaid ceangailte leis) a d'fhéadfadh bheith príobháideach nó faoi rún. Is le h-aghaidh an duine/na ndaoine nó le h-aghaidh an aonáin atá ainmnithe thuas agus le haghaidh an duine/na ndaoine sin amháin atá an t-eolas. Murab ionann tusa agus an té a bhfuil an teachtaireacht ceaptha dó bíodh a fhios agat nach gceadaítear nochtadh, cóipeáil, scaipeadh nó úsáid an eolais agus/nó an chomhaid seo. Más trí earráid a fuair tú an teachtaireacht leictreonach seo cuir, más é do thoil é, an té ar sheol an teachtaireacht ar an eolas láithreach. Deimhnítear leis seo freisin nár aims odh víreas sa phost seo tar éis a scanadh.

From: [redacted]
To: [redacted]
Cc: NBP Mapping
Subject: Translation RE: [redacted]
Date: 25 September 2019 15:23:37

Hi [redacted]

As discussed, a translation of [redacted] submission is set out below.

Regards.

[redacted]

Dear Sir,

I tried to look at the maps on Chrome and Firefox but they don't seem to be functioning at the moment.

I would like to point out that, despite a number of applications, I do not have access to [redacted] at my address. I understand that there is access to the surrounding area. My address is [redacted]. My EIRCODE is [redacted] I understand

that my neighbor has the same difficulty next door.

Best wishes

[redacted]

-----Original Message-----
From [redacted]
Sent: 16 September 2019 09:48
To: NBP Mapping
Subject: [redacted]

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

A dhuine uasail,
Rinne mé iarracht breathnú ar na léarscáil ar Chrome agus Firefox ach ni cosúil go bhfuil siad ag feidhmiú faoi láthair.

Is mian liom a chur in iúl nach bhfuil rochtain ar [redacted] ag mo sheoladh, in ainneoin roinnt mhaith iarratais a bheith déanta ina leith. Tuigtear dom go bhfuil fáil ar sa cheantar máguaird. Is é [redacted] mo sheoladh. Is é [redacted] mo eircód. Tuigim go bhfuil an deacracht céanna ag mo chomharsan béal dorais.

Le dea ghui
[redacted]
Sent from my iPhone

From: [redacted]
To: NBP Mapping
Subject: Broadband service
Date: 18 September 2019 21:06:25

CAUTION: This email originated from outside of the organisation. Do not click links or open attachments unless you recognise the sender and know the content is safe.

Hi,

I am writing to you in relation to broadband services in my area. I was given this email address by customer service in the national broadband service.

I have recently moved into a house in [redacted], eircode [redacted] but cannot avail of broadband service from a number of companies. I enquired in store with both Virgin media and Eir and also had an order with sky. It was when the technician for sky was out, he found that cables had not been continued from the front of the estate to the back where I am. The cables stop only meters from my house.

There are a number of houses around me which are in the same position and more soon to come. Can you give me any information as to when this service will become available?

Kind regards,
[redacted]