UK Interoperability Standards

Open Forum 2021



16th November 2021

Further Thoughts on a UK Neutral Access Network

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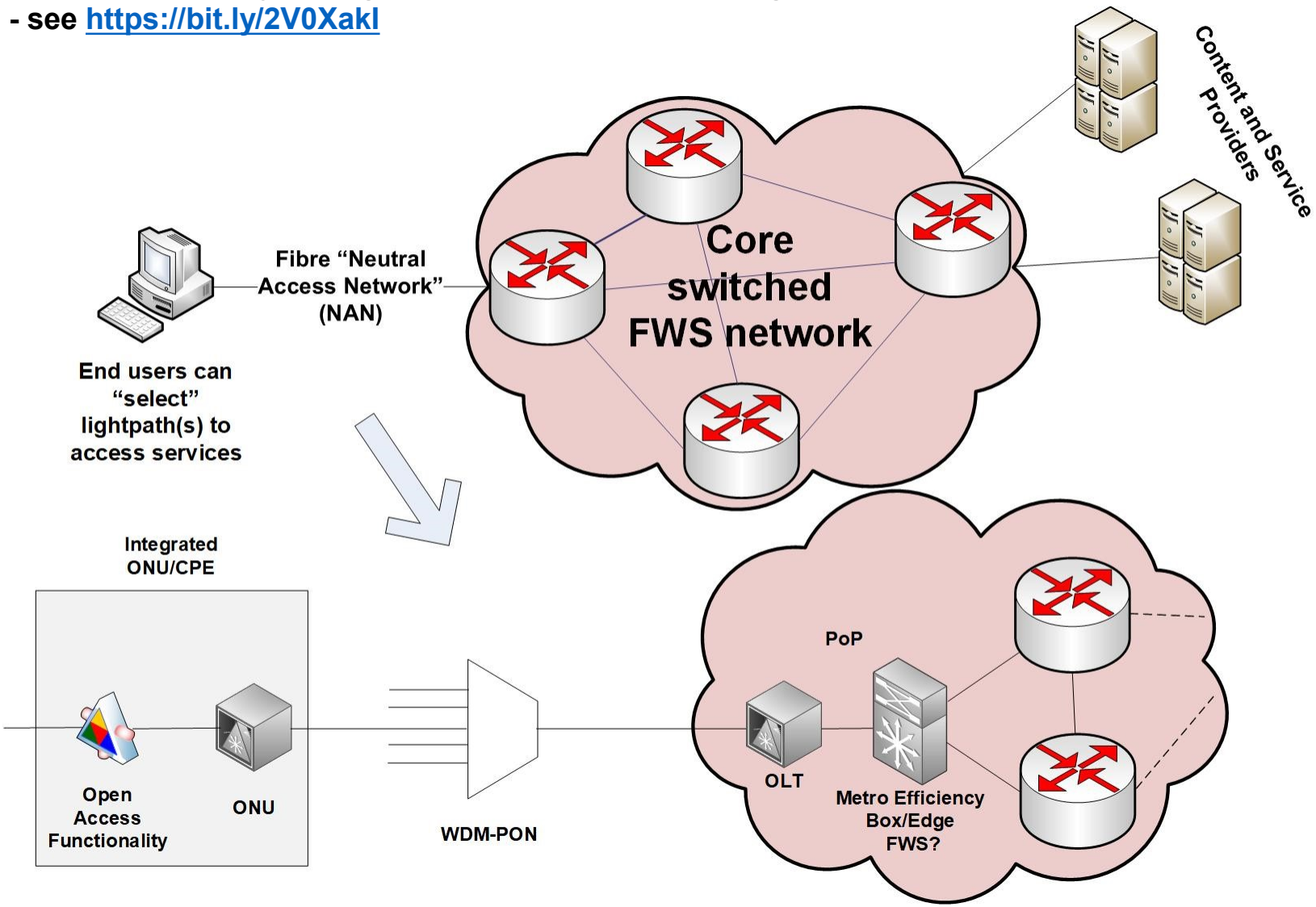
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Discussion

Part One	Where did all this come from ?
Part Two	Initial thoughts (Sep 19)
Part Three	What has changed?
Part Four	Summary and closing observations
Annex One	A note on John Harper
Annex Two	Reading list

Part One - Where did all this come from?

Innovate UK Study during Nov 2009 - March 2010 "Lightpaths on Demand" - see https://bit.ly/2V0Xakl

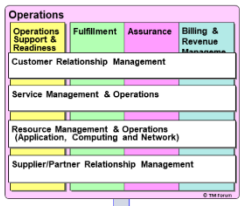


Part Two – Initial Thoughts (Sep 19)

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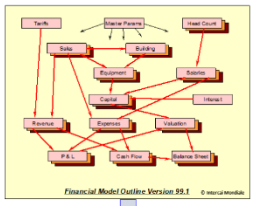
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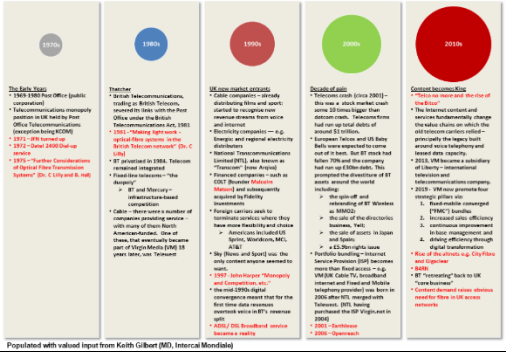
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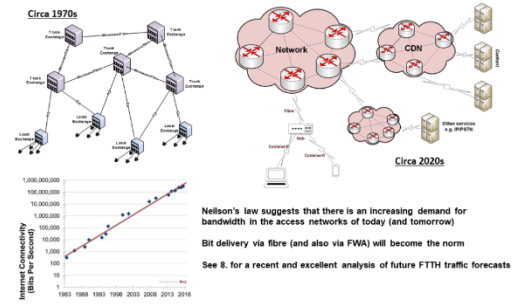
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Populated with valued input from Keith Gilbert (MD, Intercai Mondiale)

"Telco no more" and the rise of the "Bitco"

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Neilson's law suggests that there is an increasing demand for bandwidth in the access networks of today (and tomorrow)

Bit delivery via fibre (and also via FWA) will become the norm

See 8. for a recent and excellent analysis of future FTTH traffic forecasts

A snapshot of the UK Fibre access market (Aug 19)

A few of the "players" in the FTTH/B access market are identified below and, with the exception of OR, KCOM and Virgin Media, all the players consider themselves to be "Altnets." The self builds from the likes of B4RN, etc., are excluded, as are the "bigger" fibre business market players e.g. Zayo, Verizon, etc., who do not participate in this market. Compiled (mostly) with data from the excellent "ISP Review" site (see - https://www.ispreview.co.uk/)

British Fibre Networks	Gigaclear	IFNL	Truespeed
Cityfibre	G.Networks	Openreach	Virgin Media
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Fibrus	KCOM	toob	zzoomm

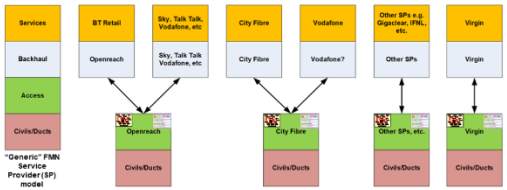
Investor Support (a sample)

Investor	Player
Amber	Community Fibre toob
Aviva Investors	Truespeed County Broadband
M&G Investments (via Infracapital)	WightFibre Gigaclear SSE Telecom (50% stake)

Observations
All players are likely to have:
1. an access component (fibre) in their offering and also the necessary backhaul to the Internet
2. a fibre installation capability
3. set up (at minimal) some form of Fulfillment, Assurance, and Billing (FAB) support systems.
4. support staff to carry out FAB activities (maybe outsourced?)
5. Have we been here before?

Our first model "Islands of Access Networks"

Based on the earlier snapshot, we constructed a simple graphical model of the service delivery chain of a generic UK fibre access SP and applied it to a representative sample of SPs in the UK.



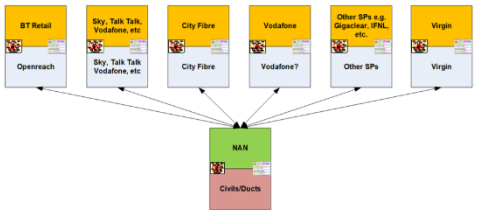
Services delivered over UK fibre networks may be delivered via:
1. an OR product
2. another SP access network e.g. VF and City Fibre
3. an integrated delivery chain e.g. Virgin Media, KCOM, and others
4. in house or cloud based BSS/OSS? (e.g. https://d1.awsstatic.com/whitepapers/next-generation-oss-with-aws.pdf?did=wp_card&trk=wp_card)

Note the FAB and Business Plan "objects" shown within the SP models are to illustrate systems and operational costs, etc., and are likely to be within the backhaul component of the model but are omitted for clarity.

Our second model

Our observations on the "Islands" model are threefold, viz:
1. We suggest that there are similarities in costs across all SPs. Note that this assumption has not been tested with financial modelling, but as any good CFO will comment in that containing and reducing costs is paramount
2. FMN further suggest that competing access infrastructures leads to "land grab" and whilst initially it offers an SP the opportunity to deliver faster internet speeds, the end user is restricted in choice as to how they "switch" – see electricity supply as a model
3. During our research[5] we investigated the concept of using WDM-PONs as a future mechanism for the delivery of services on a wavelength basis. This could be implemented with current access network structures, but once again there is potentially duplications of costs and systems.

This led us to consider the "Neutral Access Network (NAN)" and is our second model – see below.



Our second model (cont...)

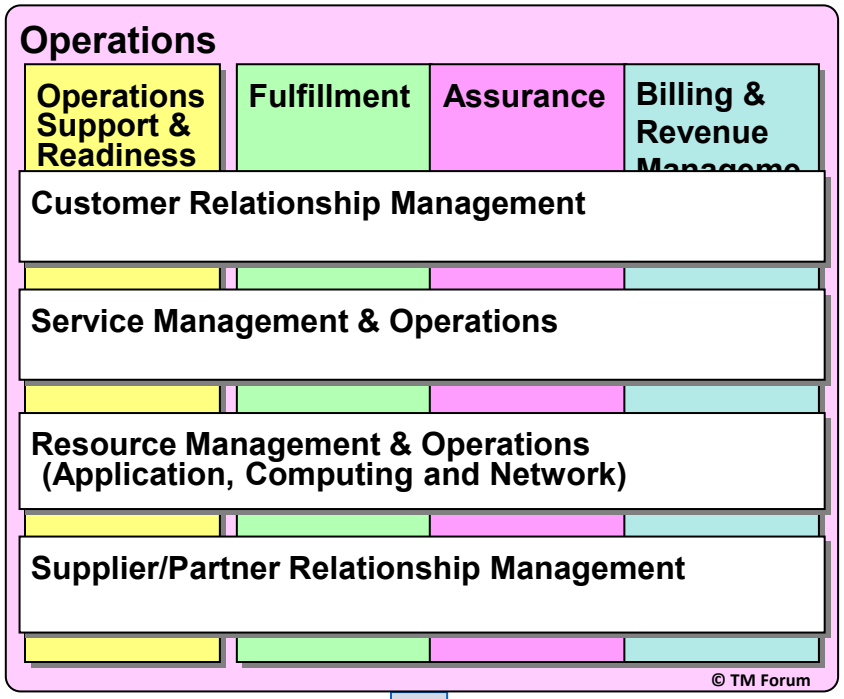
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1. Fundamentally, the NAN's aim is to reduce costs for all UK SPs with a secondary benefit of enabling users to switch SPs (subject to contractual agreements) as required. As a precursor, the cost reductions suggested could be initially tested by high level financial modelling.
2. Historically, our model is not new and in fact the Earthlease proposition suggested something similar to the NAN in the early 2000s (albeit for the copper network).
3. We are suggesting that the NAN is owned by a consortium that includes all UK SPs and investors – this approach is based upon John Harper's review of the UK telecoms industry in 1997 – see Reference 1, but a brief summary is introduced within Annex One. Most importantly, the articles of incorporation for the proposed consortium would not allow take over by another body (and maybe a "golden share" owned by the UK government is one such mechanism to ensure this). In memory of John Harper, we refer to any such proposed NAN consortium as the "Harper" model.
4. The NAN concept has been subject to considerable research and whilst we are not aware of an actual implementation that mirrors the UK market, Alessandro Bogliolo[2] describes an excellent introduction to the possible mechanics, etc. More detailed discussions and agreements would be needed to progress, etc.
5. The regulatory regime could be "lightened" as OR and other UK SPs would be "incorporated" into one organisation and hence the regulatory regime would no longer be focussed on the SMP of OR.
6. Further cost reductions by lightening of the "bit" tax load (see Part Three).
7. Fibre "Backhaul" would continue to be a competitive market?
8. Civil work would be co-ordinated with a "one dig" mantra.

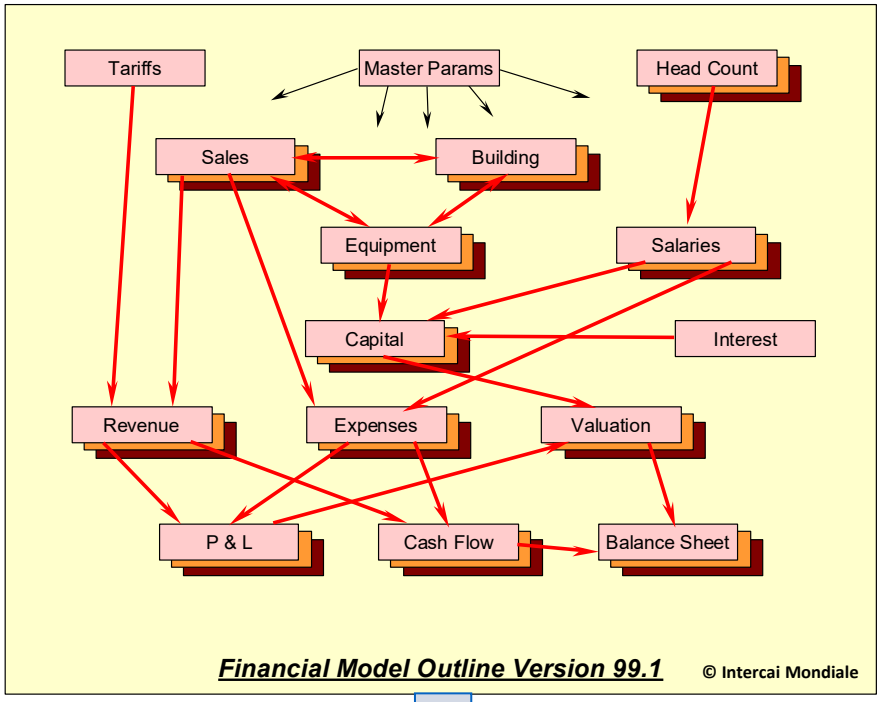
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The Early Years

- 1969-1980 Post Office (public corporation)
- Telecommunications monopoly position in UK held by Post Office Telecommunications (exception being KCOM)
- 1971 – JFN turned up
- 1972 – Datel 2400 Dial-up service
- 1975 – "Further Considerations of Optical Fibre Transmission Systems" (Dr. C Lilly and B. Hall)



Thatcher

- British Telecommunications, trading as British Telecom, severed its links with the Post Office under the British Telecommunications Act, 1981
- 1981 - "Making light work - optical-fibre systems in the British Telecom network" (Dr. C Lilly)
- BT privatised in 1984. Telecom remained integrated
- Fixed-line telecoms – "the duopoly"
  - BT and Mercury – infrastructure-based competition
- Cable – there were a number of companies providing service – with many of them North American-funded. One of these, that eventually became part of Virgin Media (VM) 18 years later, was Telewest



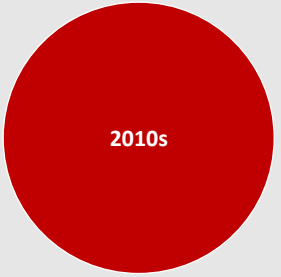
UK new market entrants

- Cable companies – already distributing films and sport; started to recognise new revenue streams from voice and internet
- Electricity companies — e.g. Energis; and regional electricity distributors
- National Transcommunications Limited (NTL), also known as "Transcom" (now Arqiva)
- Financed companies – such as COLT (founder Malcolm Matson) and subsequently acquired by Fidelity Investments
- Foreign carriers seek to terminate services where they have more flexibility and choice
  - Americans included US Sprint, Worldcom, MCI, AT&T
- Sky (News and Sport) was the only content anyone seemed to want.
- 1997 - John Harper "Monopoly and Competition, etc."
- the mid-1990s digital convergence meant that for the first time data revenues overtook voice in BT's revenue split
- ADSL/ DSL Broadband service became a reality



Decade of pain

- Telecoms crash (circa 2001) – this was a stock market crash some 10 times bigger than dotcom crash. Telecoms firms had run up total debts of around $1 trillion.
- European Telcos and US Baby Bells were expected to come out of it best. But BT stock had fallen 70% and the company had run up £30bn debt. This prompted the divestiture of BT assets around the world including:
  - the spin-off and rebranding of BT Wireless as MMO2;
  - the sale of the directories business, Yell;
  - the sale of assets in Japan and Spain;
  - a £5.9bn rights issue
- Portfolio bundling – Internet Service Provision (ISP) becomes more than fixed access – e.g. VM (UK Cable TV, broadband internet and Fixed and Mobile telephony provider) was born in 2006 after NTL merged with Telewest. (NTL having purchased the ISP Virgin.net in 2004)
- 2001 – Earthlease
- 2006 – Openreach



Content becomes King

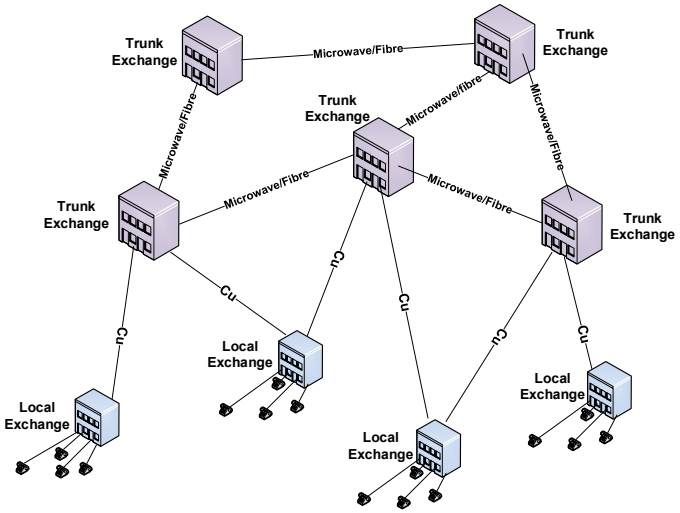
- "Telco no more and the rise of the Bitco"
- The Internet content and services fundamentally change the value chains on which the old telecom carriers relied – principally the legacy built around voice telephony and leased data capacity.
- 2013, VM became a subsidiary of Liberty – international television and telecommunications company.
- 2019 - VM now promote four strategic pillars viz:
  1. fixed-mobile converged ("FMC") bundles
  2. increased sales efficiency
  3. continuous improvement in base management and
  4. driving efficiency through digital transformation
- Rise of the altnets e.g. City Fibre and Gigaclear
- B4RN
- BT "retreating" back to UK "core business"
- Content demand raises obvious need for fibre in UK access networks

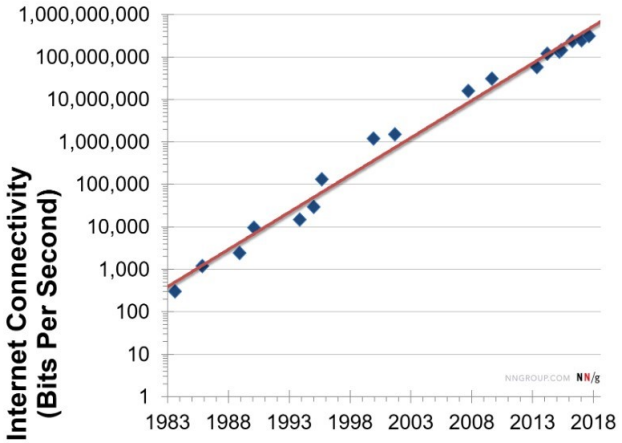
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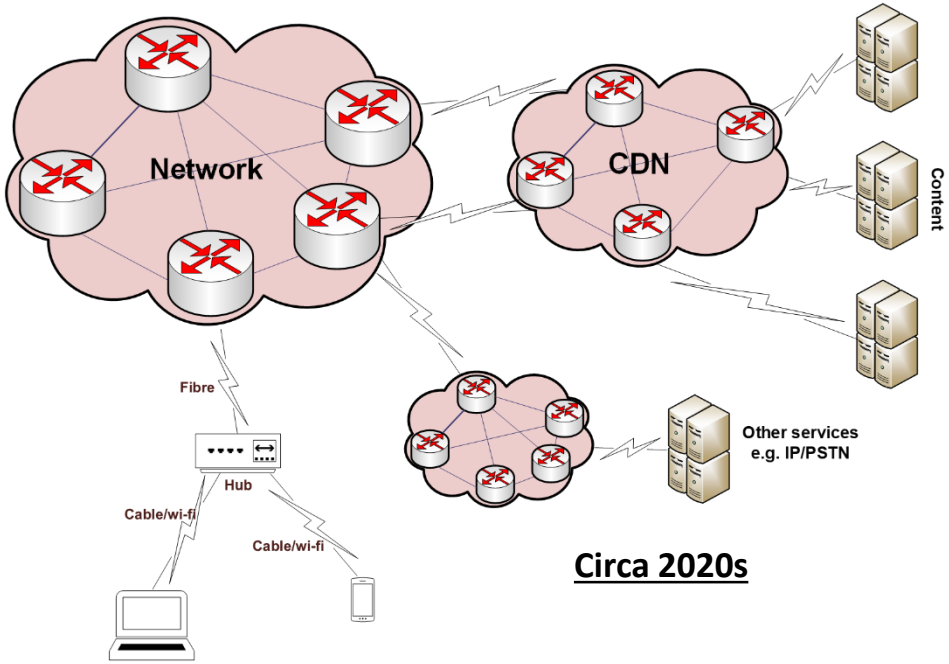
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Circa 1970s







Circa 2020s

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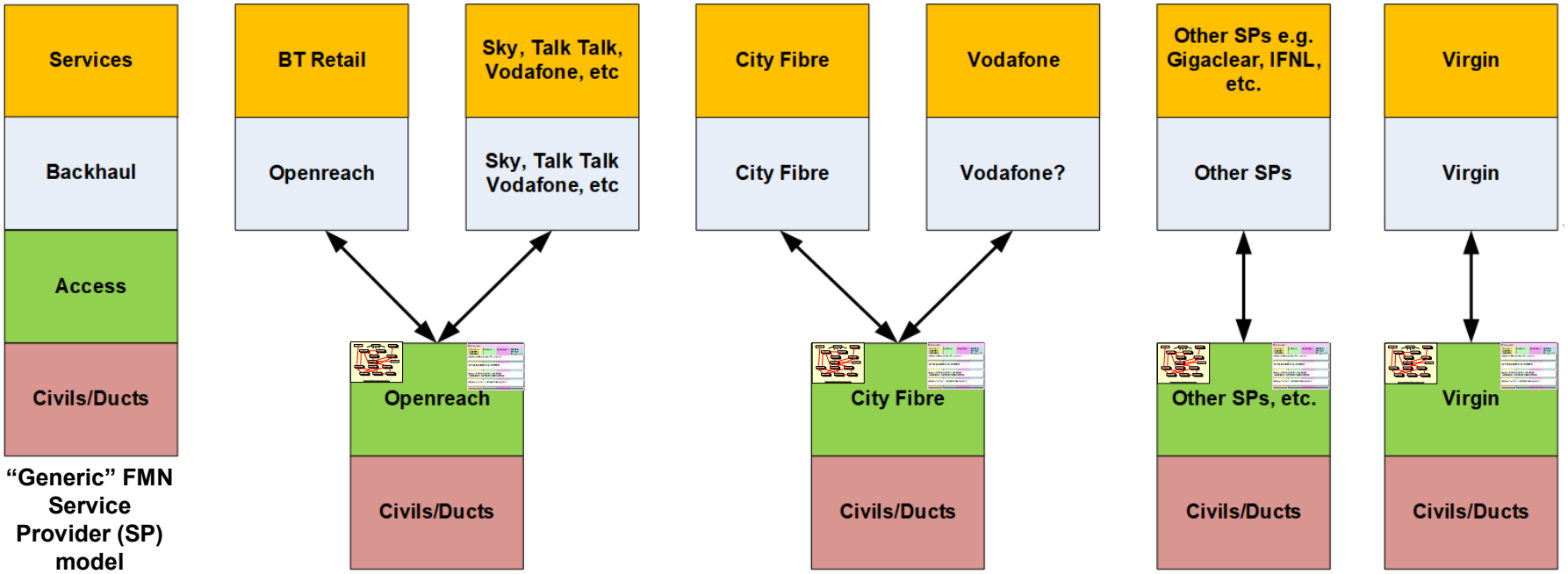
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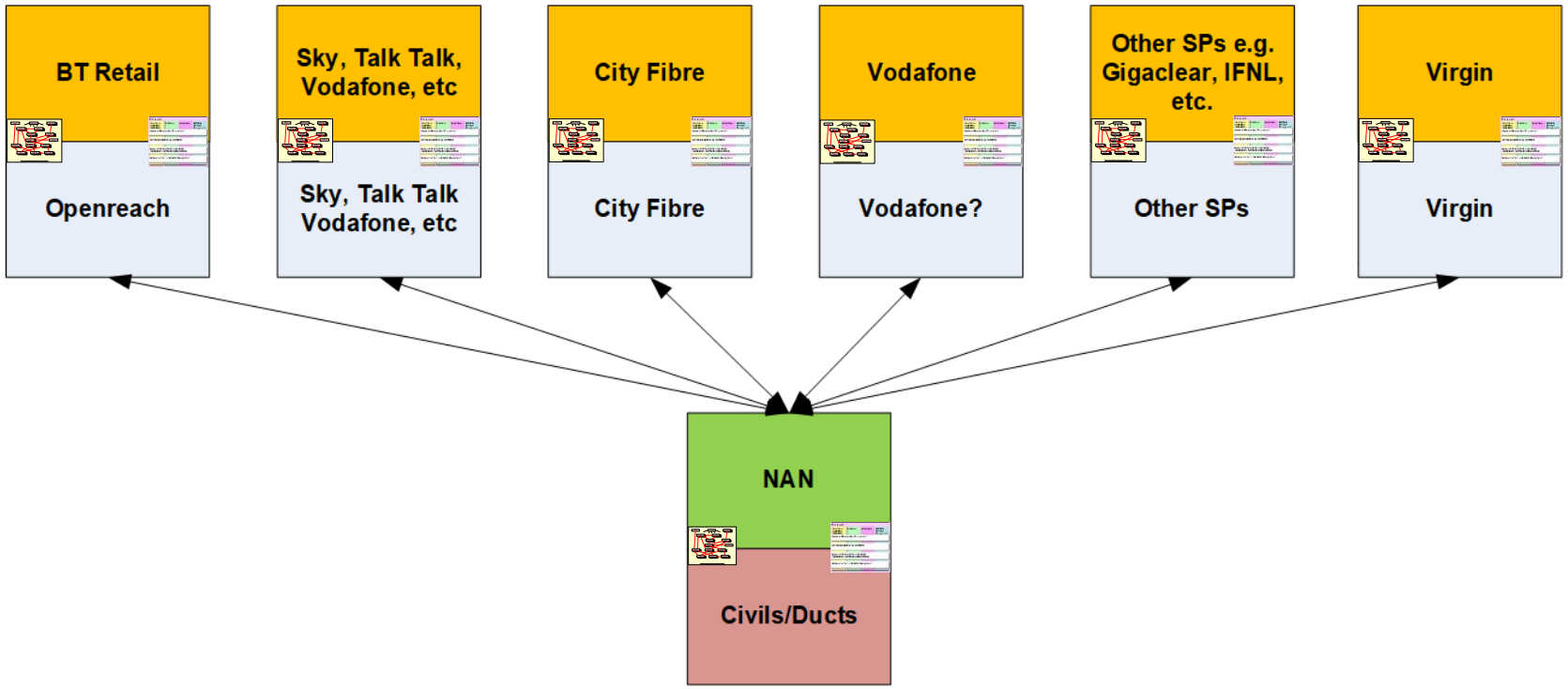
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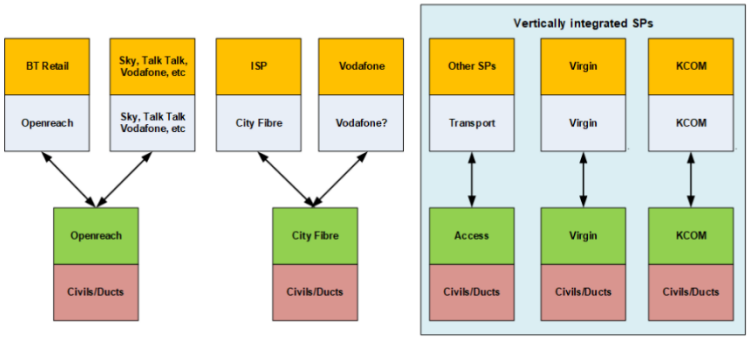
7. **Fibre "Backhaul" would continue to be a competitive market?**

8. **Civil work would be co-ordinated with a "one dig" mantra.**

Part Three – What has changed?

Note on the role of NICC in the ongoing support of UK fibre providers

As a general comment, retail "services" are provided over a wholesale network be it from wholesale network providers, or "vertically integrated."



NICC has a role to play here i.e. supporting the development of "open interfaces" to enable interoperability between (as examples):

1. VF and City Fibre
2. an integrated delivery chain e.g. Virgin Media, KCOM, and others

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A snapshot of the UK Fibre consumer market (Sep 21)

Explosive growth…. Samples again compiled with data from the excellent ISP Review at https://www.ispreview.co.uk/). See also timely analysis from Point Topic (Figure 3.) at https://point-topic.com/free-analysis/superfast-ultrafast-broadband-deployments-uk/

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Lit Fibre	YouFibre	Swish Fibre	Lightning Fibre
B4RK	Broadway Partners	Full Fibre	BT Broadband
Hampstead Fibre	BeFibre	B4RN	Jurassic Fibre
FibreNest (Persimmon)	Ogi	Freedom Fibre	Airband

Have we been here before? "Land Grab" and cable network consolidation (see "Decade of Pain").

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"Thar's Gold in Them Thar Hills" (Oct 21)

Observations:

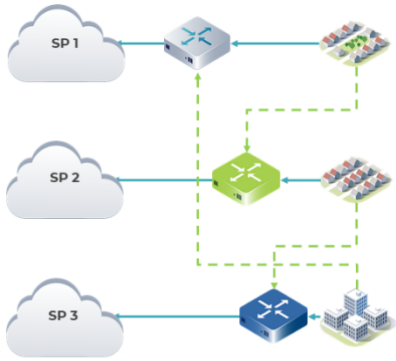
1. The market is a mix of wholesale, retail, and vertically integrated operators
2. Some "big" infrastructure players are now "playing" – why?
3. Is fibre infrastructure now an asset class? - https://bit.ly/3uqiQV0

Initial/Current Fund	Operator	Model (W, R)
Albion Capital	Grain	R
Amber (via The National Digital Infrastructure Fund NDIF)	Toob Nextgenaccess (Dark Fibre)	R W
Antin Infrastructure Partners/West Street Infrastructure Partners	Cityfibre	W
Aviva Investors	ITS Technology Group Truespeed County Broadband	W R R
Basalt Infrastructure Partners	Full Fibre	W
BT Group Plc (and maybe others????)	Openreach	W
Cube Infrastructure	G.Network Trooli	R R
Downing LLP	Broadway Partners	R
Fern Trading	Giganet Jurassic Swish	R R W
ING Bank	Zzooom	R
KKR	Hyperoptic	R
Liberty Global	VM/O2	R
Macquarie Capital	KCOM	R
M&G investments (via Infracapital)	Wightfibre Gigaclear Neos Fibrus Spectrum	R R N/A R R
Toscafund	Talk Talk (and Freedom Fibre?)	R
Warburg Pincus	Community Fibre	R

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What if the customer wants to switch to another SP?

The delivery of fibre networks by SPs entails considerable engineering effort (cost) with the "prize" being the delivery to new customers (who may have been served by copper in the past). As a general observation in that once fibre connectivity is delivered to a customer, by and large, the customer is "stuck" with the fibre delivery SP. Currently, some customers do have the ability to change SPs with (relative) ease i.e. those customers who are supplied via a wholesale infrastructure provider who "offer" multiple SPs. Even so, it may be that the reason customers wish to change suppliers is because of the underlying wholesale infrastructure.



More recently, Ofcom have mandated that "Consumer Switching & Number Porting" via the One Touch Switch' Process (formerly EECC Fixed Line Switching and Porting)" is to be implemented – see https://www.ofcom.org.uk/news-centre/2021/easier-than-ever-to-switch

Ofcom has subsequently requested the Office of the Telecommunications Adjudicator (OTA) to manage this process – see http://www.offta.org.uk/latest-news/telecommunications-adjudicator-update-for-october-2021

Target for implementation is April 2023

NICC has "potentially" has a technical interest in the aforementioned OTA process, particularly within the Switching Design workstream

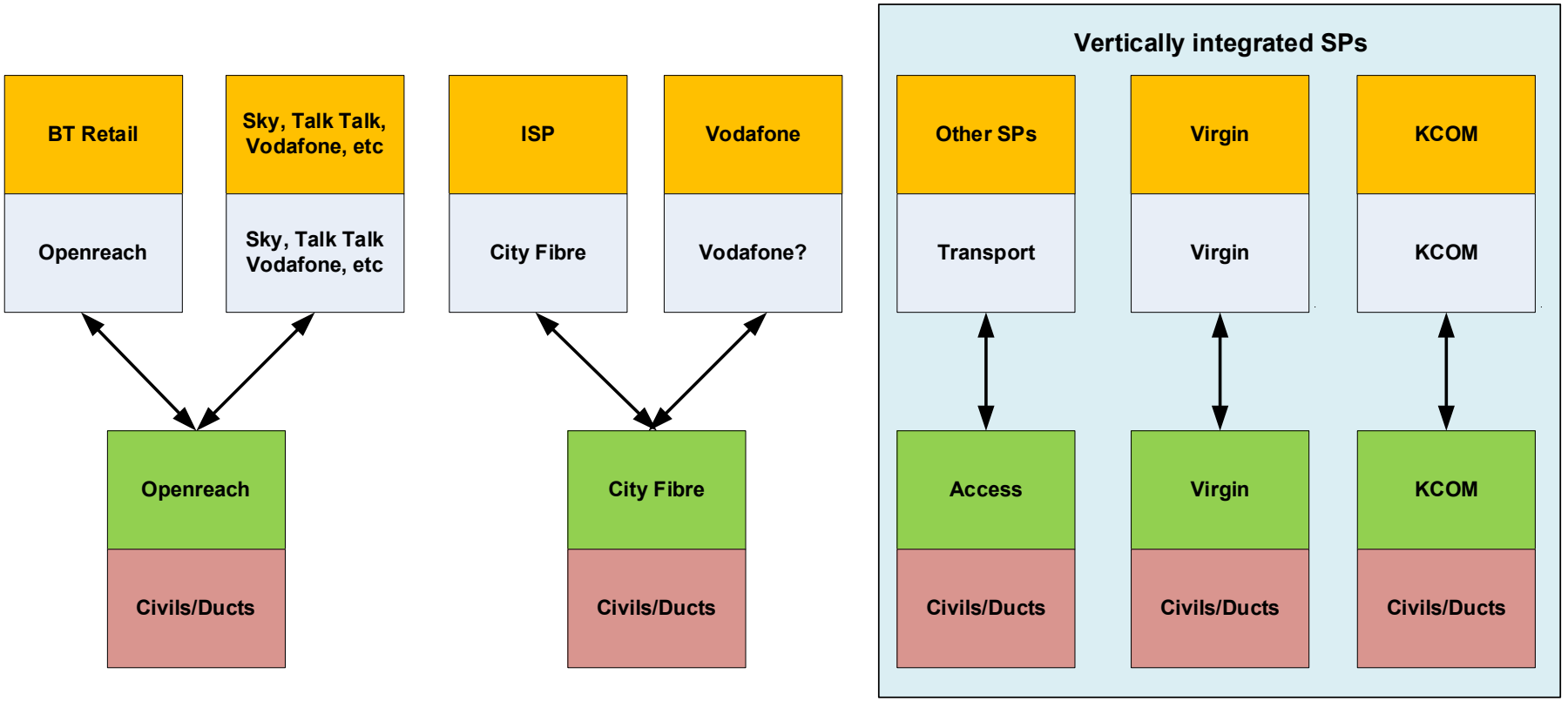
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British Fibre Networks ??	Gigaclear	IFNL/OFNL	Truespeed
Cityfibre	G.Network	Openreach	Virgin Media/O2
Community Fibre	Grain	Sky	VX Fiber (UK)
County Broadband	Hyperoptic	Talk Talk	Wightfibre
Fibrus	KCOM	toob	Zzoomm
Trooli	Upp	Glide	ITS
People's Fibre	Wessex Internet	The 4th Utility	Axione (UK)
Lit Fibre	YouFibre	Swish Fibre	Lightning Fibre
B4RK	Broadway Partners	Full Fibre	BT Broadband
Hampstead Fibre	BeFibre	B4RN	Jurassic Fibre
FibreNest (Persimmon)	Ogi	Freedom Fibre	Airband

Have we been here before? "Land Grab" and cable network consolidation (see "Decade of Pain").

"Thar's Gold in Them Thar Hills" (Oct 21)

Open Forum

UK Interoperability Standards

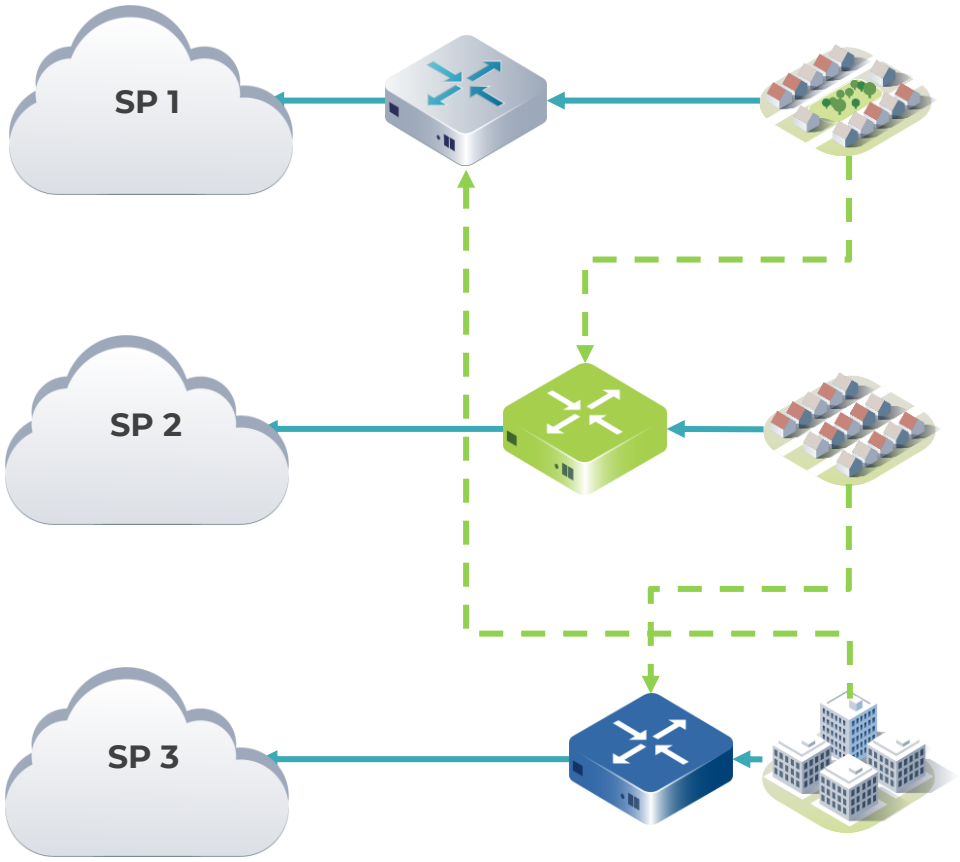
Observations:

1. **The market is a mix of wholesale, retail, and vertically integrated operators**
2. **Some "big" infrastructure players are now "playing" – why?**
3. **Is fibre infrastructure now an asset class? - https://bit.ly/3uqiQV0**

Initial/Current Fund	Operator	Model (W, R)
Albion Capital	Grain	R
Amber (via The National Digital Infrastructure Fund NDIF)	Toob Nextgenaccess (Dark Fibre)	R W
Antin Infrastructure Partners/West Street Infrastructure Partners	Cityfibre	W
Aviva Investors	ITS Technology Group Truespeed County Broadband	W R R
Basalt Infrastructure Partners	Full Fibre	W
BT Group Plc (and maybe others????)	Openreach	W
Cube Infrastructure	G.Network Trooli	R R
Downing LLP	Broadway Partners	R
Fern Trading	Giganet Jurassic Swish	R R W
ING Bank	Zzooom	R
KKR	Hyperoptic	R
Liberty Global	VM/O2	R
Macquarie Capital	KCOM	R
M&G investments (via Infracapital)	Wightfibre Gigaclear Neos Fibrus Spectrum	R R N/A R R
Toscafund	Talk Talk (and Freedom Fibre?)	R
Warburg Pincus	Community Fibre	R

What if the customer wants to switch to another SP?

The delivery of fibre networks by SPs entails considerable engineering effort (cost) with the "prize" being the delivery to new customers (who may have been served by copper in the past). As a general observation in that once fibre connectivity is delivered to a customer, by and large, the customer is "stuck" with the fibre delivery SP. Currently, some customers do have the ability to change SPs with (relative) ease i.e. those customers who are supplied via a wholesale infrastructure provider who "offer" multiple SPs. Even so, it may be that the reason customers wish to change suppliers is because of the underlying wholesale infrastructure?



More recently, Ofcom have mandated that "Consumer Switching & Number Porting" via the One Touch Switch' Process (formerly EECC Fixed Line Switching and Porting)" is to be implemented – see https://www.ofcom.org.uk/news-centre/2021/easier-than-ever-to-switch

Ofcom has subsequently requested the Office of the Telecommunications Adjudicator (OTA) to manage this process – see http://www.offta.org.uk/latest-news/telecommunications-adjudicator-update-for-october-2021

Target for implementation is April 2023

NICC may have a technical interest in the aforementioned OTA process, particularly within the Switching Design workstream

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Part Four - Summary and closing observations

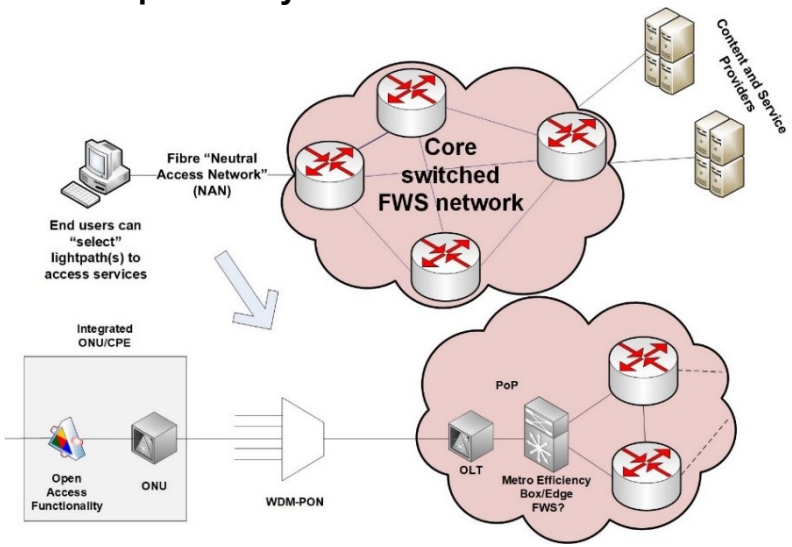
1. **The UK fibre market is experiencing spectacular growth and consists of a mixture of wholesale and vertically integrated providers. Some the newer providers are heavily "backed" by major financial institutions with incumbents such as Openreach recently announcing aggressive rollout plans. There is evidence of overbuild in some areas and we would further suggest that a number of the smaller SPs will be "absorbed" by the larger providers (who will be acquiring an enhanced customer base and reducing support costs – this is a modelling exercise for the future).**

2. **Mainly for info, but a Government consultation on the "bit tax has recently closed" (see https://www.gov.uk/government/consultations/business-rates-revaluation-2023-the-central-rating-list/business-rates-revaluation-2023-the-central-rating-list). The general principal is that if you lay fibre and "light it" business rates will apply (from 2023).**

3. **Consumers switching/changing providers is likely to be a major challenge for the industry. Is there a supporting financial model for providing multiple "competing" infrastructures into a customer?**

4. **Is one future model a few number of wholesale providers with "virtual" retail providers (cloud based?)**

5. **Or, does the NAN solve all the issues previously identified?**



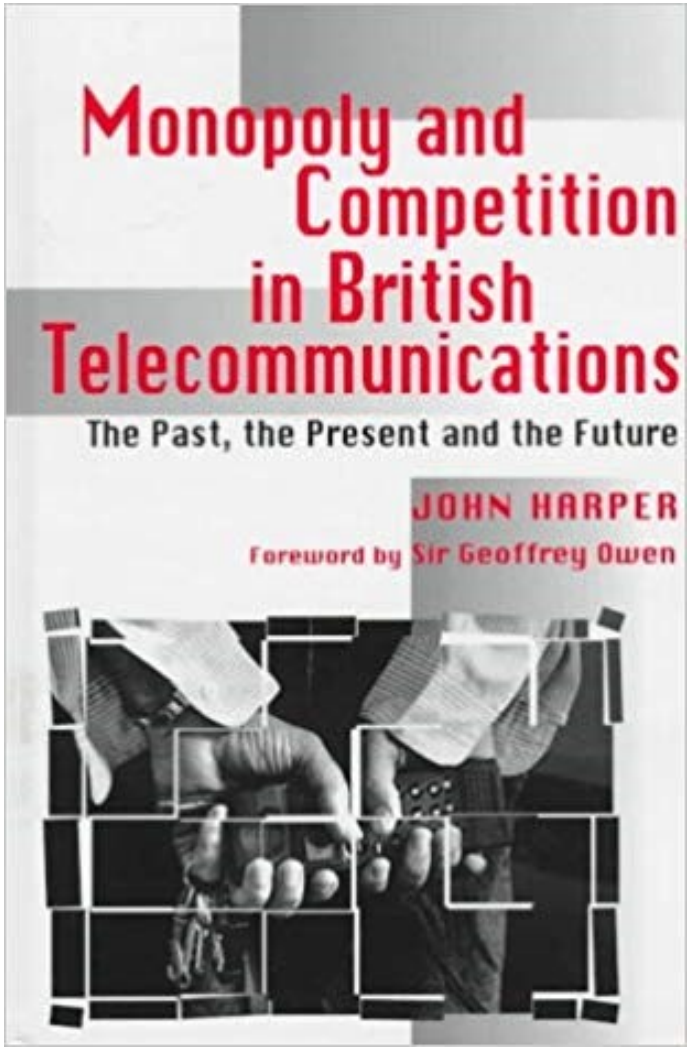
Annex One – A note on John Harper

John Harper - was MD of Inland Networks for BT and, in 1997, authored "Monopoly and Competition in British Telecommunications, the Past, the Present, and the Future."

Harper was known for his forthright opinions and, as an example, within Chapter 20 - "A better model", he identifies a structure for a future UK telecoms industry – these being:

1. **The creation and retailing of public telecommunication services, the provision and operation of the main infrastructure of the main inland public service and the provision of private telecommunications facilities should henceforth be treated as three completely distinct sectors of the industry.**
2. **In the retail public services sector unregulated companies in competition with one another should create and retail all services. Including the provision of the final drop to connect individual customers to the network infrastructure.**
3. **In continental countries the public network infrastructure should remain unified. In Britain it should be progressively unified.**
4. **There should in future be a single organisation in each country responsible for this unified public infrastructure, which is subject to national regulation.**
5. **<u>This public network organization should be owned by a group of the principal telecommunications public service retailers on a co-operative or consortium basis, with no provision for outside shareholders to hold equity shares in it.</u>**
6. **The private services and facilities sector should be thrown open to full unregulated competition by local and international firms.**

Point 5. underpins our "Harper model."



Annex Two – Reading list

1. Monopoly and Competition in British Telecommunications The Past, the Present and the Future: John Harper, 1997, Pinter.

2. Introducing Neutral Access Networks*:* Alessandro Bogliolo, 2009, IEEE Next Generation Internet Networks Conf.

3. Switching and service delivery in futuristic networks: John Buckley, 1983, BT Technology Journal Vol 11 No. 4. – see https://bit.ly/37zIMTo

4. Just Deliver the Bits: David Isenberg and John Nolan, 2010, Journal of the ITP, Vol 4 Part 1. – see https://bit.ly/36SkoMp

5. Fiber to the Home White Paper: Paul Green 2003 – see https://bit.ly/3xHkcL5

6. Internet Economics: McKnight and Bailey, 1997, MIT Press.

7. Regulatory Creep and Regulatory Withdrawal: Cubbin and Currie, 2002 - https://bit.ly/3CGIt7E

8. Meeting the Traffic Requirements of Residential Users in the Next Decade with Current FTTH Standards: Hernandez, et al. IEEE Communications Magazine, June 2019.

9. A 10 Point Plan for a better Openreach: Sky, et al, 2016 – see https://bit.ly/3iBKz0t

10. The potential for wavelength switching to provide virtual structured cabling across the UK: First Mile Networks, 2010 – see https://bit.ly/2V0XakI

11. Patterns in Network Architecture: John Day, 2008, Prentice Hall.

12. Andrew Odlyzko: Papers on Communication Networks and Related Topics – see http://www.dtc.umn.edu/~odlyzko/doc/networks.html

13. Optical Fibre Systems (Chapter 8): Dr. Chris J. Lilly, British Telecom Jan 1981 – see https://bit.ly/3zUDePh

Thank You