Fibre in access: a necessary revolution?

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"...It is the entire innovation process, not just its inventive component, that most distinguishes the market economies from all other known economic systems"

William J Baumol

Outline

- FTTH today: the status quo and market forecasts
- Drivers and business relevance
- Disruptions
- Impact on society
- Conclusion

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Background and way forward

- FTTH has been around the corner for many years but never commercially materialised (other than in Japan)
- Several cycles of technology have progressed based on similar concepts until the present days
  - Three technology now dominates B-PON, G-PON, E-PON (GE-PON)
- Is the infrastructure safe to support network evolution and long term bandwidth demand?
- What is the socio-economic impact onto a economic area that cannot benefit from a broadband enabling infrastructure?

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Current PON Technologies

A variety of PON technologies / standards have emerged.

Characteristic	B-PON	G-PON	E-PON
Standard	ITU-T G.983.x	ITU-T G.984.x	IEEE 802.3ah
Reach (km)	20	20 (60)	20
Subscribers per OLT port	32	64	16
Downstream Line Rate (Mbit/s)	155, 622	1244, 2488	1244
Upstream Line Rate (Mbit/s)	155, 622	155, 622, 1244, 2488	1244
Layer 2 protocol	ATM	ATM or GEM	Ethernet

- **Full Service Access Network (FSAN) committee defined A-PON**
- **ITU-T endorsed A-PON as G.983.x**
- **A-PON enhanced and renamed to B-PON**
- **FSAN proposed a higher-speed PON technology: G-PON**
- **ITU-T endorsed G-PON as G.984.x**
- **Ethernet First Mile Alliance (EFMA) and IEEE 802.3ah study group proposed an alternative PON technology based on Ethernet: E-PON**

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Today's snapshot

- The PON market is finally taking off
- Japan is the first and largest market for PON
- The RBOCs (USA) are now expected to deploy PONs in volume
- Europe remains a relatively small market for PON deployments
- BPON is currently the dominant technology, but is expected to be replaced by GPON and EPON in the future

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Market Drivers and Inhibitors

A variety of factors are driving and inhibiting the growth of PONs.

Drivers:

- Video services
- Long loop lengths (e.g USA)
- High subscriber density (e.g. MTUs)
- Positive regulatory framework (e.g. Japan & USA)
- Lower cost than p2p fibre solutions (shared fibre, passive components & reduced number of CO ports)
- Greenfield residential/business sites
- 3G mobile network backhaul

Inhibitors:

- Negative regulatory framework (e.g. Europe)
- High cost (equipment & fibre installation) compared to DSL
- Advances in DSL technologies (G.SHDSL, ADSL2 & VDSL)
- Questions on long term scalability
- Uncertainty about future service and bandwidth needs

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FTTP - The triple play

Application		Bandwidth
2xHDTV	2x20 Mb/s	40 Mb/s
2xSDTV	2x2 Mb/s	4 Mb/s
CD quality audio	200 Kb/s	0.2 Mb/s
Phone	100 Kb/s	0.1 Mb/s
Web surfing	10 Mb/s	10 Mb/s
		~55 Mbs

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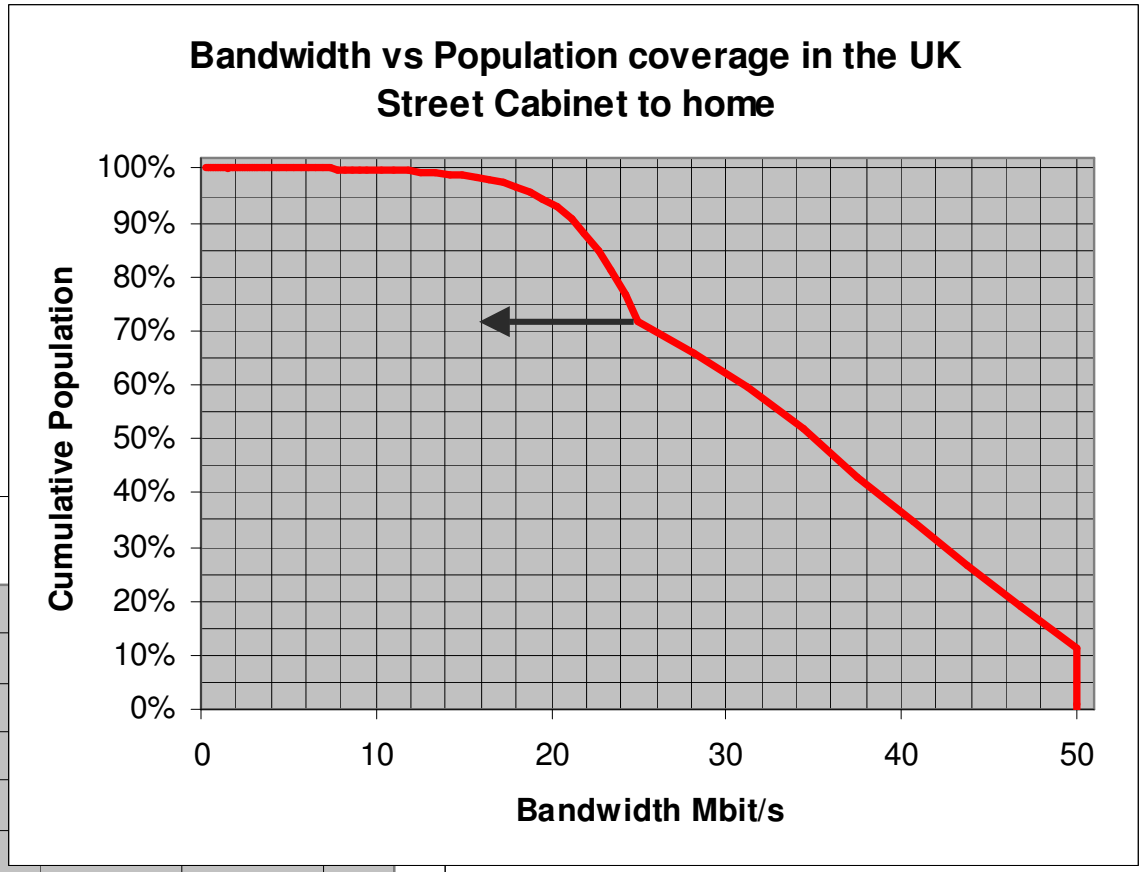
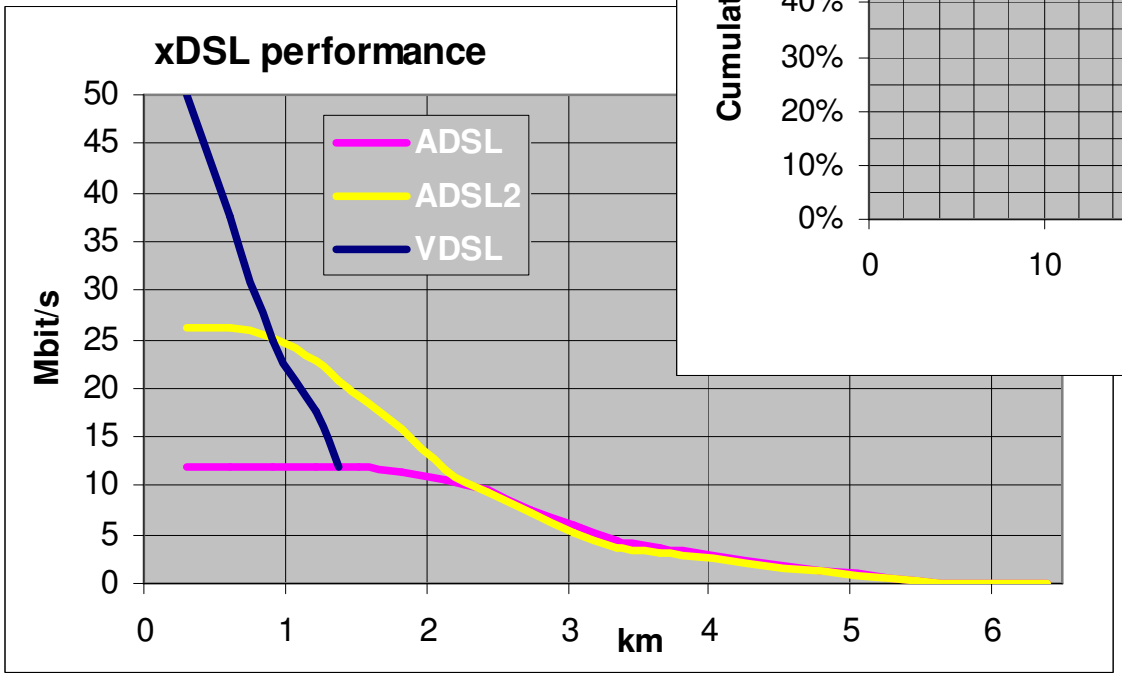
Existing Access

Copper limits ~25 Mb/s





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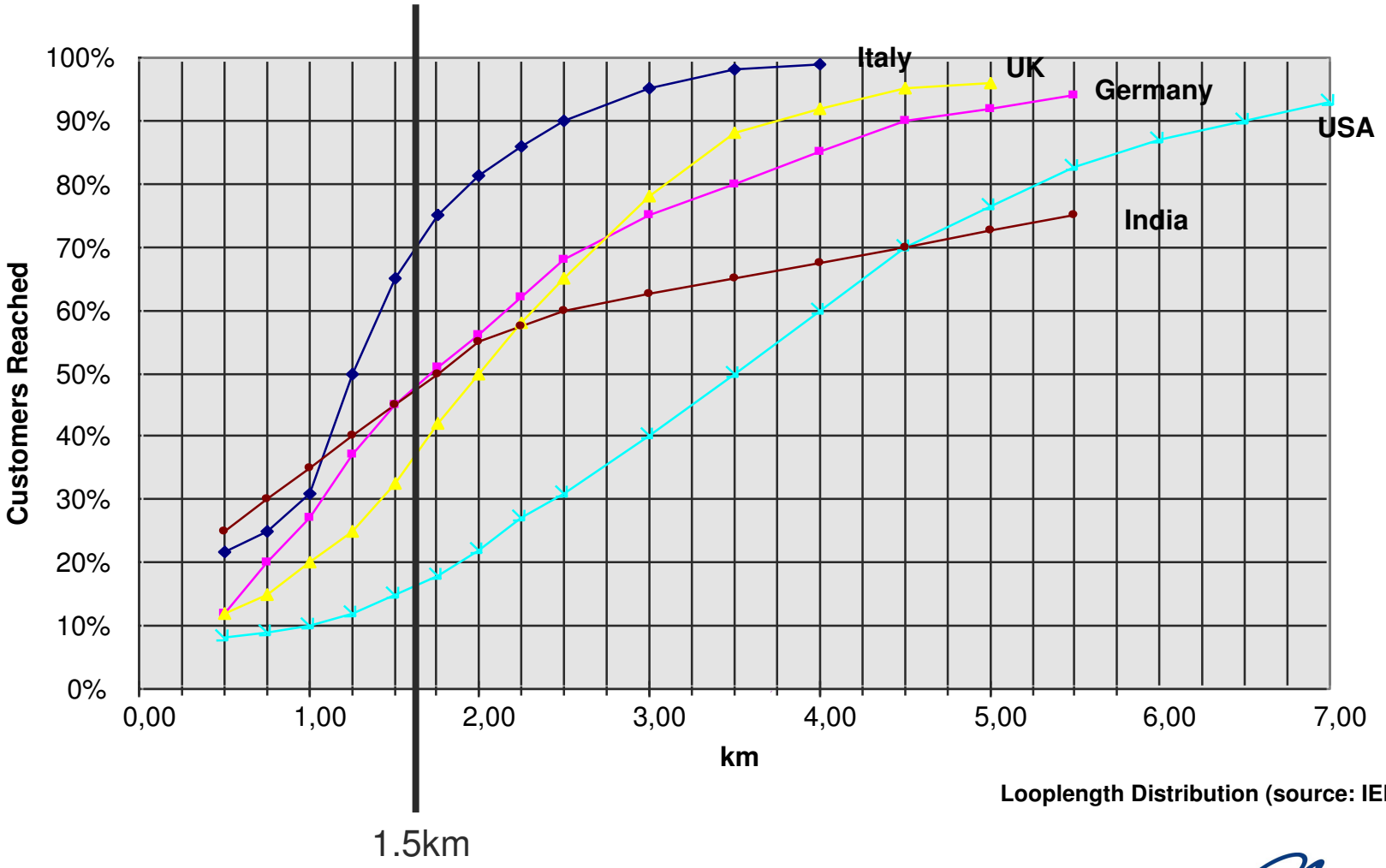
Loop length distributions



Looplength Distribution (source: IEEE)

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Examining the USA scenario

The Sanford Bernstein & Co. - Telcordia report

- With the technical support of Telecordia, Sanford C. Bernstein & Co. conducted a long term analysis on the impact of network modernisation (or lack of) onto the long term business value of the RBOCs.

- The model identified the legacy copper access network and its unavoidable burden onto OPEX as the major threat to the long term future of the RBOCs.

- The results concluded that only an agressive Fiber to Home deployment starting from 2005 could help maintaining the RBOCs historic operating profit growth rates as required by the investors.

- The report is free at: http://www.telcordia.com/products/fttp/bernstein_report.html

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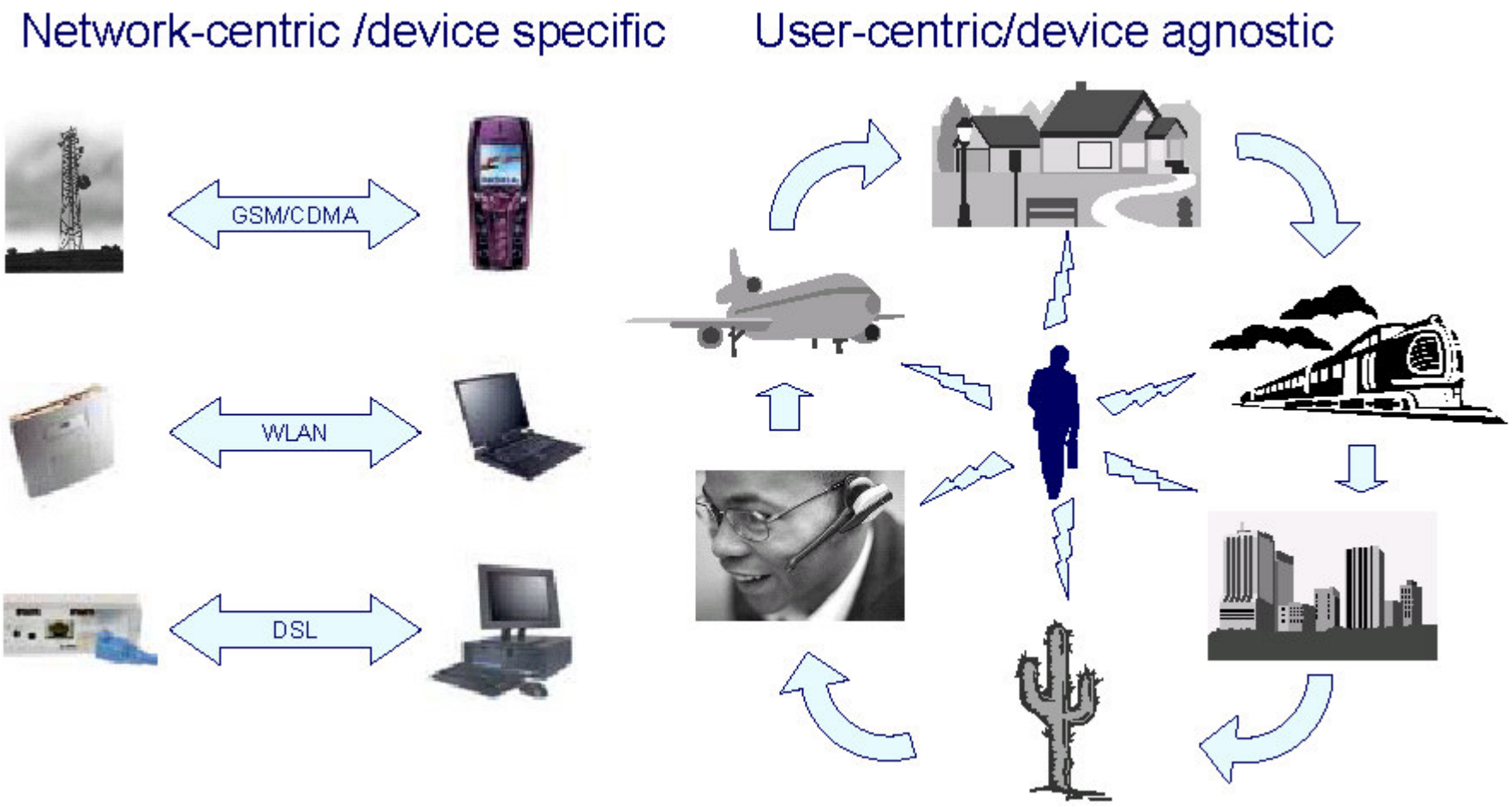
Key trend - focus moving to the end user

Computers are flexible and universal devices and they talk IP



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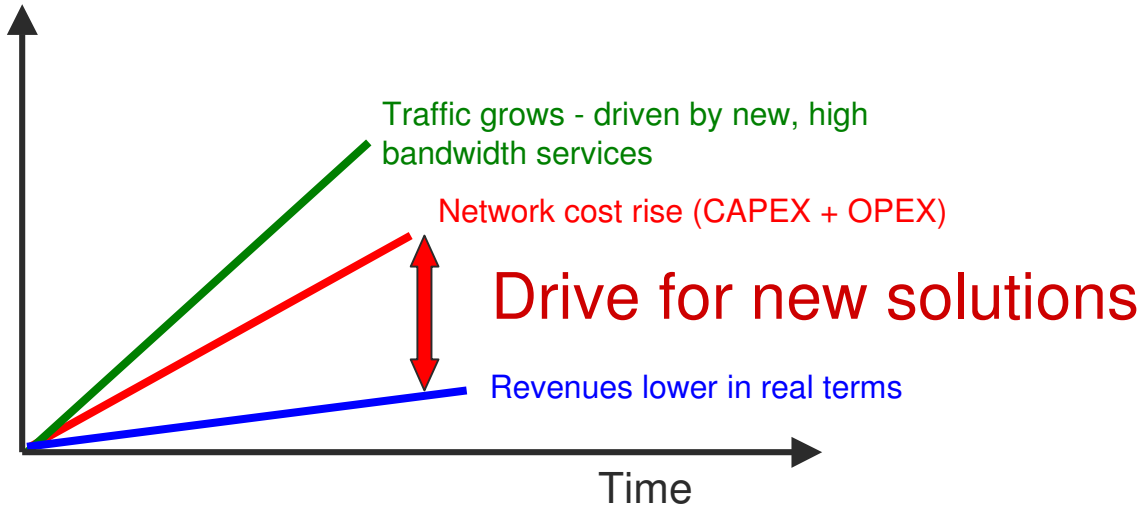
Revenues and bandwdith

- Greater bandwdith means increased revenues
- But cost is rising faster
- Margins reduce as “conventional networks” become uneconomic



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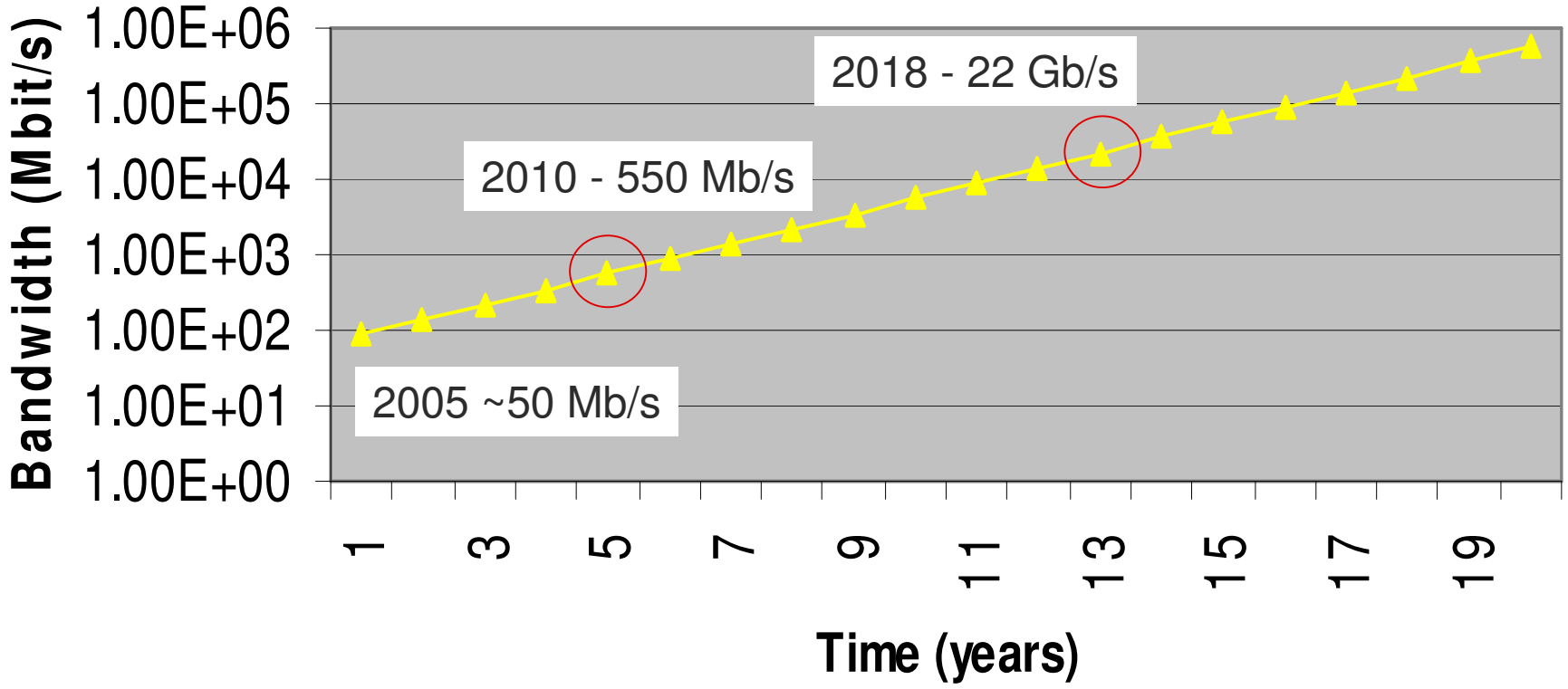
Bandwidth ratio to Moore's Law...



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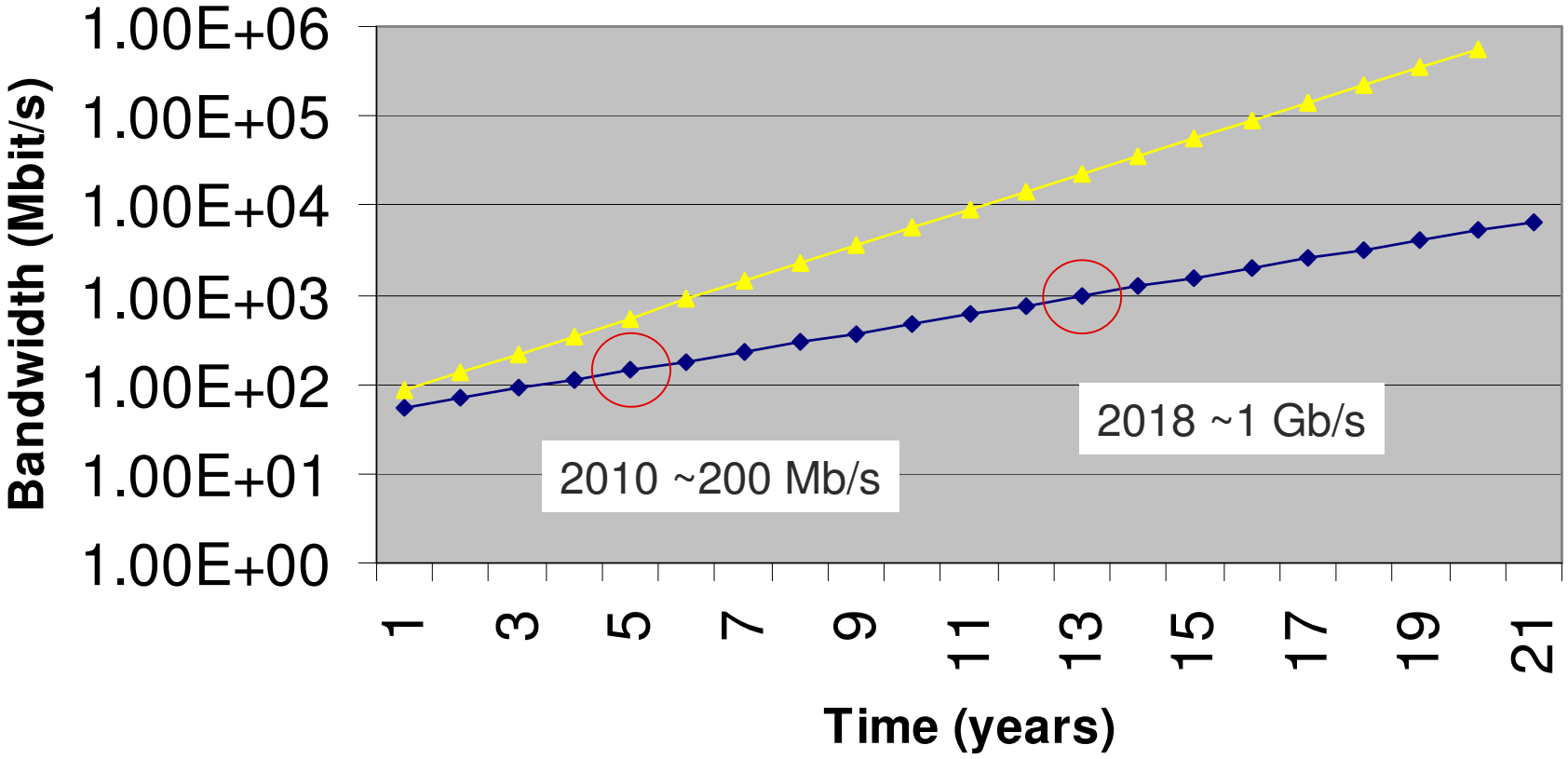
...including compression techniques



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Is 2.5Gb among 32-128 users enough?

- This equates to 20-80Mb/s average bandwidth and it is not too dissimilar from what could be done on copper (despite the peak bandwidth difference)

- Given that we are talking today of 50-100 Mb/s per user, is the assumption of 1Gb/s per user a too daring scenario for the year 2020?

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A logical consequence: spectrally efficient PONs

Let's assume that:

- No perceived difference for mobile and fixed services
- Networks cost of ownership must reduce over time

Then

- More bandwidth and less equipment is required to cover the same area

So

- (Bandwidth x Distance) product must increase for the access infrastructure

And

- A wise use of photonics in the access network is the only likely sensible answer!

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Needs for a Technology Roadmap

- Various technologies we are studying or planning to here at Cambridge include:
  - Hybrid DWDM & splitter based fiber structure using TDM/TDMA, SCM and OCDMA

- Basic opto-devices technology is key. Alternative systems can help simplifying it. (eg. λ comb distribution techniques vs DWDM chip integration)

- Particular relevance is put on network simplicity and its ability to scale and to support wireline and wireless convergence

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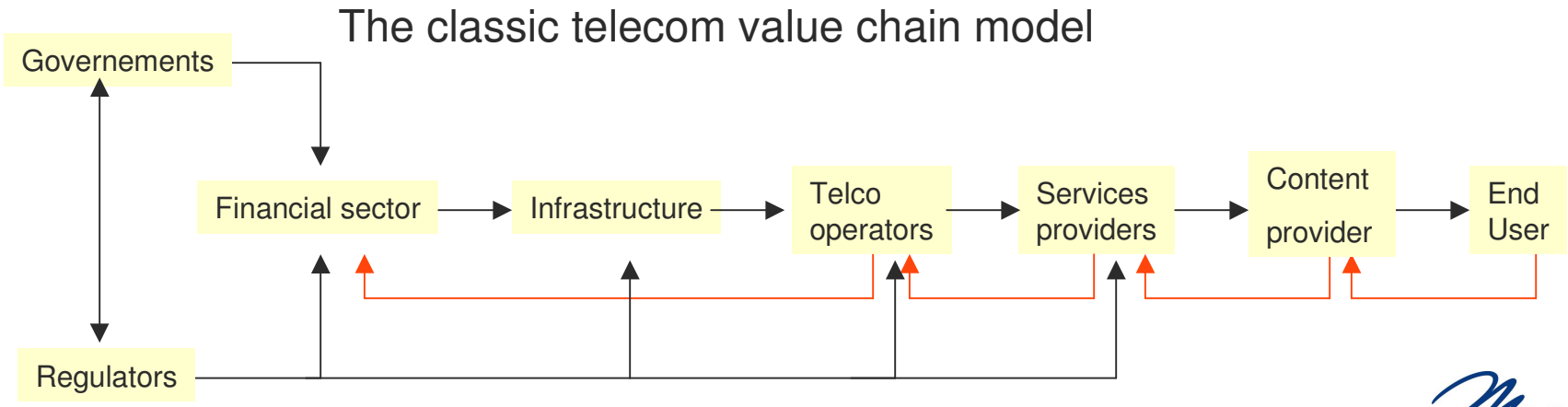
The infrastructure: When do we need to think bigger?

- Q: Why cable TV did not change the world?
- A: Did it aim at a new form of communication?



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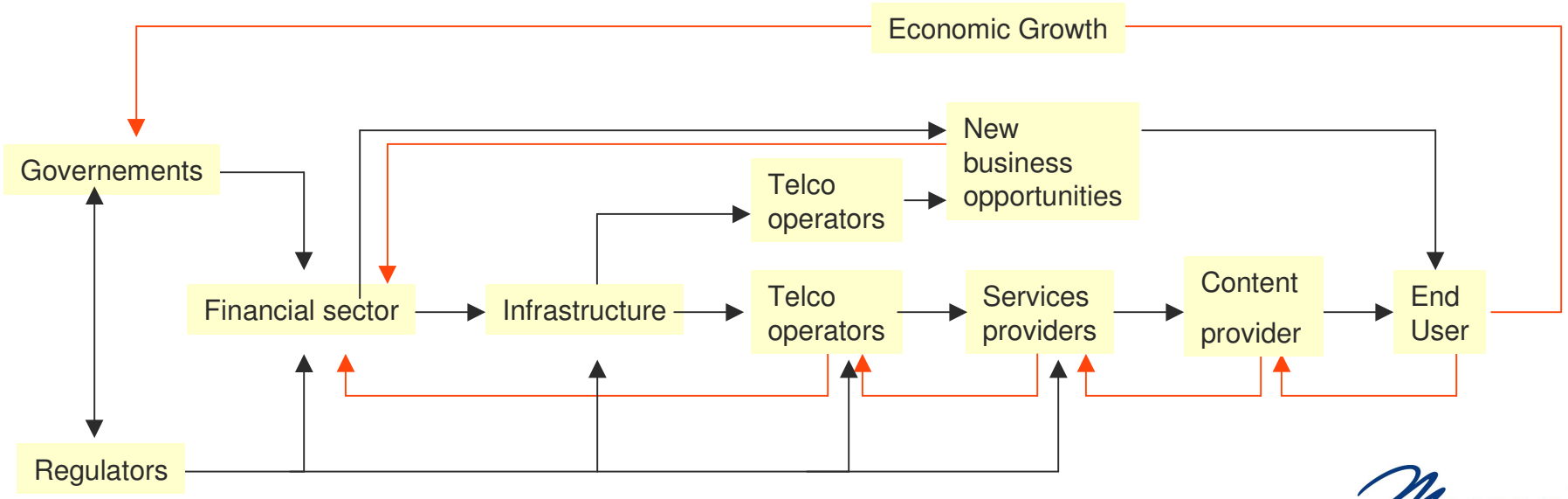
The bigger picture

- Q: Is a true broadband infrastructure an enabler for economic growth?
- If so then planning regulations and investments need to involve the whole eco-system beyond the immediate industrial sector.



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Need for a Socio-economic study

- Proposed approach: considering scenarios for such eco-systems and assuming the impact on them of unlimited access bandwidth to end-user

- Firstly we need to clarify the current status quo worldwide in terms of competitions, guidance, financials and regulatory aspects (work is ongoing on this)

- Then we need to focus on the existing valence of the telecom infrastructure onto the economic system and consider the effect on GDP growth of removing the end-user bandwidth bottleneck

- The output is a report for such “what if’s” scenarios for those economic areas who are early or late adopters of an unlimited bandwidth to the user, with particular focus onto the EU

- There is interest in Italy to work on this from the SSS Anna School of Economics but it is essential that a broader, representative and independent European consortium is involved.

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Conclusions

- FTTP does have huge potential to become the common infrastructure for access wireline and wireless networks of the future and to remove bandwidth bottlenecks
- Indeed PON technology is now being deployed in volume mostly in EPAC and USA.
- However there is need now to think about long term evolution and a suitable technology roadmap to allow a much better exploitation of fibre optical spectral efficiency
- Europe is somewhat late in issuing guidance and related regulatory actions on this subject. It is felt that the risk of being a late adopter may be detrimental to the economic growth.

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