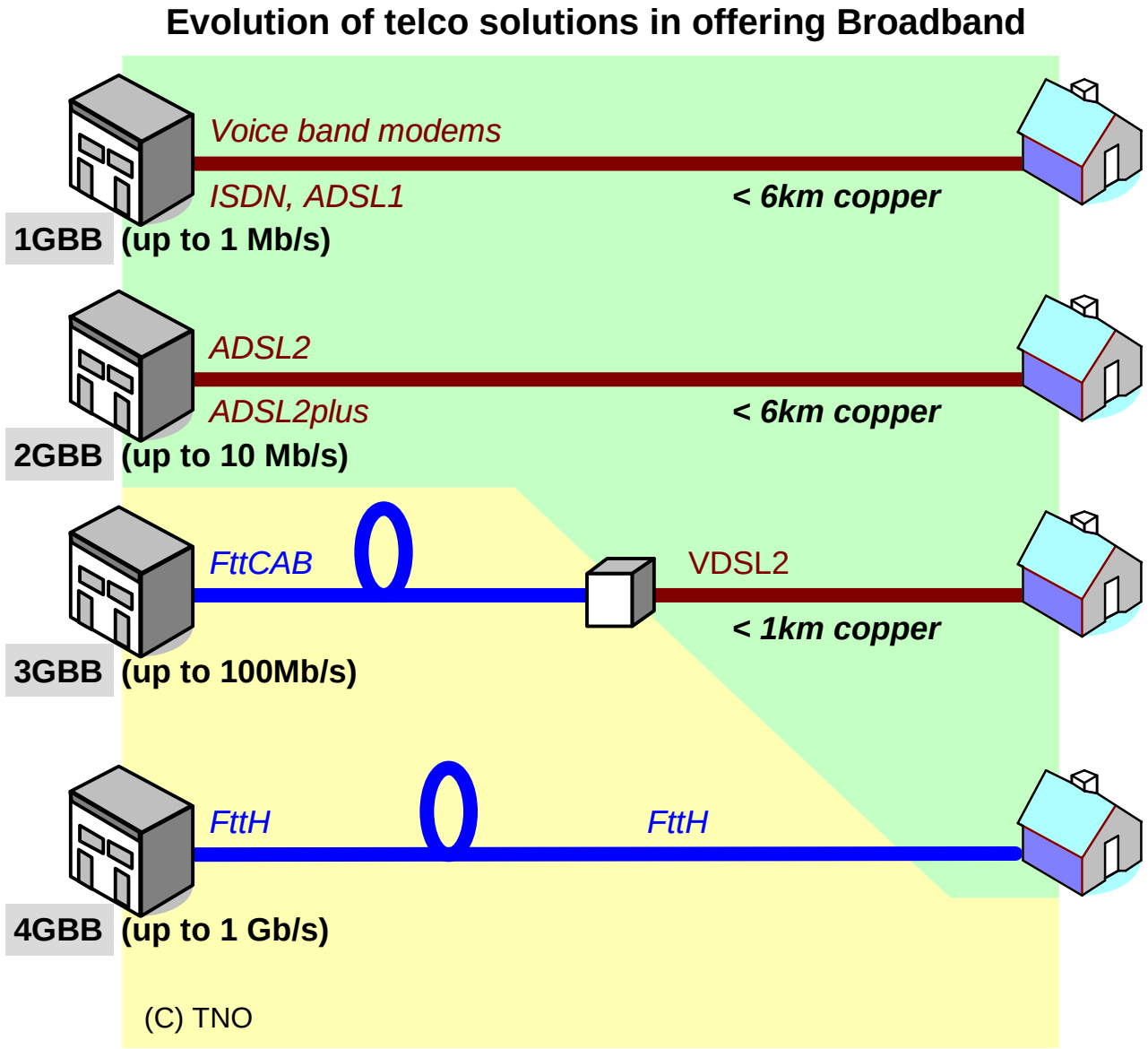
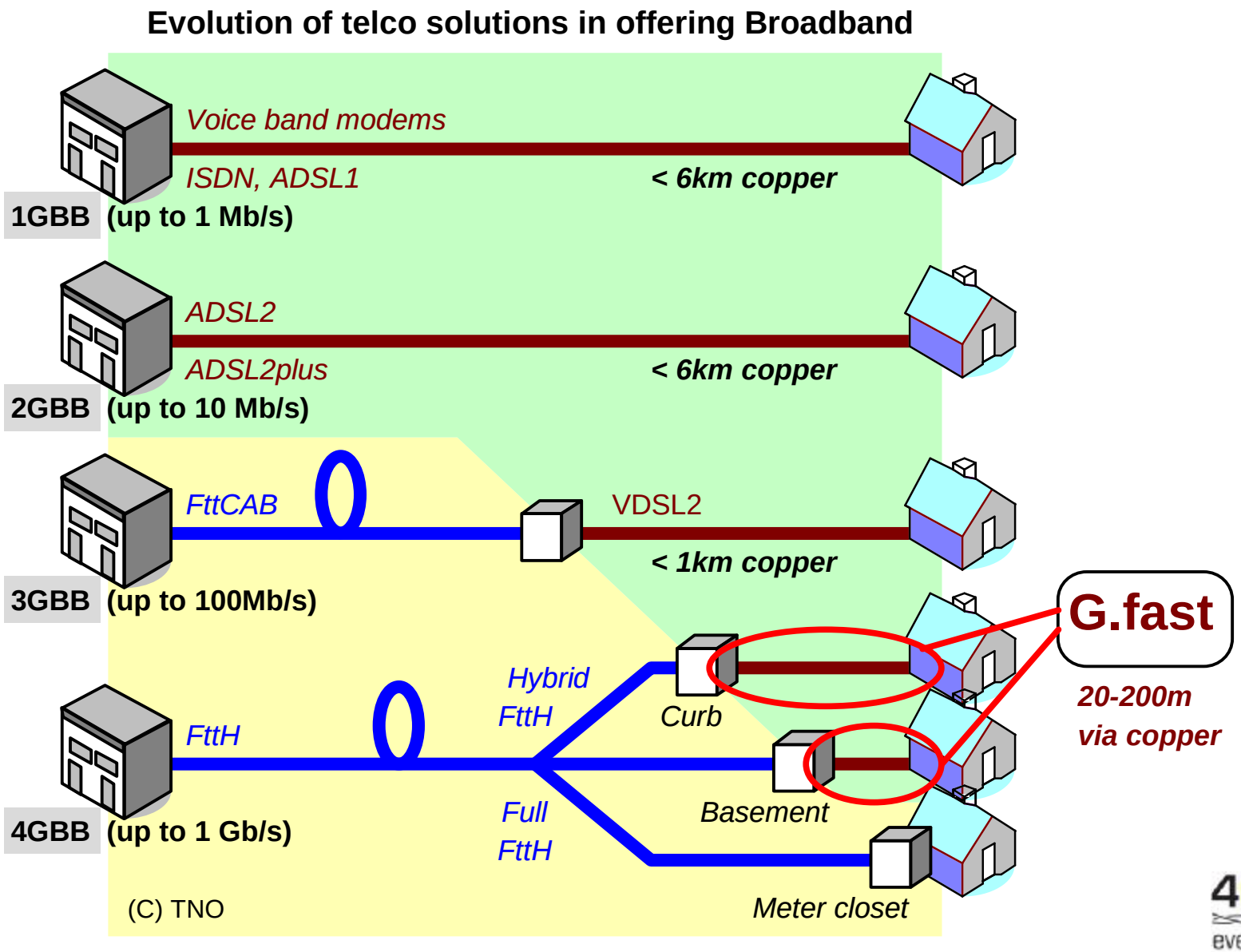
Feasibility of hybrid FttH solutions

Rob F.M. van den Brink

Hybrid FttH, what do we mean?



Hybrid FttH, what do we mean?



Hybrid FttH, what do we mean?

- **Alternative names:**
  - FttD – Distribution point / Drop wire
  - FttB – Building
  - FttC – Curb
  - FttMDU – Multi Dwelling Unit
  - ...

- **Names in this presentation:**
  - “Hybrid” *and* “Full” FttH, just multiple flavors of FttH
  - “G.fast” (*ITU name*): copper technology to bridge the last 20-200m
  - “fiber speed”: hundreds of Mb/s to the homes
  - “4GBB”: a service package consuming 100-1000Mb/s

Aims of the 4GBB Consortium

- **To solve feasibility questions about Hybrid FttH:**
  - When – Techno economic feasibility
  - Where – Topology feasibility
  - How – Technical feasibility (*copper* + *equipment*)

- **To bring the industry into motion**
  - by initiating standardization in ITU-T
  - let operators think about requirements
  - let vendors start developping the technology

4GBB Consortium works on all these topics in parallel since 2009

Solving feasibility questions

FttH in multiple flavors: “full” and “hybrid”

When: Hybrid, when it has clear techno-economic advantages

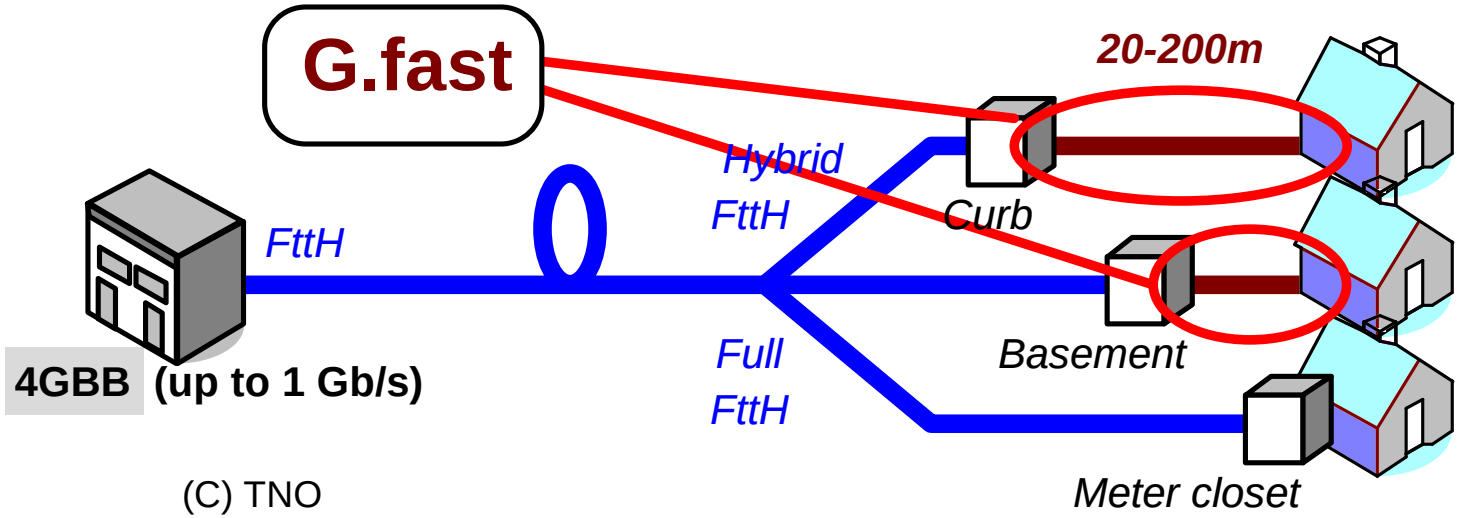
- to save costs for digging/installation by reusing existing copper
- to speed-up installation time, so faster roll-out

Where: Hybrid / Full on a case by case basis

- appartment buildings, multi-tenant houses, city centers
- FttH inside the Home: 80%? – full fiber
- FttH upto the Home: 20%? – hybrid fiber

Solving feasibility questions

- **How:** hybrid = reusing existing wiring (only when attractive)
  - via basement, wall-boxes (house front), footway boxes (curb), etc.
  - up to 1 Gb/s, via the last 20-200m existing copper
  - via single or double wire-pairs (bonding doubles the bitrate)
  - reverse power feeding when needed (from CPE side)



(C) TNO

By using a new DSL technology, up to 1 Gb/s è "G.fast"

Solving Q1: techno-economic feasibility ("when")

- **Techno-Economic Drivers:**
  - Cable solutions (DOCSIS) are fierce competitors
  - Investments for Full FttH are high **à** too high? **à** Churn?
  - Installation times for Full FttH are long **à** too long? **à** Churn?

- **Techno-Economic Opportunities:**
  - *Hybrid* FttH may reduce costs
  - *Hybrid* FttH may speed-up deployment
  - Both can increase market share

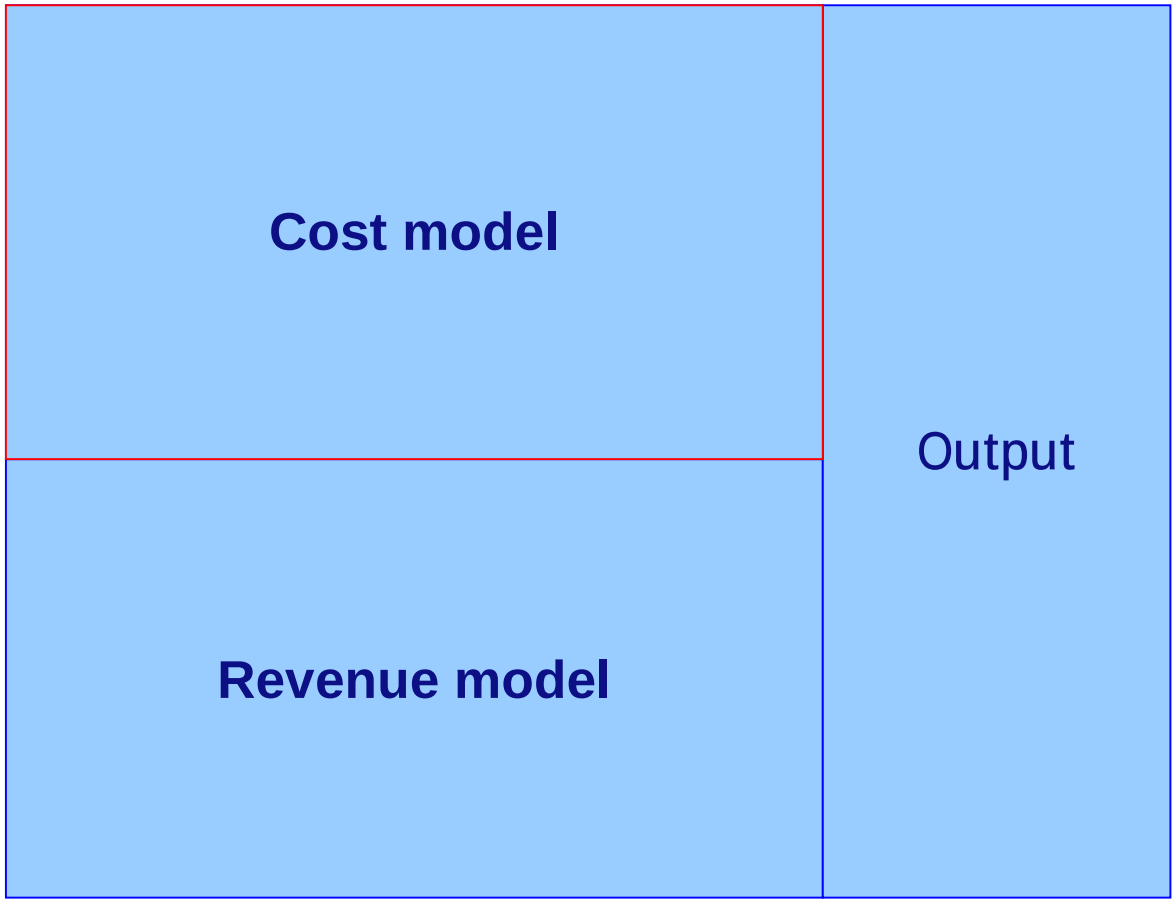
To quantify this, we need a calculation model for comparing Hybrid with Full FttH

Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model

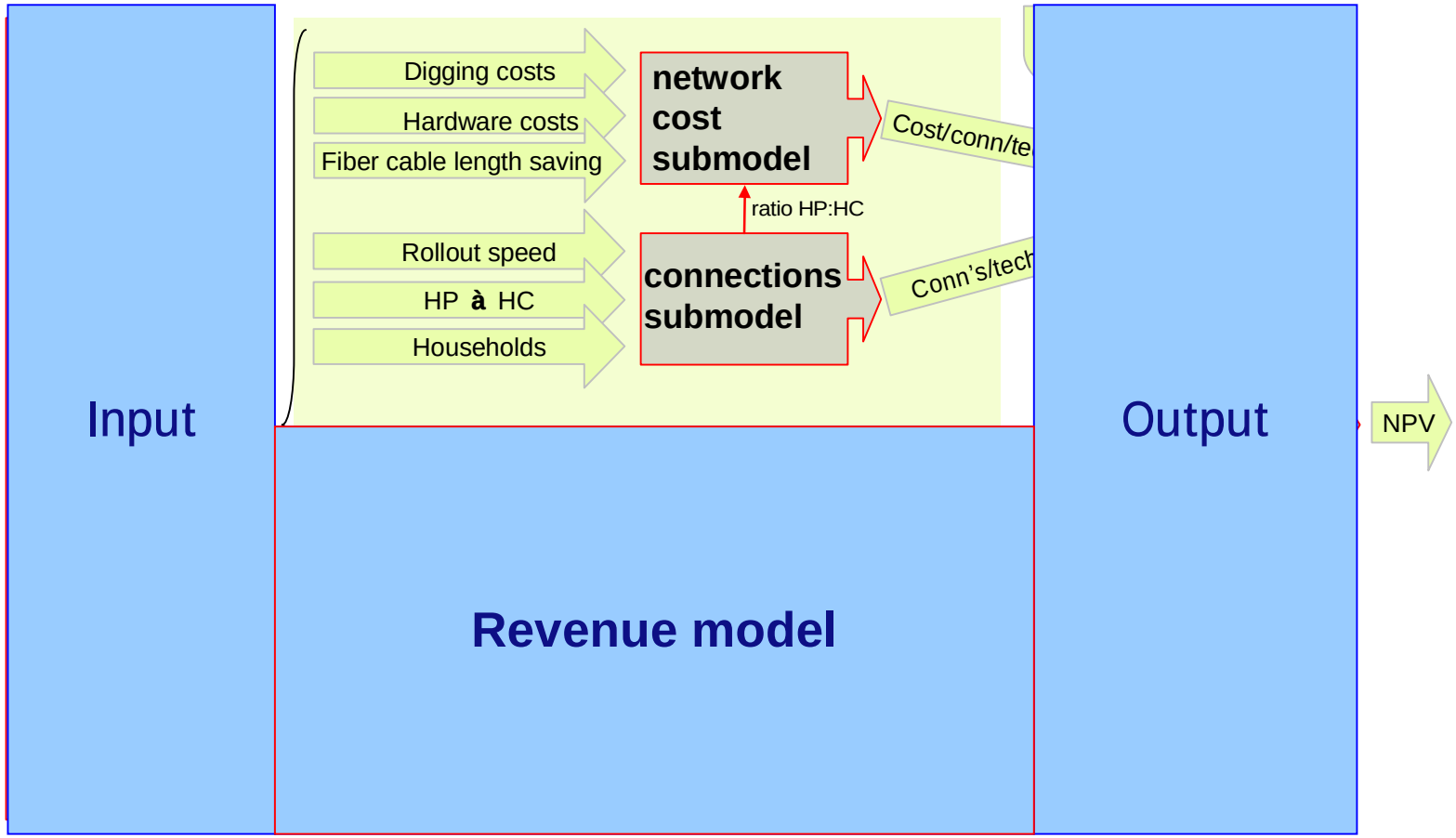
Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model



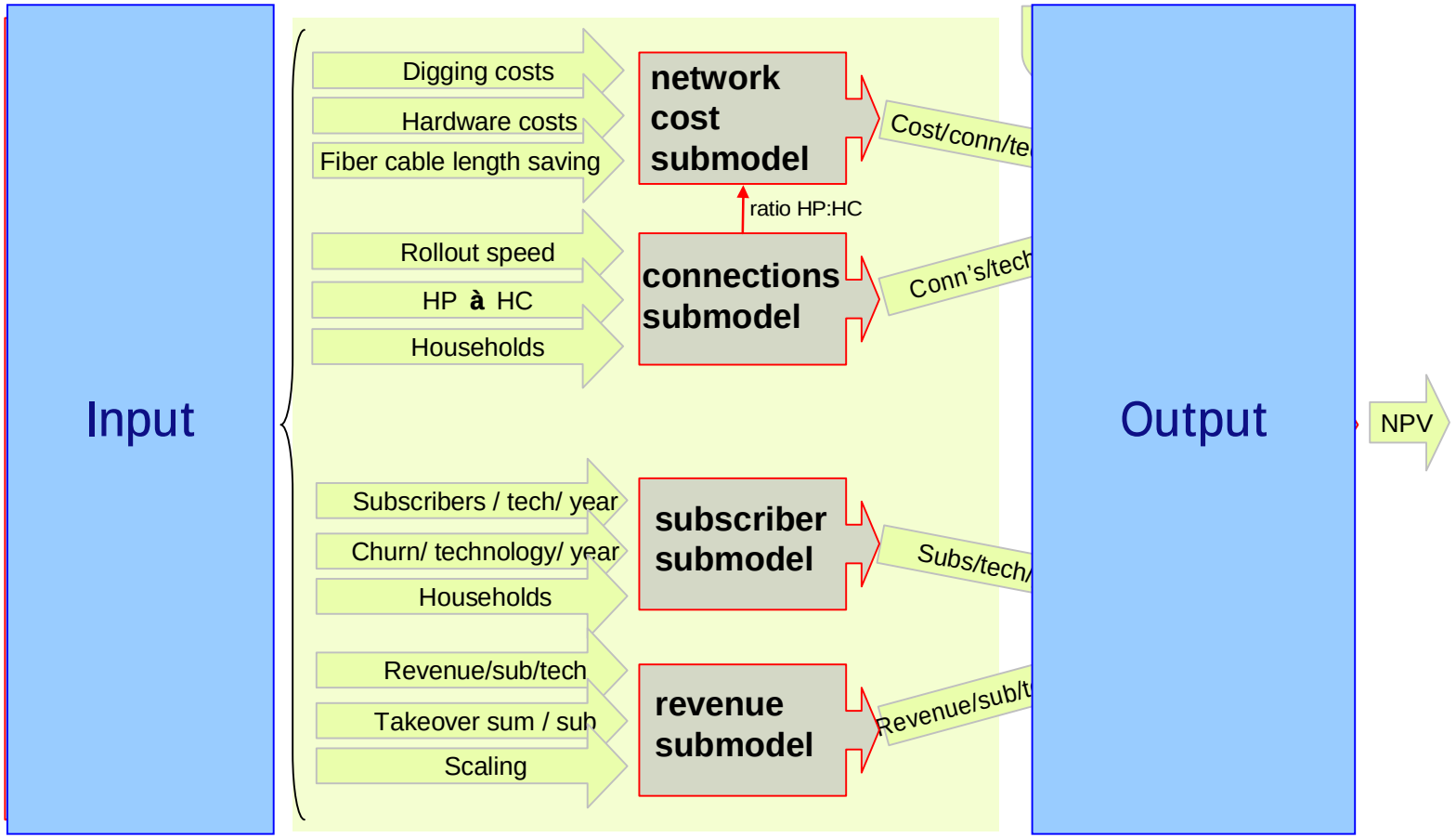
Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model



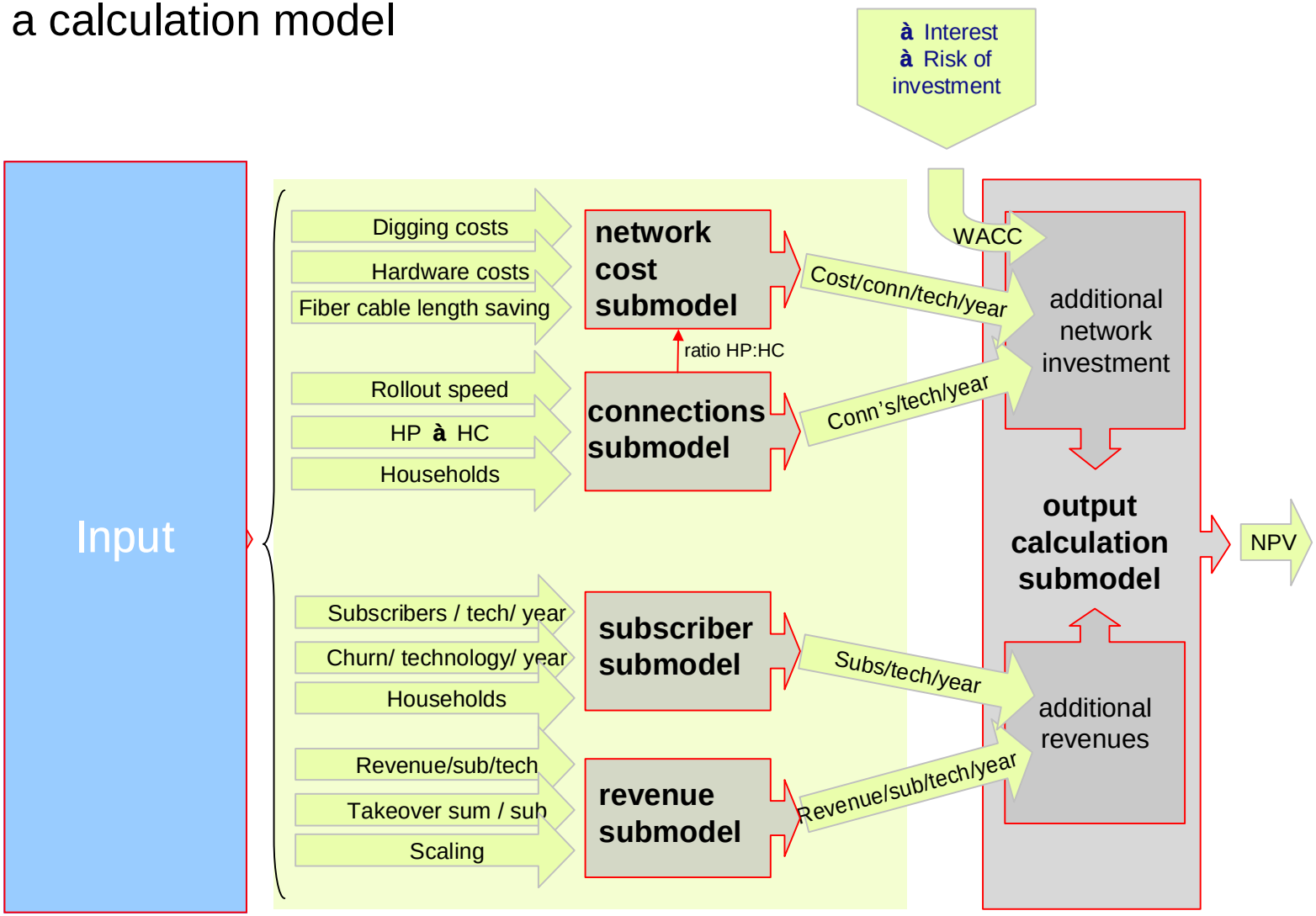
Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model



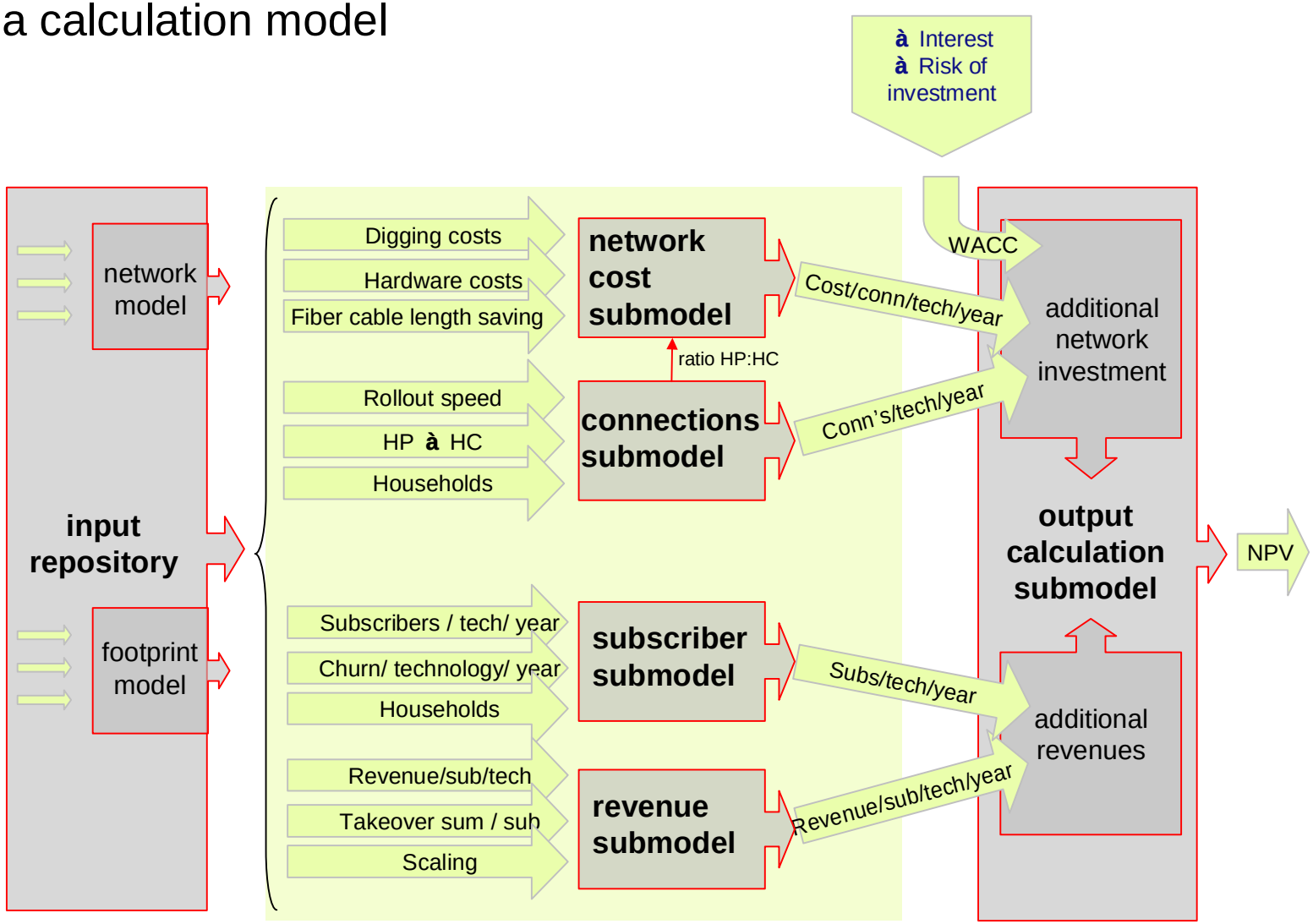
Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model



Solving Q1: techno-economic feasibility ("when")

Creation of a calculation model



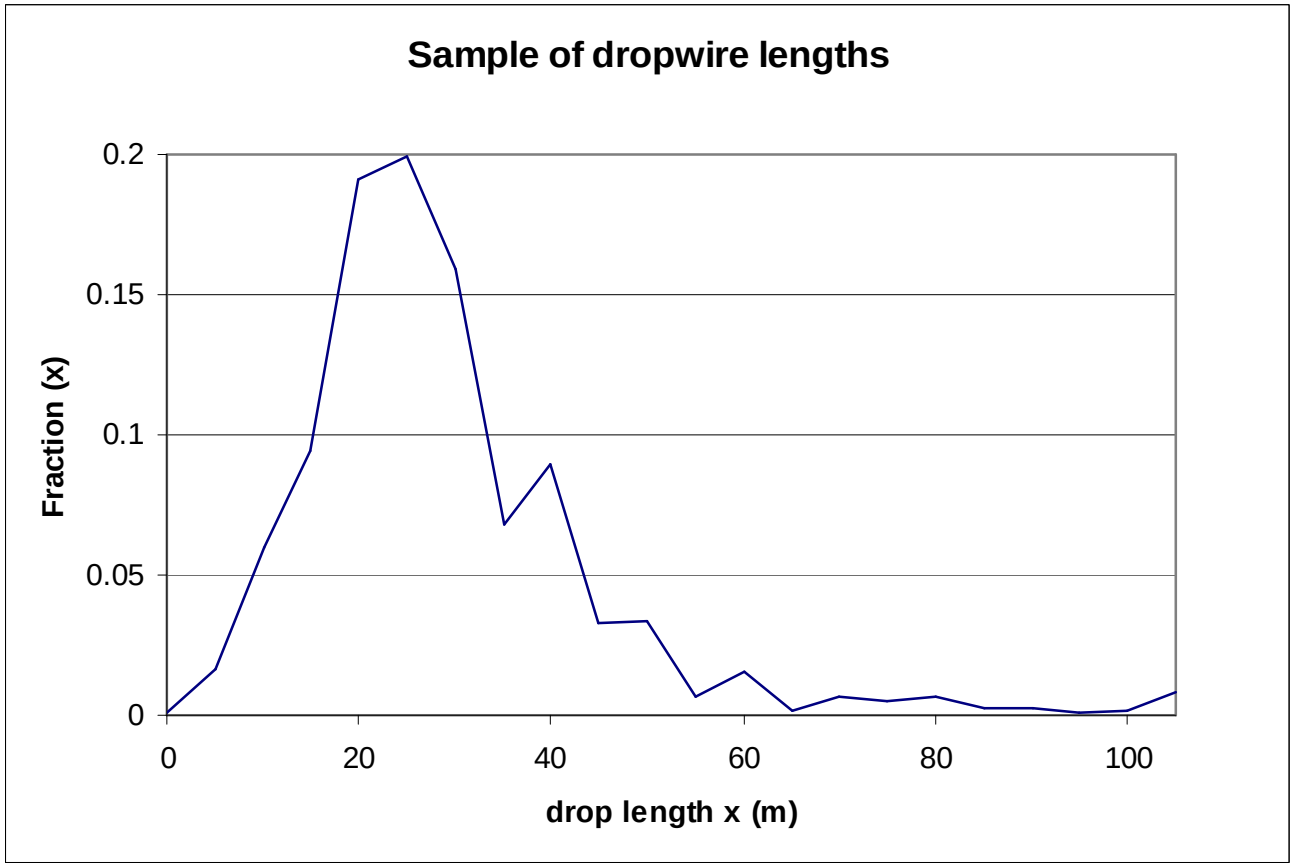
Solving Q2: topology feasibility ("where")

- **Questions:**
  - How many locations are suitable (and where)
  - What are their copper length
  - How often can we use a double wire pair?

- **Answers :**
  - country-specific

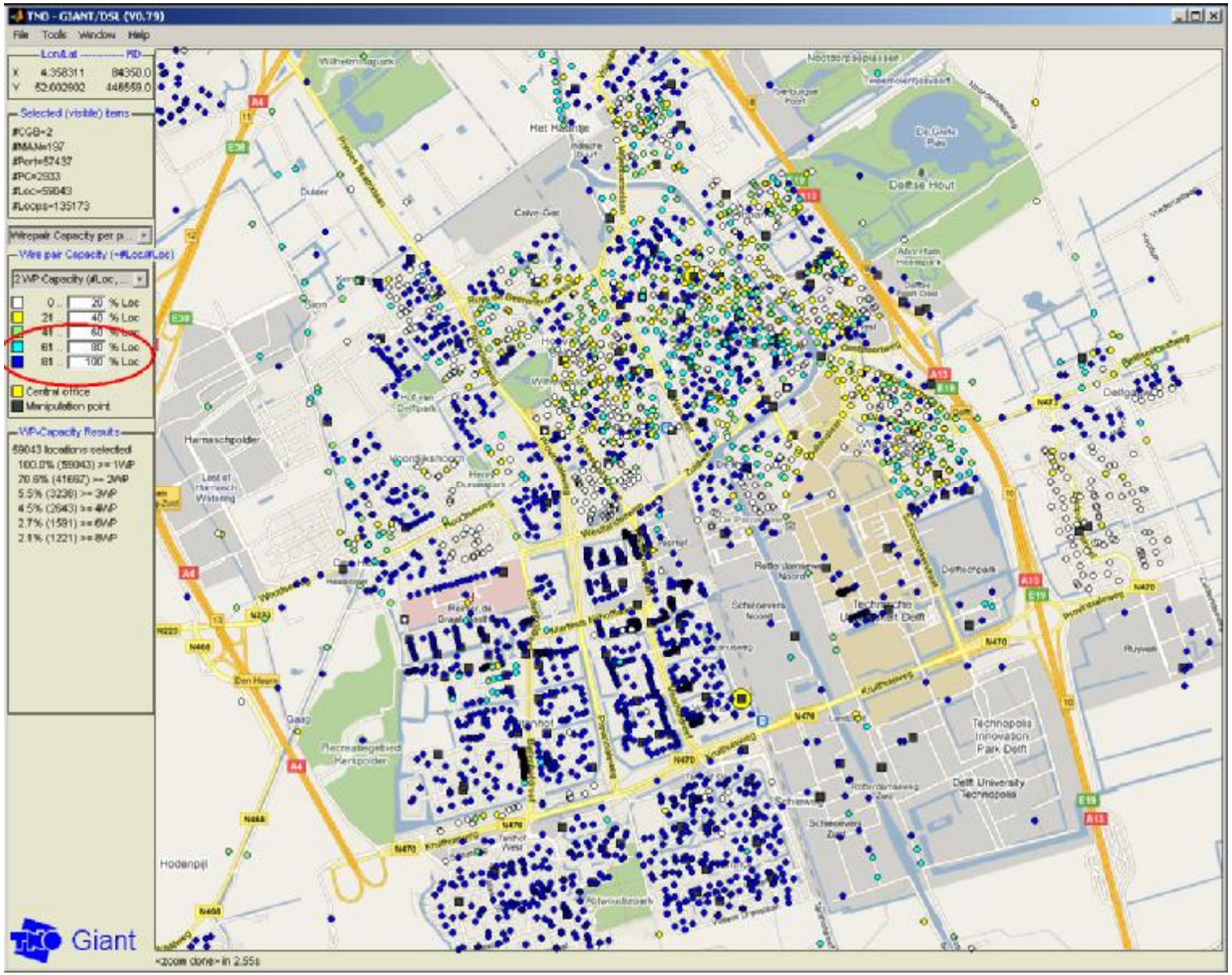
Solving Q2: topology feasibility ("where")

- **Some answers for the UK Network:**



Sample drop wire lengths, taken from
ETSI TR 102 629 (Reverse Power Feed for Remote Nodes)

Solving Q2: topology feasibility ("where")



A typical Dutch city

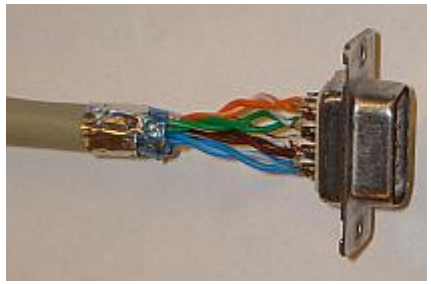
Bold markers denote 80-100% has a double wire pair

>70% in this city (example)

Solving Q3: Technical feasibility ("how")

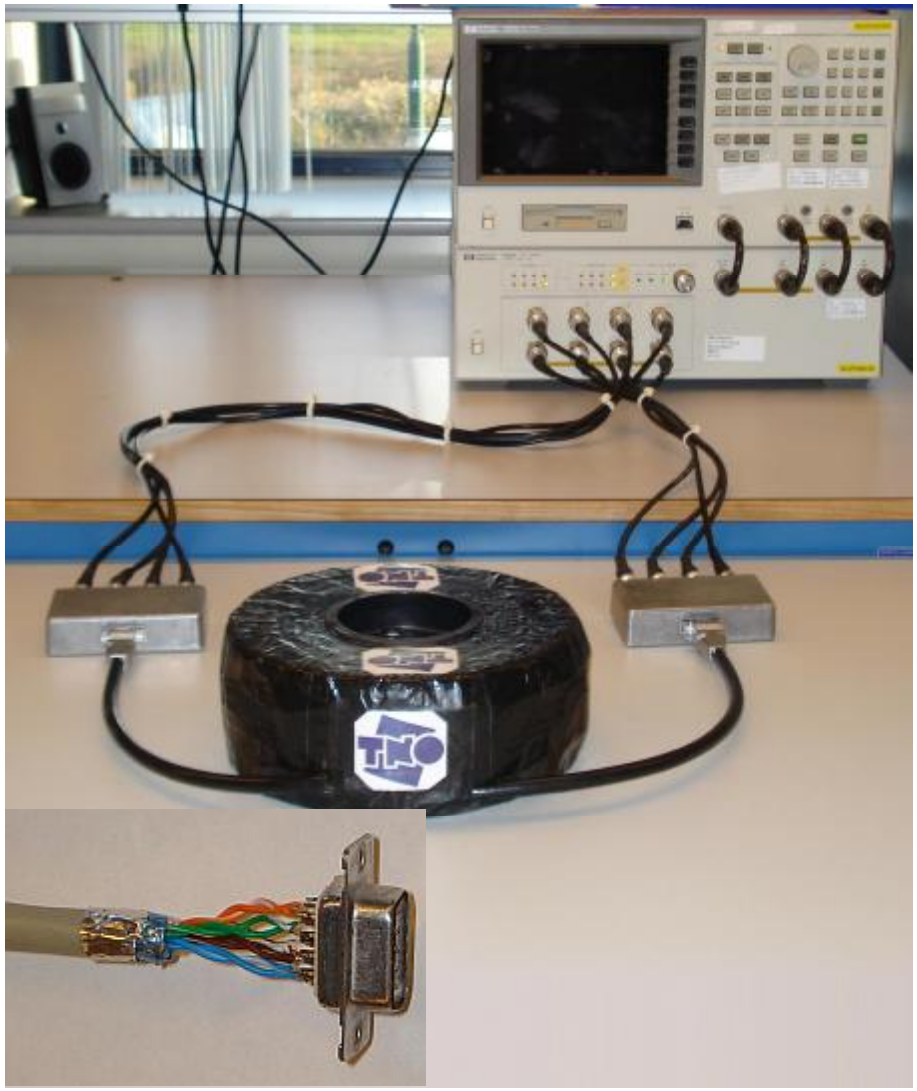
Characterizing copper cables up to 500 MHz

- Develop measurement methods
  - create setups up to 500MHz (TNO, TID, BT, EAB)
  - verify these setups via a Round Robin Test
  - facilities to measure impulse noise and RFI
- Do a lot of measurements
  - twisted pair cabling
  - irregularities, like splices, manipulation boxes, etc.
  - all kinds of ingress noise measurement



- Develop simulation models
  - two-port models for single-pair cable transmission
  - multi-port models for harmonized cable transmission (vectoring)
  - statistic descriptions of impulse noise
- Do simulations
  - define meaningful scenario's
  - predict performance and throughput

Solving Q3: Technical feasibility, cable measurements



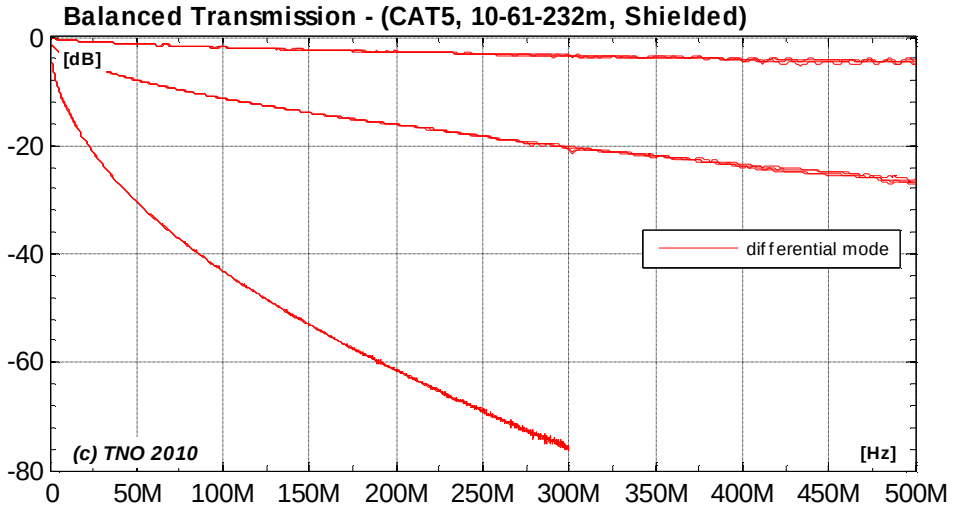
Measurement setup up to 500MHz

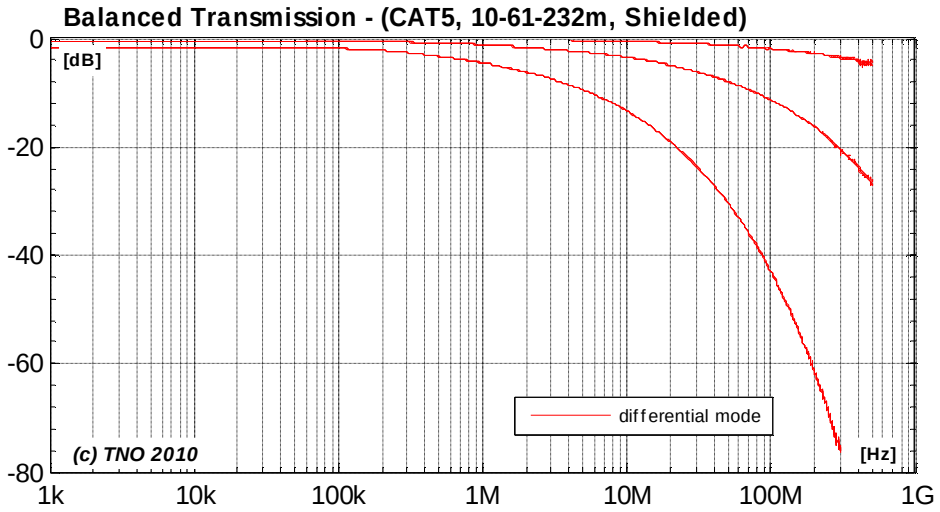
Solving Q3: Technical feasibility, cable measurements

Characterizing copper cables: example up to 500 MHz

Balanced Transmission:

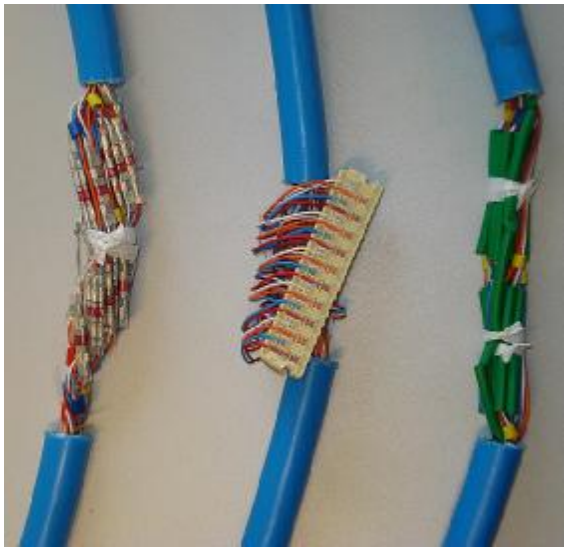
5.7 dB / 100m @ 10MHz
18.6 dB / 100m @ 100MHz

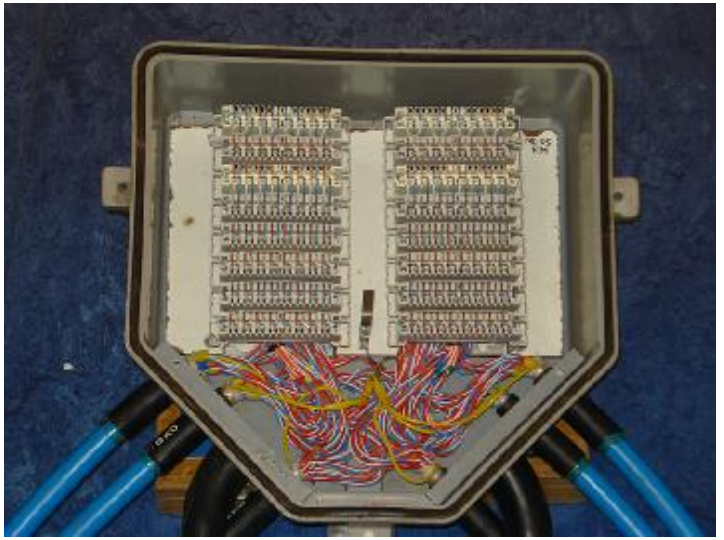




Solving Q3: Technical feasibility, cable measurements

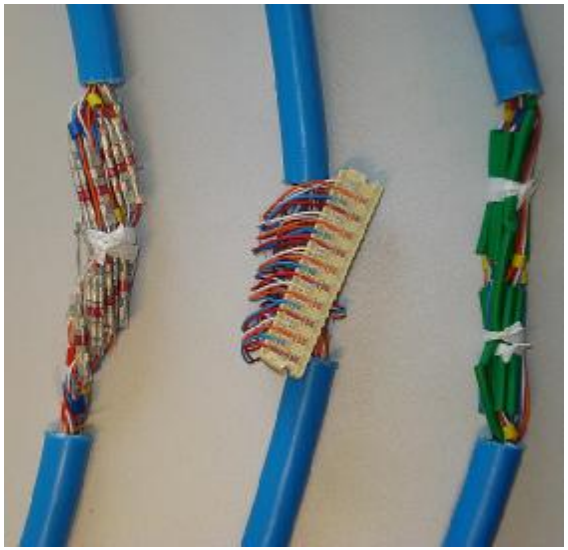
Characterizing splices and manipulation boxes

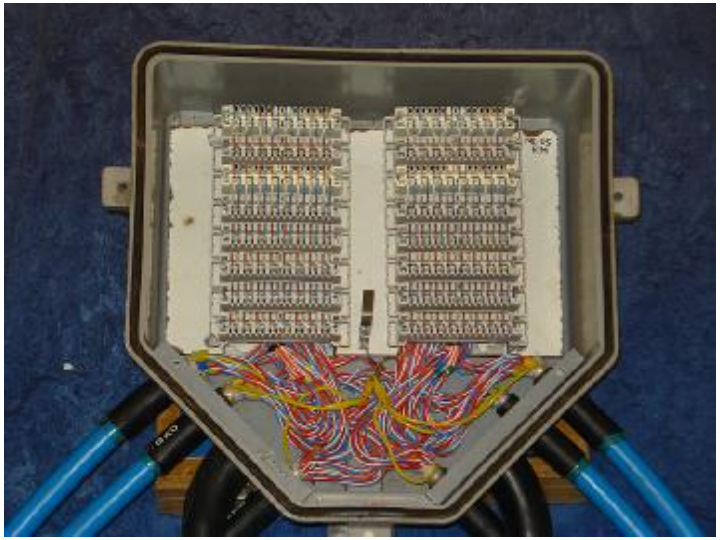




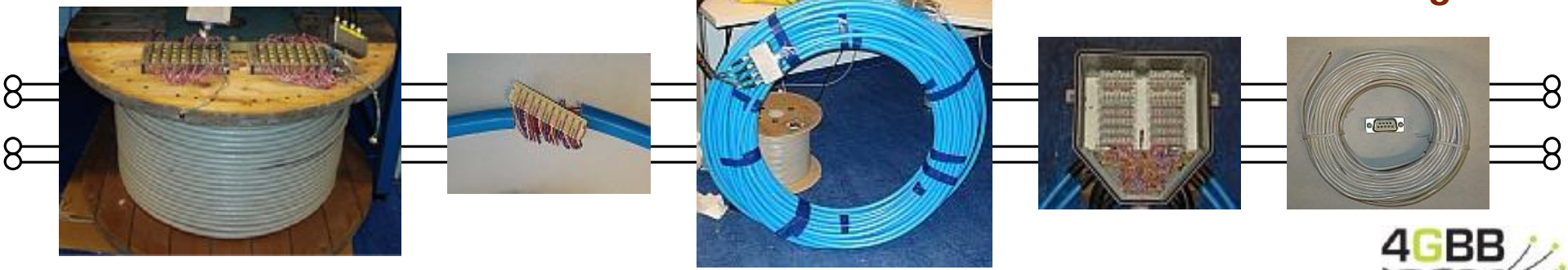
Solving Q3: Technical feasibility, cable measurements

Characterizing splices and manipulation boxes





cable **splice** **cable** **manipulation box** **in-house wiring**



Solving Q3: Technical feasibility, more questions

- How about Noise
  - q impulse noise, RFI
- How about attainable bitrate
  - q modeling, simulations
  - q **next presentation à** squeezing Gbit/s through copper
- How about line coding, modulation, transmit spectra for G.fast
- Etc.

Bringing the industry into motion

Let's initiate a standard

CELTIC consortium

4GBB everywhere

2009-2011

broadband forum

ITU

Standard(s)

Measurements on wiring
Geographic statistics
Techno-economics
Dissemination

BT, Telefonica, FT, TT, ...
TNO, Uni-Lund, Uni-Madrid, ...
Ericsson, UpZide, ...

Mid 2010: start operator requirements
Dec 2010: presentation 45min, 100-150 p

Dec 2010: liasion to ITU

Feb 2011: start of "G.fast"

--> 6 contributions
--> inspired by BBF actions

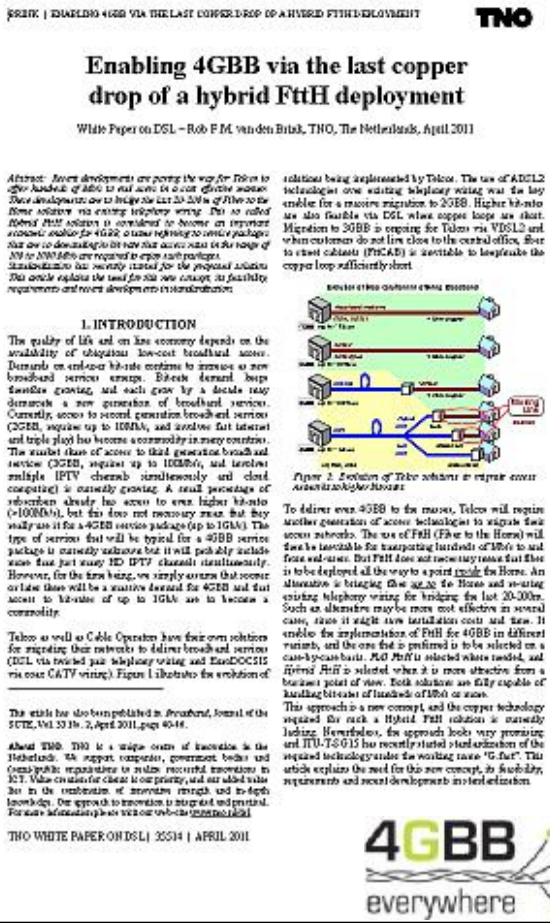
April 18: ITU-T teleconference"
--> 3 contributions

4GBB everywhere

Bringing the industry into motion

Several other activities

- Progressing definition of G.fast
  - consolidated functional requirements
    - via Broadband Forum / SPAC
  - contributions to ITU-T-SG15 (april 2011)
    - contributions about cable measurements
    - preliminary requirements (BBF)
- Making the concept known
  - white paper on “Enabling 4GBB” in *Broadband Journal of the SCTE* (same text also available during this seminar)
  - Presentations DSL Seminar 2011, 2010, 2009
  - More on website www.4GBB.eu



Enabling 4GBB via the last copper drop of a hybrid FttH deployment

White Paper on DSL – Rob F.M. van den Brink, TNO, The Netherlands, April 2011

Conclusions

Conclusions

- Deploying a mix of Hybrid & Full FttH looks very attractive
  - Hybrid variant may reduce cost (wrt. Full)
  - Hybrid variant may speed-up deployment (wrt. Full)
  - Both advantages reduce churn to competition (cable operators)

Conclusions

- Deploying a mix of Hybrid & Full FttH looks very attractive
  - Hybrid variant may reduce cost (wrt. Full)
  - Hybrid variant may speed-up deployment (wrt. Full)
  - Both advantages reduce churn to competition (cable operators)

- Hybrid FttH is feasible
  - Studies about when, where, how are ongoing in 4GBB consortium
  - Interim results are being disseminated

Conclusions

- Deploying a mix of Hybrid & Full FttH looks very attractive
  - Hybrid variant may reduce cost (wrt. Full)
  - Hybrid variant may speed-up deployment (wrt. Full)
  - Both advantages reduce churn to competition (cable operators)
- Hybrid FttH is feasible
  - Studies about when, where, how are ongoing in 4GBB consortium
  - Interim results are being disseminated
- Hybrid FttH is gaining more and more interest from the industry
  - “G.fast” has recently initiated within ITU-T-SG15
  - Functional requirements are being identified via BBF

Conclusions

- Deploying a mix of Hybrid & Full FttH looks very attractive
  - Hybrid variant may reduce cost (wrt. Full)
  - Hybrid variant may speed-up deployment (wrt. Full)
  - Both advantages reduce churn to competition (cable operators)
- Hybrid FttH is feasible
  - Studies about when, where, how are ongoing in 4GBB consortium
  - Interim results are being disseminated
- Hybrid FttH is gaining more and more interest from the industry
  - “G.fast” has recently initiated within ITU-T-SG15
  - Functional requirements are being identified via BBF

If you see a need for affordable bitrates at “fiber speed”, then investigate how “Hybrid FttH” fits in your strategy