

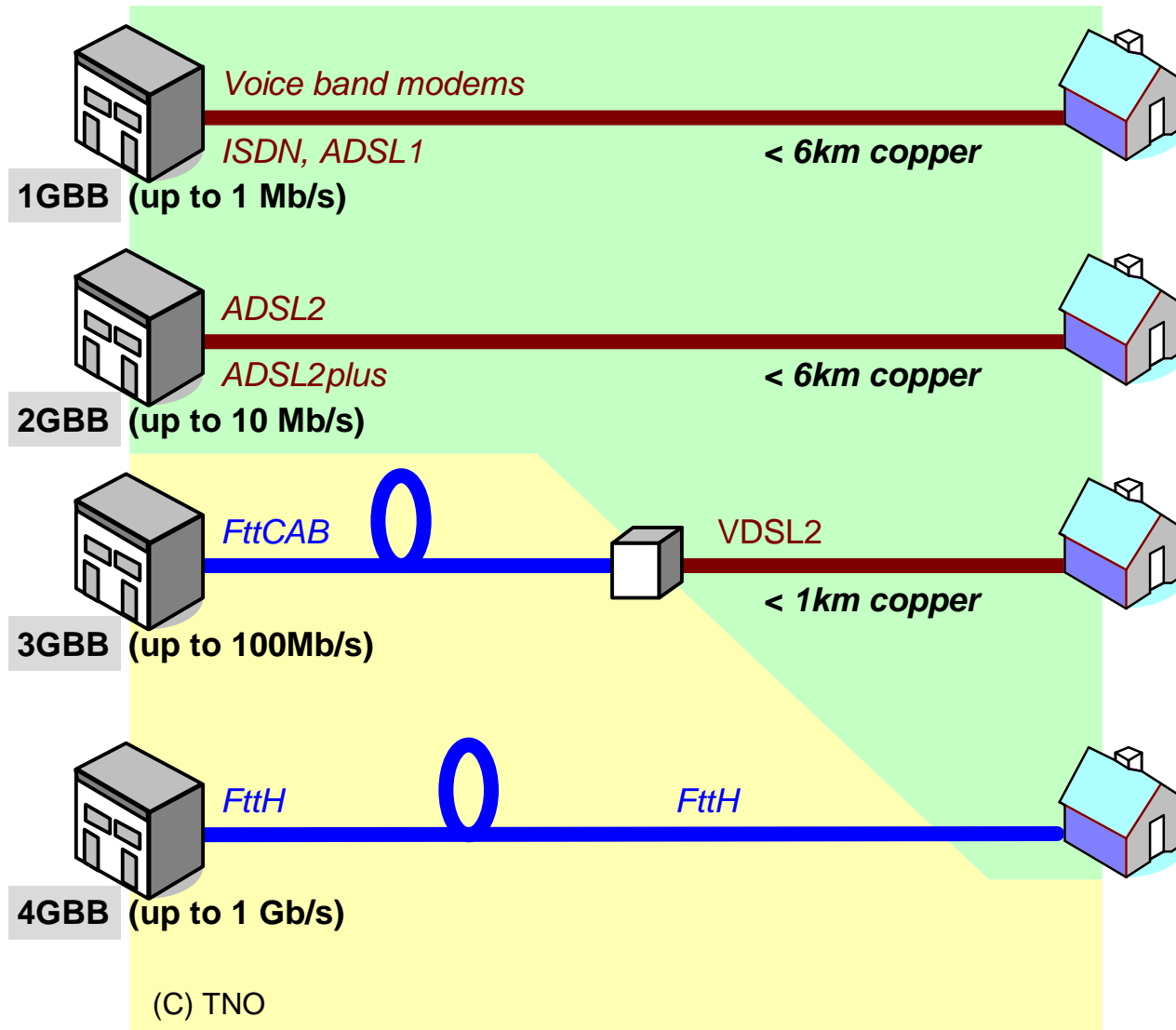
Feasibility of hybrid FttH solutions

Rob F.M. van den Brink



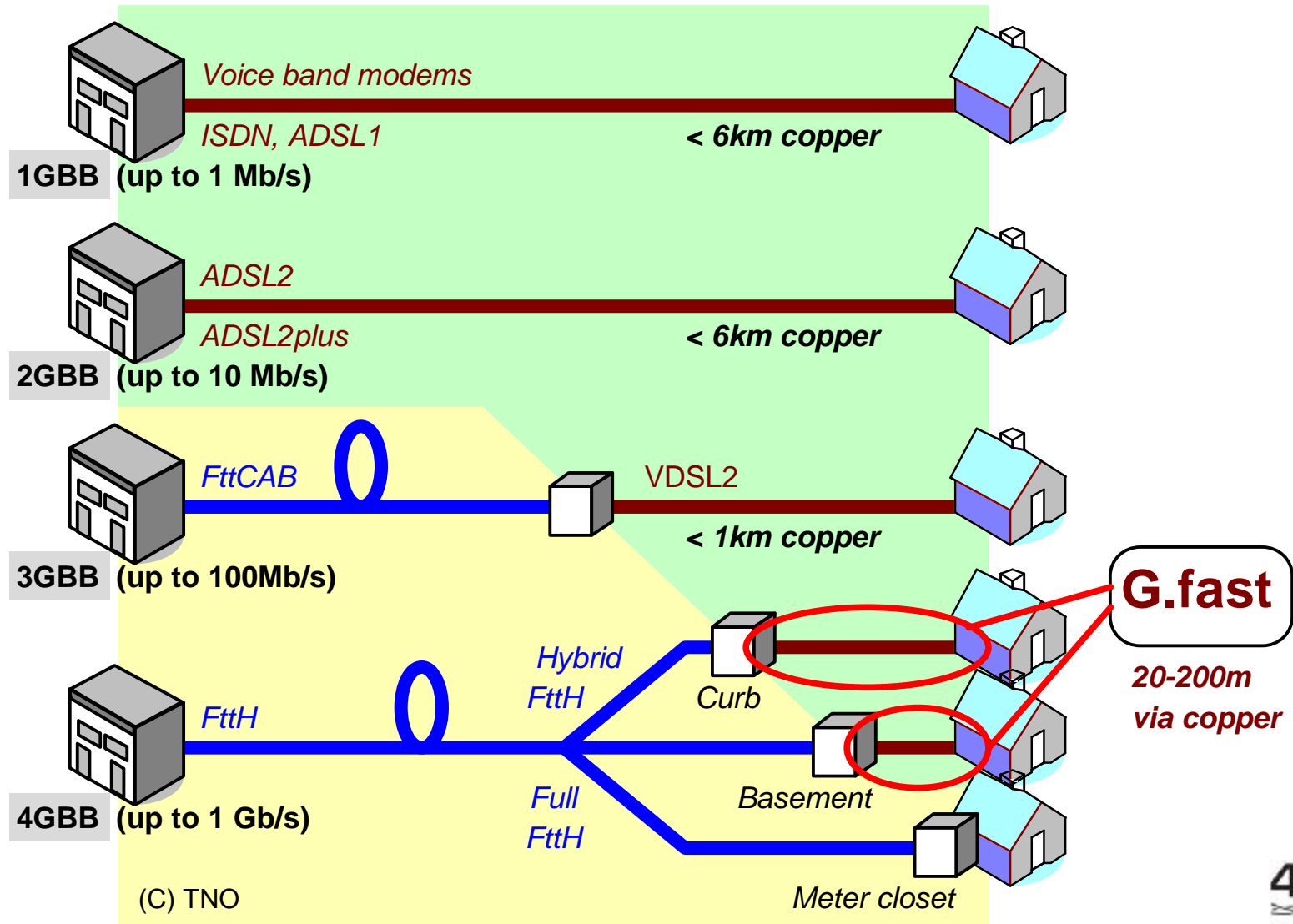
Hybrid FttH, what do we mean?

Evolution of telco solutions in offering Broadband



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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 developing 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

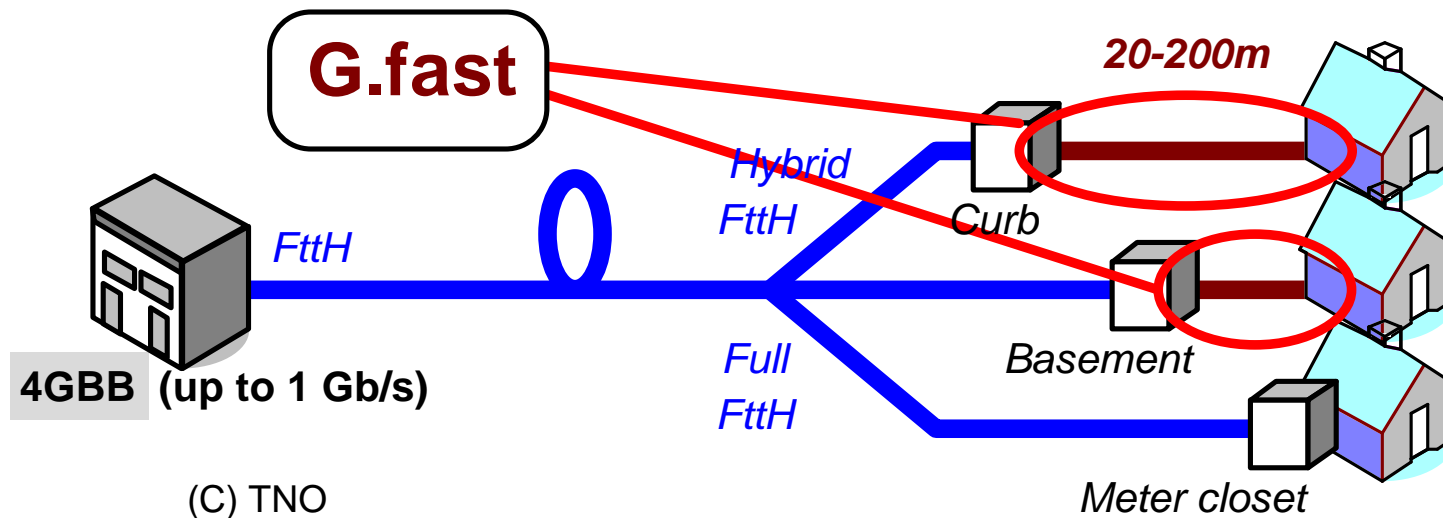


Where: Hybrid / Full on a case by case basis

- apartment 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)



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



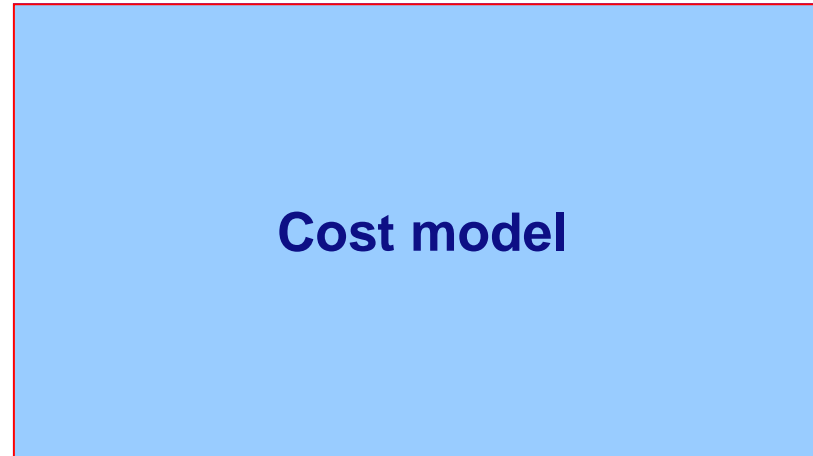
Solving Q1: techno-economic feasibility (“when”)

- **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**

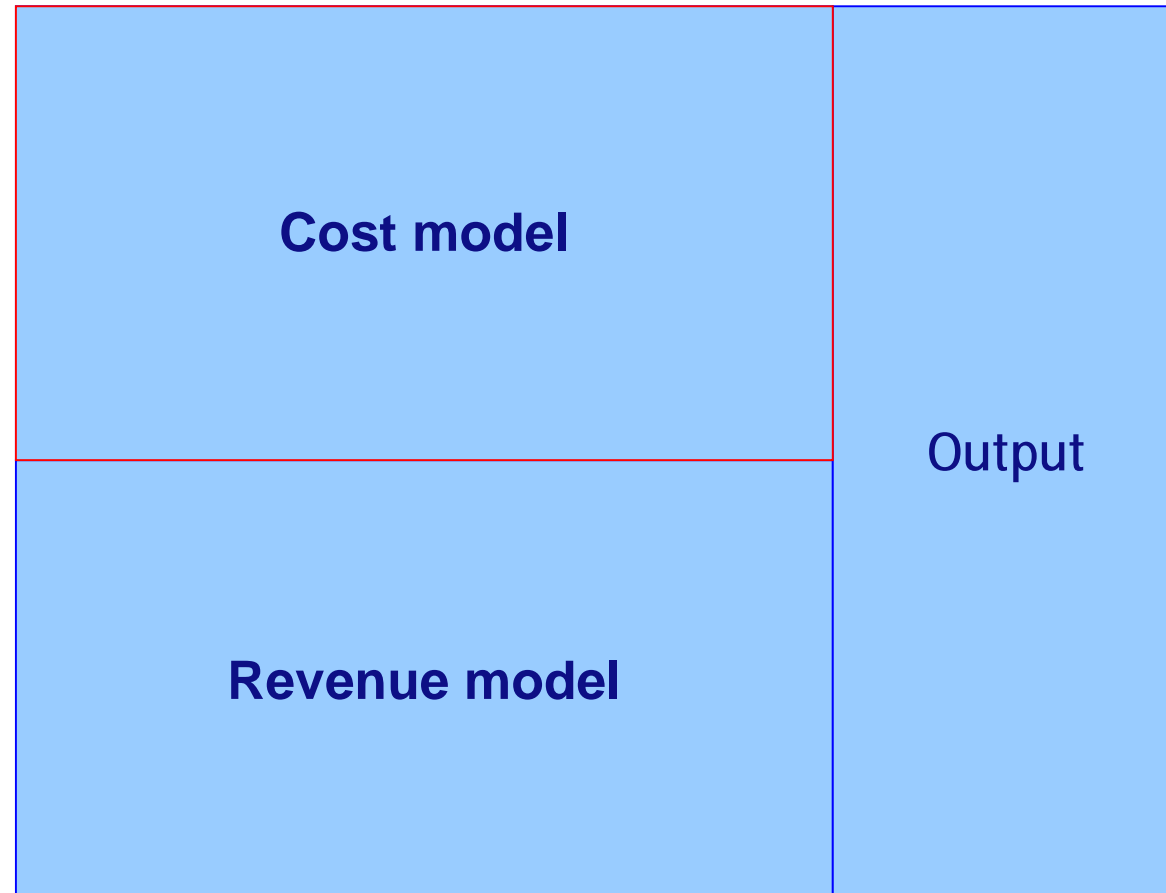
Solving Q1: techno-economic feasibility (“when”)

Creation of a calculation model



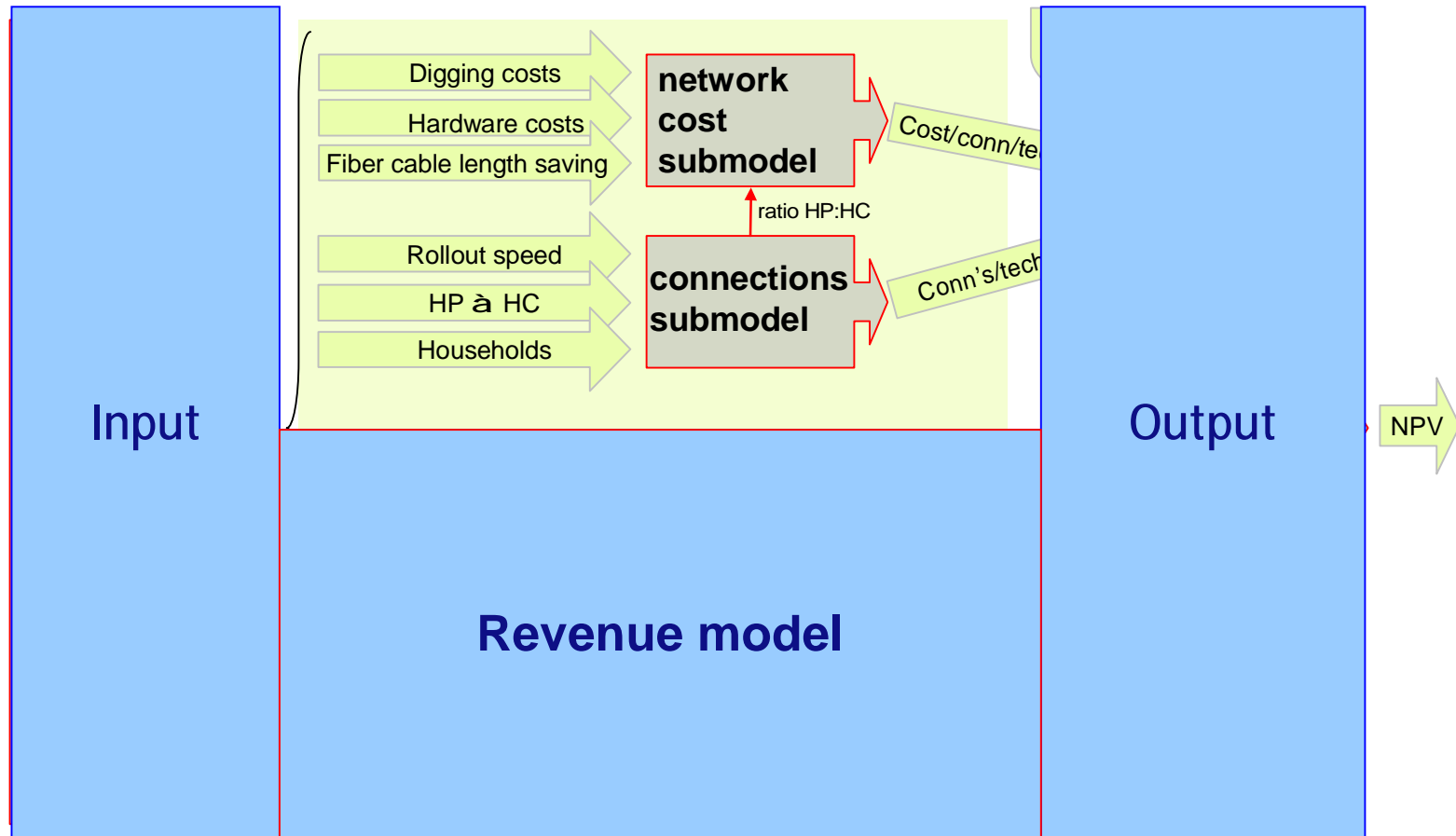
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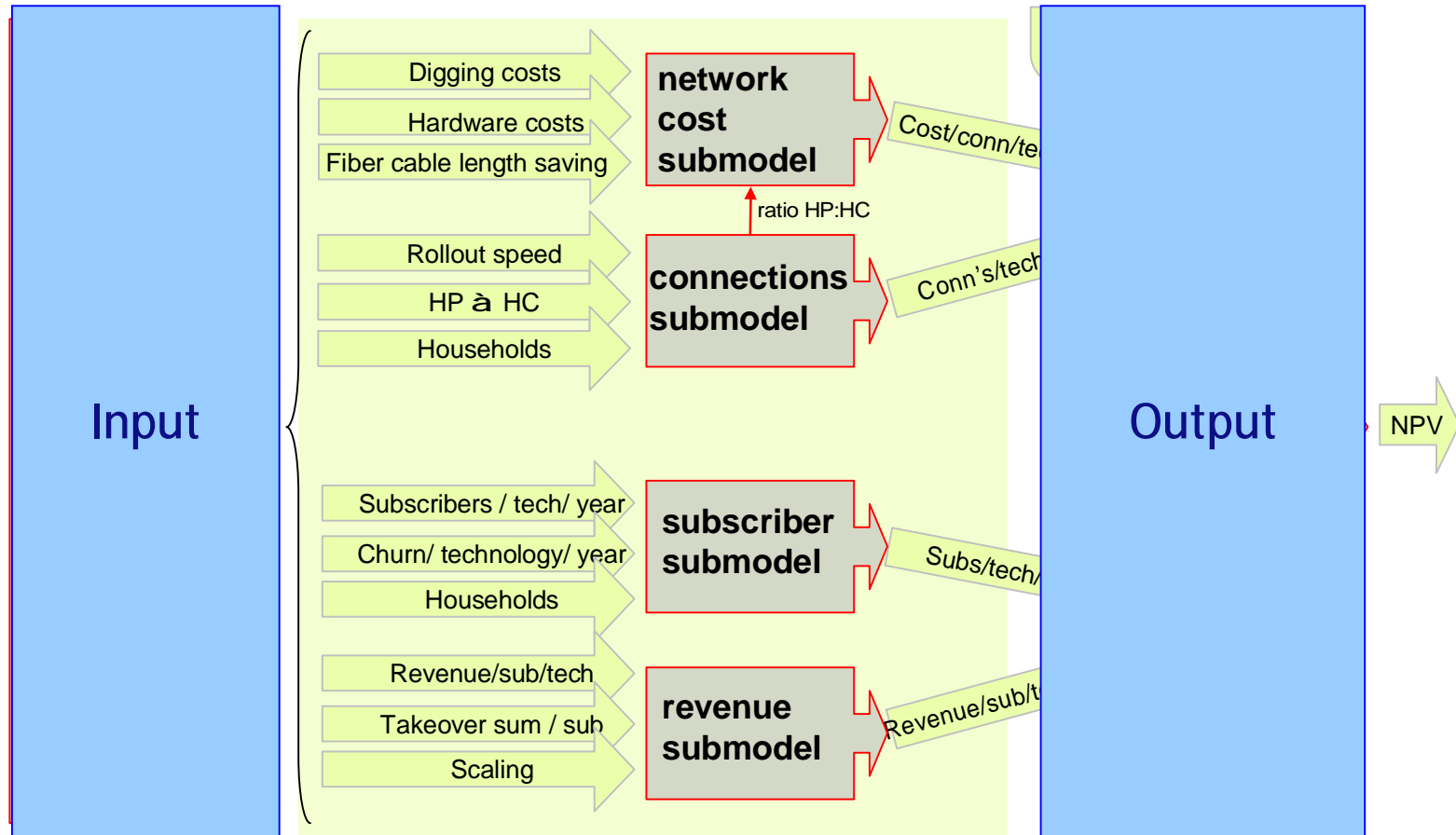
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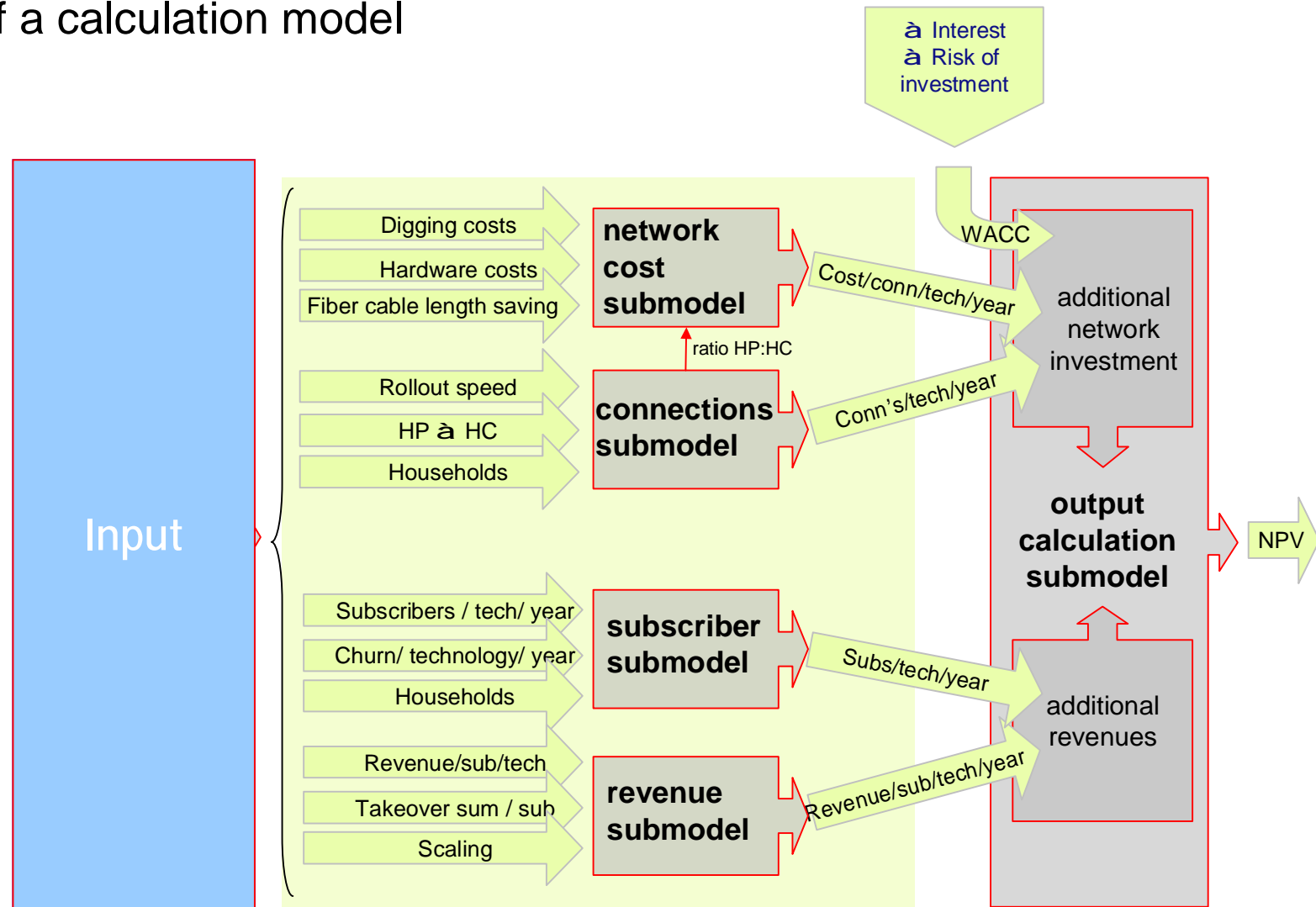
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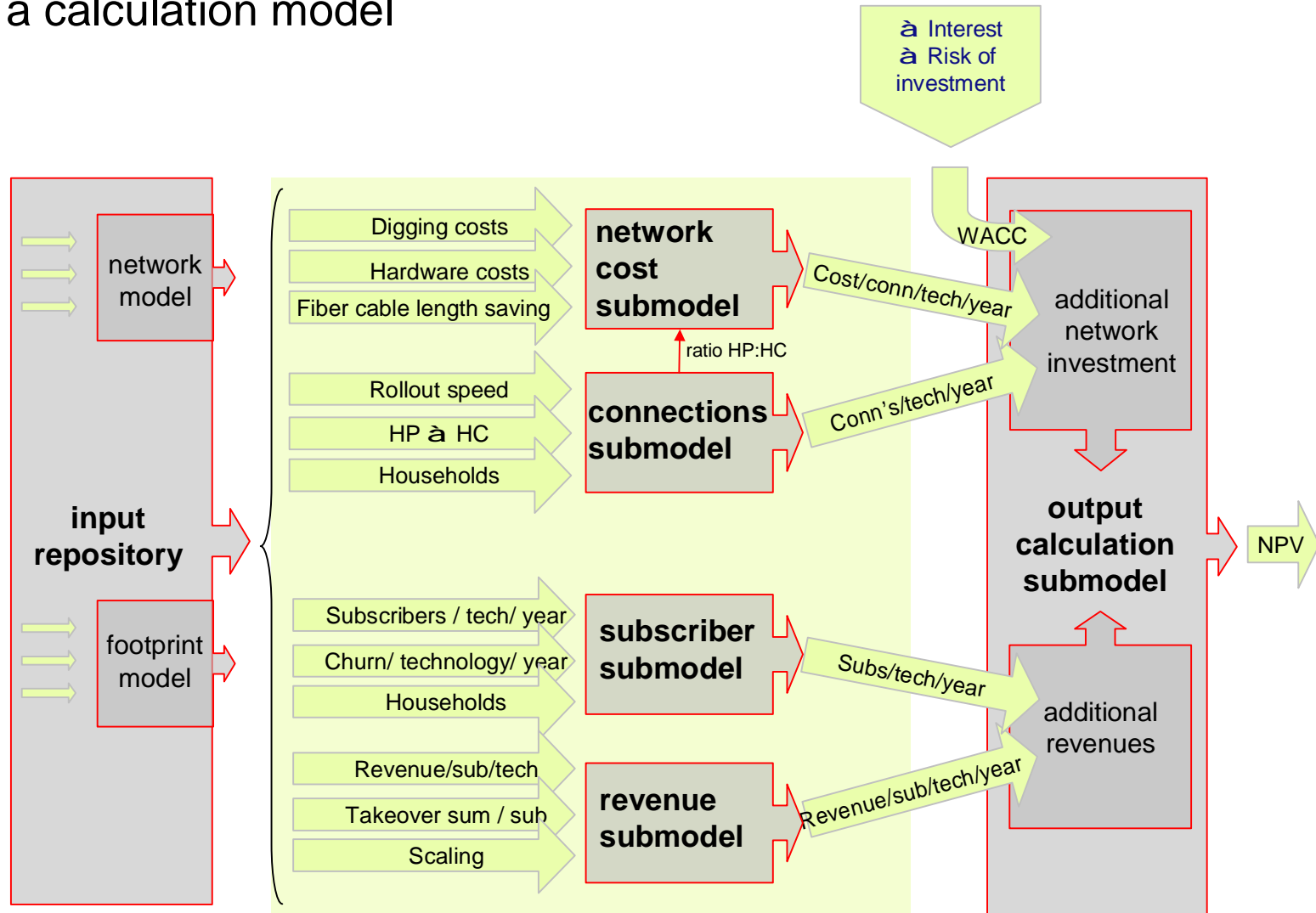
Solving Q1: techno-economic feasibility (“when”)

Creation of a calculation model



Solving Q1: techno-economic feasibility (“when”)

Creation of a calculation model



Solving Q2: topology feasibility (“where”)

- **Questions:**

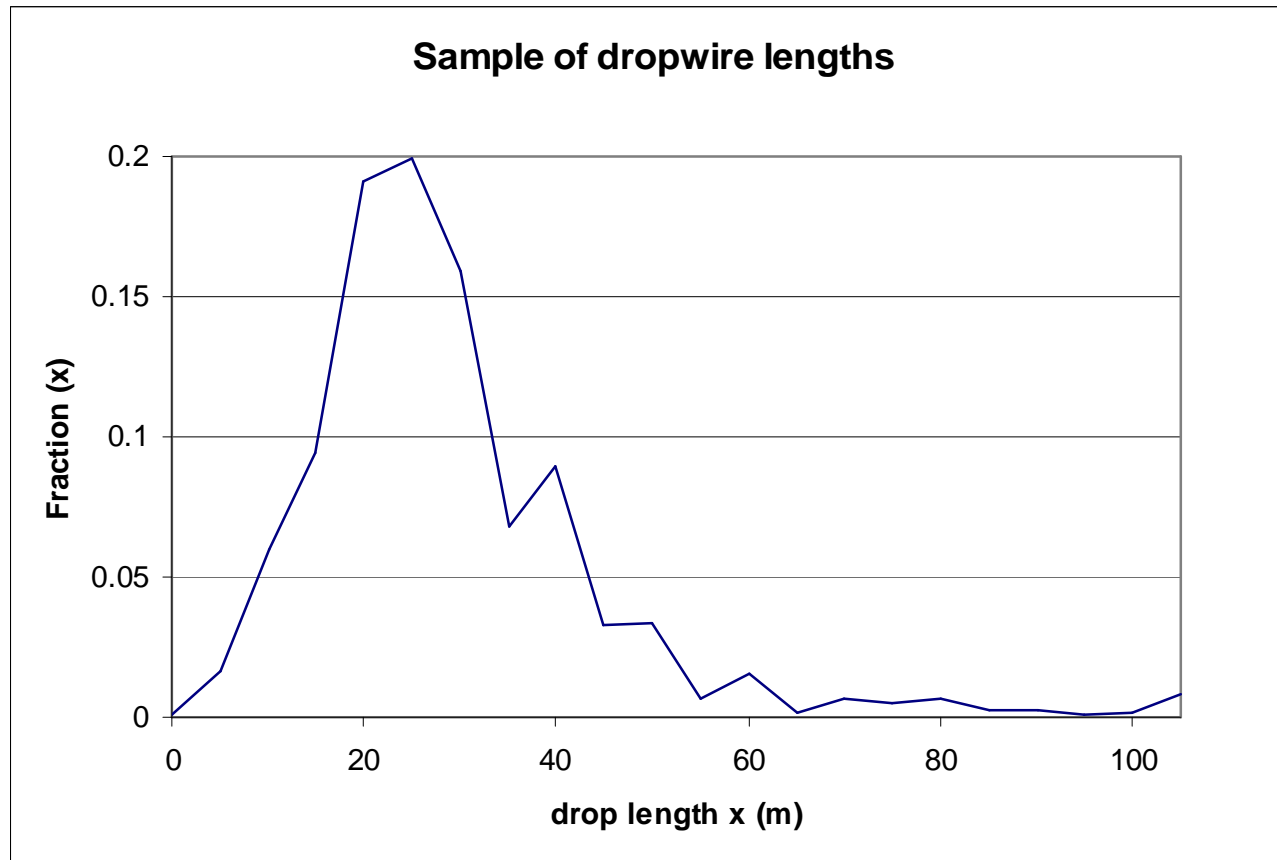
- How many locations are suitable (and where)
- What are their copper length
- How often can we use a double wire pair?

- **Answers :**

- country-specific

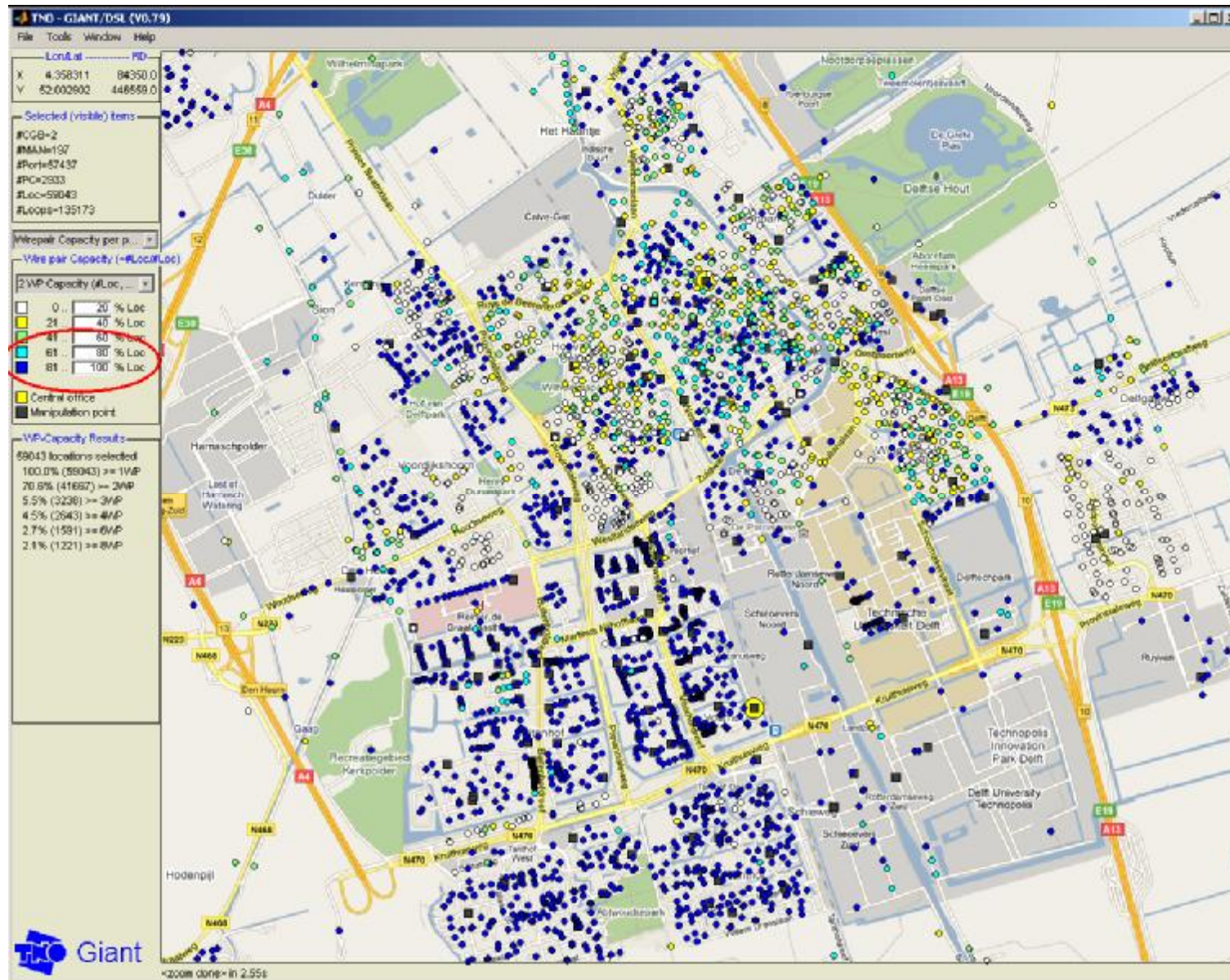
Solving Q2: topology feasibility (“where”)

- 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

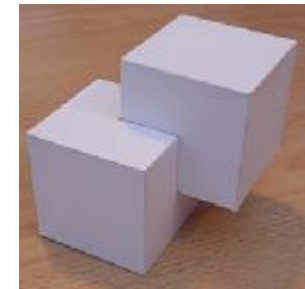
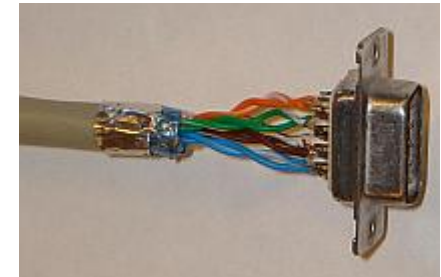
>70% in this city (example)



Solving Q3: Technical feasibility (“how”)

Characterizing copper cables up to 500 MHz

- **Develop measurement methods**
 - q create setups up to 500MHz (TNO, TID, BT, EAB)
 - q verify these setups via a Round Robin Test
 - q facilities to measure impulse noise and RFI
- **Do a lot of measurements**
 - q twisted pair cabling
 - q irregularities, like splices, manipulation boxes, etc.
 - q all kinds of ingress noise measurement
- **Develop simulation models**
 - q two-port models for single-pair cable transmission
 - q multi-port models for harmonized cable transmission (vectoring)
 - q statistic descriptions of impulse noise
- **Do simulations**
 - q define meaningful scenario's
 - q predict performance and throughput



Solving Q3: Technical feasibility, cable measurements



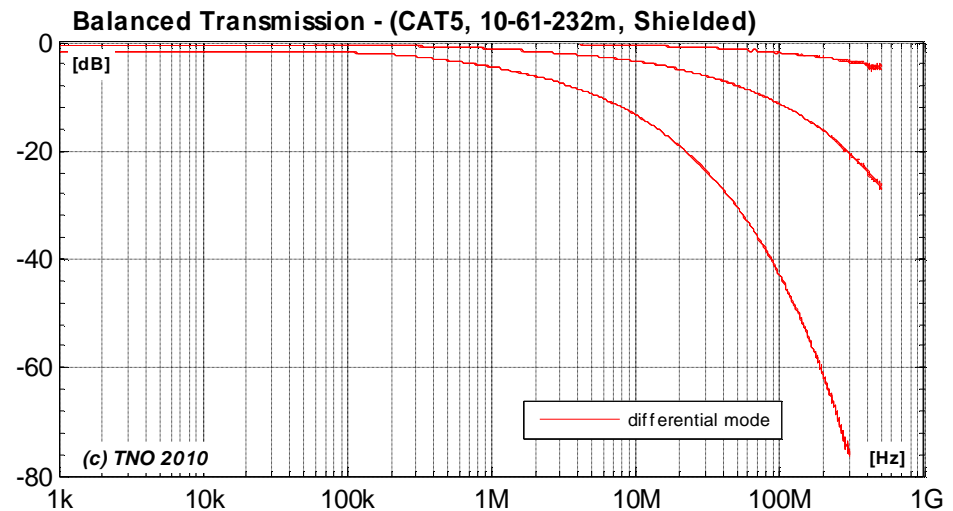
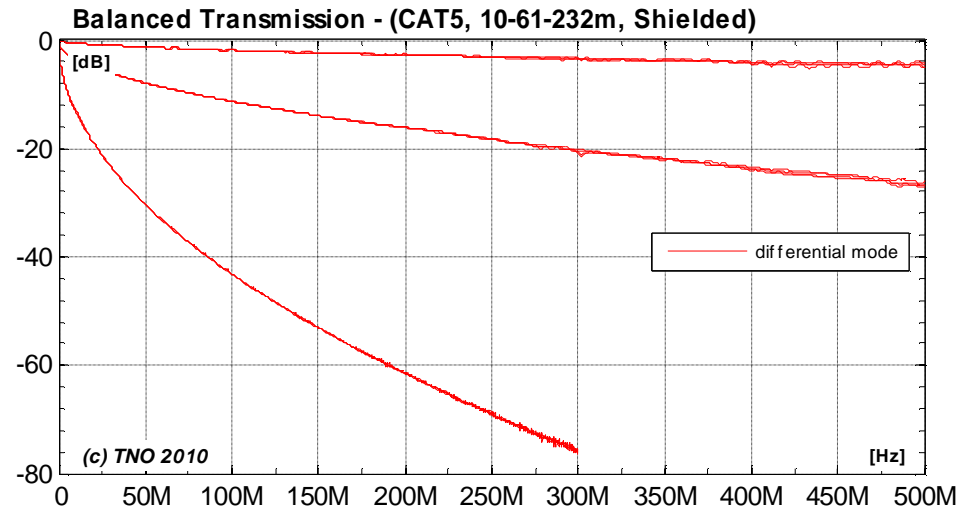
Measurement setup up to 500MHz

Solving Q3: Technical feasibility, cable measurements

Characterizing copper cables: example up to 500 MHz

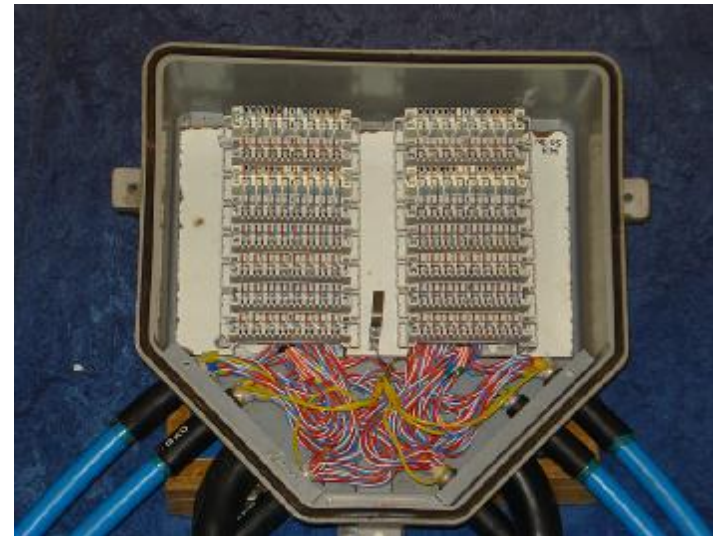
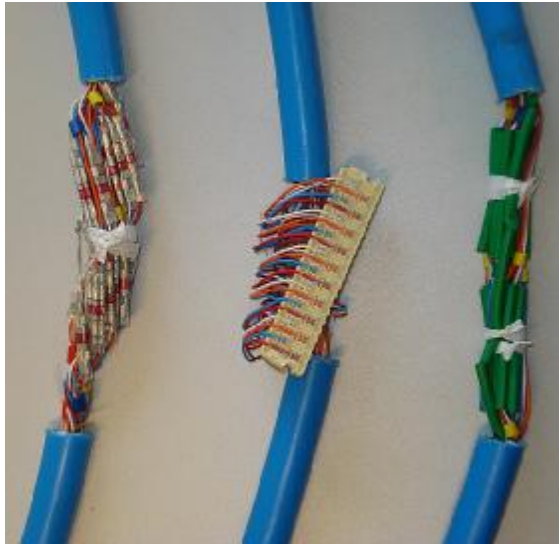
Balanced Transmission:

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



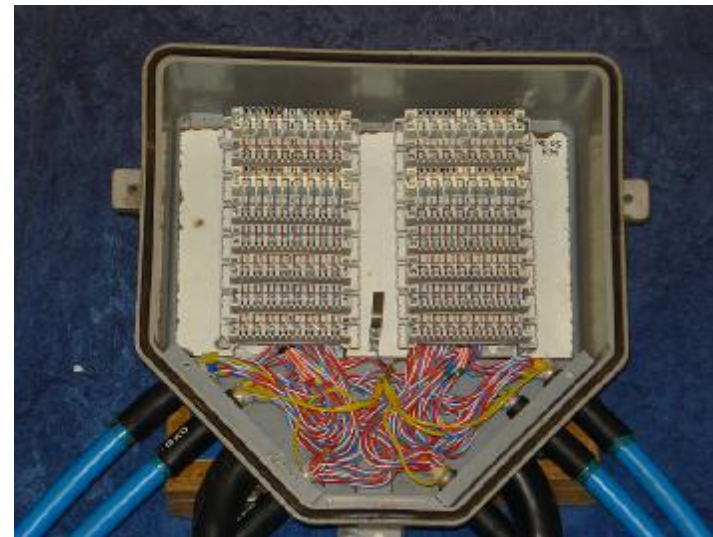
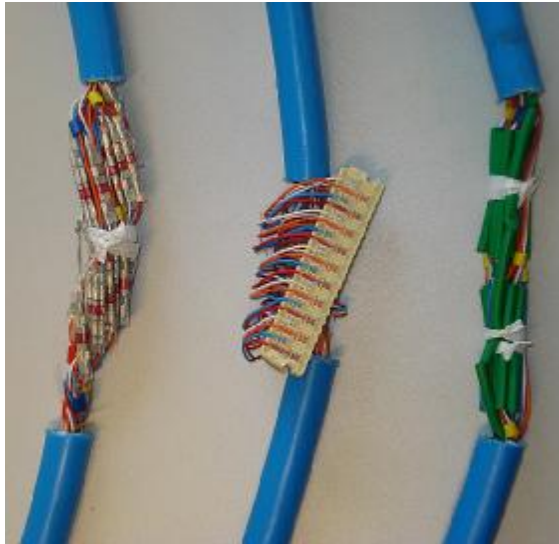
Solving Q3: Technical feasibility, cable measurements

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** → 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



2009-2011

*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: liaison to ITU*



Feb 2011: start of "G.fast"

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

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

Standard(s)



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

TNO

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

Abstract: Recent developments are paving the way for Telenor to offer bandwidth of 4GBB to end users in a cost effective manner. This development can be traced back to the fact that the use of fiber to the home (FTTH) via existing telephony wiring can be a viable option. This solution is considered to become an important element in the 4GBB ecosystem. This white paper explains the need for this new concept, its feasibility requirements and recent developments in standardization.

1. INTRODUCTION

The quality of life and on the economy depends on the availability of ubiquitous low-cost broadband access. Demand on end-user bandwidth continues to increase as new broadband services emerge. E-mail demand keeps steadily growing, and each year grows by a factor that demonstrates a new generation of broadband services. Currently, access to second generation broadband services (2GEB), requires up to 100Mbps, and access to fast internet and triple play has become a commodity in many countries. The market share of access to third generation broadband services (3GEB), requires up to 100Mbps, and includes multiple IPTV channels simultaneously and cloud computing) is steadily growing. A small percentage of subscribers already has access to even higher bandwidth (>100Mbps), but this does not necessarily mean that they really use it for a 4GBB service package (up to 1Gbps). The type of services that will be typical for a 4GBB service package is steadily increasing but it will probably include more than just many HD IPTV channels simultaneously. However, for the time being, we simply assume that some of these users will be a massive demand for 4GEB and fast access to bandwidth of up to 1Gbps are to become a commodity.

Telenor as well as Cable Operators have their own solutions for migrating their networks to deliver broadband services (DSL via twisted pair telephony wiring and Fiber-to-the-Home via coaxial CATV wiring). Figure 1 illustrates the evolution of the network.

Figure 1 illustrates the evolution of the network. It shows three stages: 1. DSL network: DSLAM, DSL line, DSL modem, PC. 2. Hybrid FTTH network: FTTH cabinet, FTTH line, FTTH splitter, FTTH modem, PC. 3. Full FTTH network: FTTH cabinet, FTTH line, FTTH splitter, FTTH modem, PC.

To deliver over 4GBB to the masses, Telenor will require another generation of access technologies to migrate their access networks. The use of FTTH (Fiber to the Home) will be a key technology for transporting hundreds of Mbps to end users and access. But FTTH has not been easy to roll out. It has to be deployed all the way to a point inside the Home. An alternative is bringing the access to the Home and re-using existing telephony wiring for bringing the last 20-300m. Such an alternative may be more cost effective in several cases, since it avoids new installation cost and time. It enables the implementation of FTTH for 4GBB in different variants, and the one that is preferred is to be selected on a case-by-case basis. FTTH is selected where it is more attractive from a business point of view. Both solutions are fully capable of handling bandwidths of hundreds of Mbps or more.

This approach is a new concept, and the copper technology required for such a Hybrid FTTH solution is steadily evolving. Hereafter, the approach looks very promising, and ITU-T-SG15 has recently started standardization of the required technology under the working name “G.fast”. This article explains the need for this new concept, its feasibility requirements and recent developments in standardization.

TNO WHITE PAPER ON DSL | 35514 | APRIL 2011

4GBB
everywhere

Conclusions

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- 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)

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

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

