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TITLE: G.fast: Is G.fast deployable in Amsterdam?

**ABSTRACT**

In this contribution the city of Amsterdam is analyzed as potential deployment target for G.fast. The main conclusions from this case study show that there are large opportunities for the G.fast deployment in Amsterdam, even already from existing manipulation points (cabinets). But, due to the copper infrastructure, a G.fast deployment in Amsterdam will require G.fast modules with more than 48 ports. This contribution is for information only.

# 1. Introduction

It is expected that the deployment of G.fast will mainly focus on densely populated city centers and fiber to the building situations. It is our opinion that hybrid FttH with G.fast ***should not be positioned as an interim solution*** towards full FttH, but should offer a long term solution. If hybrid FttH with G.fast can offer aggregate bitrates up to 500-1000Mb/s, and to a significant number of homes, then there may not be a need to replace it by Full FttH for a very long time.

In this contribution the city of Amsterdam is analyzed as potential deployment target for G.fast. The results of this analysis support or refine the requirements identified in [1,2].

# 2. Network topology Amsterdam

The analysis starts with the assumption that G.fast in the Netherlands will be deployed for loops up to 200m to guarantee competitive service rates.

The copper access network topology in Amsterdam (see figure 1) has the following characteristics:

- The copper access network topology consists of cabinets (in streets or buildings) from which cables of 50, 100, 300 and occasionally even, 450 and 900 twisted pairs leave towards the customer premises.
- A cable leaving the Street Cabinet consists in most cases of a first long part, before branching out in a tree of thinner cables,
- At the branches, the network contains typical underground splices which are not easily accessible for manipulation,
- The access network is terminating in so-called “End of Cable points” (EC).

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**Contact:**
TNO, Bas van den Heuvel — Email: bas.vandenheuvel@tno.nl
TNO, Bas Gerrits — Email: bas.gerrits@tno.nl
TNO, Harrie van de Vlag — Email: harrie.vandevlag@tno.nl
TNO, Rob van den Brink — Email: rob.vandenbrink@tno.nl

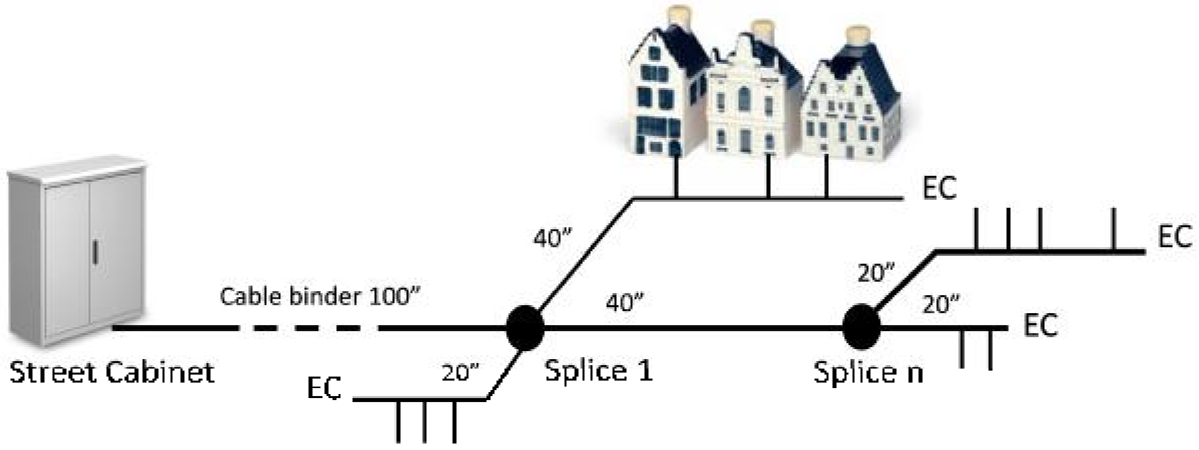


**Figure 1: Schematic example of a typical (secondary) access network in Amsterdam.**

## <u>Some statistics:</u>

- In the Netherlands, about 95% of the households have potential capability for a double wire pair connection between cabinet and house. In fact, 58% are already fully pre-installed while the remaining 37% need manipulation at the splices. In Amsterdam, the percentage of readily available double wire pairs is estimated to be larger than 80%.
- Amsterdam has 11.070 (secondary network) cables leaving a cabinet covering about 442.500 unique addresses.
- 87% of these cables are of size 100”, with 100 wire pairs.
- 45% of the unique addresses are connected by cables with a maximum EC length of 200 meter.
- For those 45% of the addresses, the connecting cable is almost always a 100 wire pair (100”) cable.

Focusing on those 45% of the addresses and connected through a 100” cable (see figure 2):

- 89% of these 100” cables connect no more than 48 unique addresses (and most of them via double wire pairs), 11% of the these cables have more than 48 unique addresses to connect.
- More than 50% of these 100” cables connect between 32 and 48 unique addresses (and most of them via double wire pairs).

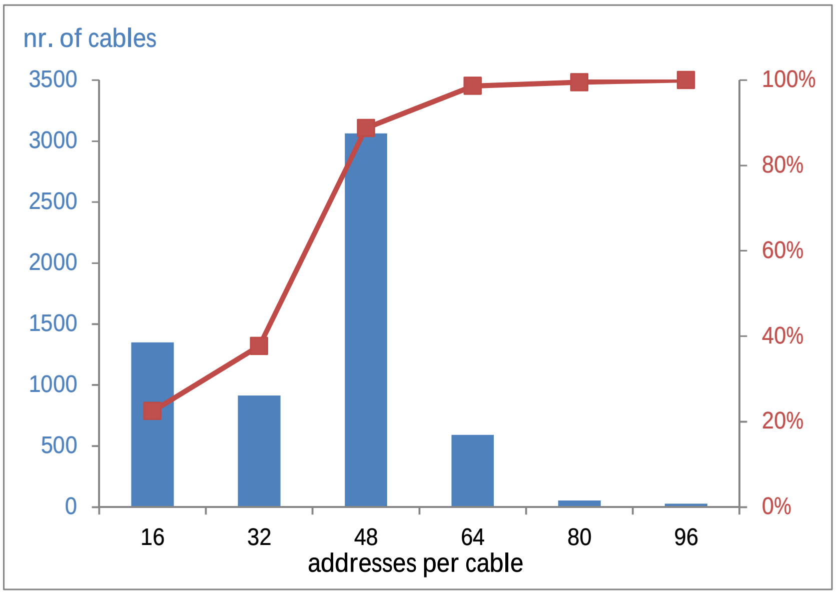


**Figure 2: Distribution of the number of unique addresses connected on the 100” cables in which all connected addresses are located within 200 m (EC-length).**

Figure 3 shows how large the deployment opportunity is for G.fast in the center of Amsterdam. It shows all the street cabinets, with the green coloured cabinets having all their addresses  within 200m copper distance (EC length). Note that this is a slightly different analytic approach as written above namely, cabinet-centered instead of cable-centered.

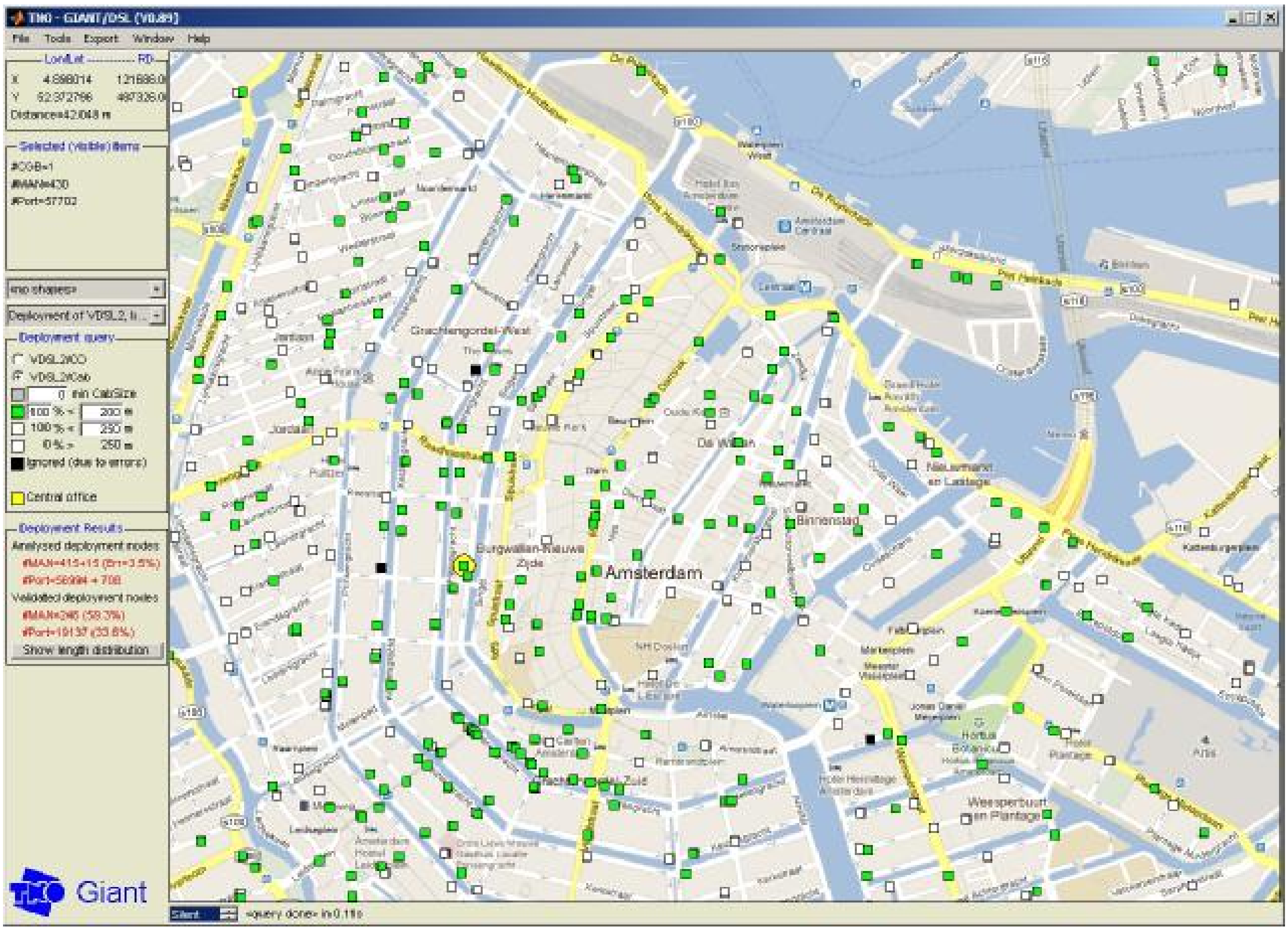


**Figure 3: All Street cabinet locations in central Amsterdam. This figure illustrates the large deployment opportunity (green colored cabinets) for G.fast in this area. The detailed numbers shown in the figure may differ from the numbers in the text due to e.g. a different selection of cabinets, and a cabinet-centered approach instead of a cable-centered approach**

# 3. Scenarios

Based on the outcome of the analysis of the copper infrastructure in Amsterdam, two deployment scenarios for G.fast can be identified:

1. Deployment from existing distribution points (cabinets). Almost half of Amsterdam can be covered by G.fast in this way, since 45% of the addresses in Amsterdam are connected by cables with a maximum EC-length less than 200m from the cabinet. Deployment from these cabinets can be cost- and time efficient, in particular in those cases where VDSL2 is already deployed ensuring the presence of fiber and electricity.
2. Deployment from new distribution points where cables between the addresses and street cabinets are longer than 200m. Because the Netherlands do not have so-called man-holes, new distribution points need to be created by digging-up the cable/splice and cutting or opening them.

# 4. Scenario 1: deployment from existing distributions points (cabinets)

In this scenario, G.fast is deployed on cables leaving existing cabinets where the maximum EC-length in that cable is less than 200m[2]. Analysis has shown that these are all 100" cables and 89% have a maximum of 48 unique addresses connected, see figure 3. Furthermore, it is known that most of the addresses have a double wire pair connection, which makes bonding very attractive.

Which operator requirements can be identified when deploying G.fast from the cabinet?

*Requirement on module/vector group size:*
In this scenario, the required module/vector group size depends on:

- the maximum number of wire pairs in the cable from cabinet to addresses (using bonding where feasible).
- market share, the actual number of addresses in the cable to connect

The fact that 11% of the cables are connecting more than 48 addresses already shows that a maximum module/vector

[2] This includes FttB scenarios with the 'cabinet' in e.g. the basement of a building.

group size of 48 is too low, even for the case of non-bonded G.fast. For the case of bonded G.fast, the fact that more than half of the cables connect between 32 and 48 unique addresses (most of them via double wire pairs) leads to required module/vector group sizes between 64 and 96 for half of the cables.

It is acknowledged that on average the required module size will be lowered by the fact that the Telco does not have 100% market share. However, there will be spread in the market share from one cable to the other, making it again clear that a maximum module size of 48 will not be enough for a substantial part of the network.

Note that requirements on the initialization time will be necessary from QoE perspective. These requirements may be more challenging for large number of lines in the vector group.

*Requirement on bonding:*
Bonding is very desirable for the Dutch market, since 58% of the addresses in the Netherlands have a double wire pair connection between house and cabinet already available, and about 95% of the addresses in the Netherlands have the potential capability for such a double wire pair connection.

*Requirement on powering:*
Deployment from a cabinet has the advantage that in most cases (local or remote) powering is available and/or that the heat from power dissipation is manageable. This allows to relax the strict requirements on reverse powering and on power dissipation for "bigger" modules.

## 5. Scenario 2: deployment of new distributions points (splices)

In this scenario, deployment from the street cabinet is not an option due to cable lengths exceeding 200m. The deployment will be from new distribution points strategically located within 200m from the targeted addresses.

This strategic location for a new distribution point can be found when optimizing the balance between service rates (depends on the maximum distance from the potential customers) and deployment costs per potential costumer (depends on the number of households and digging/installation costs). A logical location for a new distribution point will be near a splice, e.g., near splice 1 (see figure 1).

Other options are e.g., just cutting the cable at a strategic length. Note, that the Netherlands has underground cables and splices which are not (easily) accessible for wire pair manipulation. Therefore, it is expected that most of the modules will be deployed underground (in the curb) or on building walls in small pizza boxes.

The following requirements can be identified in case of deployment from new distribution points:

*Requirement on module/vector group size:*
The requirement on module/vector group size is expected to be maximally 48 ports.

*Requirement on bonding:*
The nearer the new distribution point is located to the customers, the higher the percentage of addresses where a double wire pair connection between house and cabinet is already available (increasing from 58% to 95%). Hence, bonding is very desirable for the Dutch market.

*Requirement on powering:*
Deployment from a underground splice requires reverse powering, and limitations on power dissipation.

*Requirement on system/management:*
Because of underground deployment and therefore no-easy access, zero touch deployment/maintenance will be required.

## 6. References


[1] KPN, TNO, "*G.fast: KPN requirements for G.fast*", Contribution ITU-T SG15/Q4a 2012-06-4A-039, Antwerp, Belgium, June 2012.

[2] KPN, TNO, "*G.fast: KPN requirements for G.fast*", Contribution ITU-T SG15/Q4a 2012-11-4A-024, Chengdu, China, November 2012.


## 7. Summary

This paper should be presented under the G.fast agenda item, and is related to issue 2.1.2.4 of the issue list and to other operator requirements. It provides arguments for requiring the support of G.fast module sizes of up to 100 ports. This contribution is for information only.