Automated Geography-Based Fixed Network Planning Tool

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This work has been funded by the German Research Foundation (DFG) under grant numbers MA6529/2-1 and KE1863/4-1.

Fixed Network Planning

Inputs & Constraints

Given:
- City street topology,
- Central Office (CO) location,
- Demands,
- Possible Remote Node (RN) locations,
- Access Network Parameters

Constraints:
- Cost, availability, delay
- Street length metric
- Minimize civil works

Plan:
- RN placement
- Fiber routing

Automated Planning Tool Information

General Information

- Based on Geographic Information System (GIS) – ArcGIS¹
- Real street topologies – Open Street Maps²
- Python-based implementation
- Ready to use tools with easy GUI

Methodology³

Assigning demands to a RN = clustering:
- Location-Allocation Problem with capacity constraint⁴
- Cluster head defines the RN position
- Performed for every stage of the network
- Cut-off

Shortest path routing:
- Relies on the street topology (not Euclidian distances)⁵

Outputs:
- RNs locations
- Fiber and duct lengths
- Input for cost, availability and further analyses

Cost Analysis Example

Implemented Planning Scenarios

Fiber-To-The-Building (FTTB)

Central Office (OLT)

Splitting Ratio (SR):
- Dependent on the equipment: e.g., Power Splitter (PS) can have 2ⁿ ports
- With (80%) or without (100%) ports reserved for the future use
- Link-disjoint path protection
- Shortest path fiber

Greenfield: planning from scratch
- All possible RN locations, e.g., street intersections

Brownfield: reusing existing infrastructure
- RN locations – constraint with existing ones
- Duct reuse – encouraging using the existing duct

Residential Fiber-To-The-Cabinet (FTTCab)

Central Office (OLT)

Brownfield: Last Mile Copper → Fiber Copper:
- Calculated to get the possible RNs locations for the fiber case to reuse
- RN2 in this case is ONU and a DSLAM
- Cut-off of 250m to 4000m

Fiber:
- The RN2 possible locations from the copper LM
- RN2 → Power Splitter

Greenfield: Last Mile Fiber
- RN2 can be placed at any possible location
- Power Splitter at RN2

Joint Fiber-To-The-Cabinet (FTTCab)

Central Office (OLT)

Joint Planning:
- Physical infrastructure is shared between the residential users (time division multiplexing) and BSs (full wavelength).

NG-PON2 or Hybrid PON (HPON):
- RN1 is an AWG
- BSs and RN2 are clustered together

Footnotes:

¹ https://www.arcgis.com
² https://www.openstreetmap.org
³ E. Grigoreva, C. Mas Machuca, L. Kellerer
⁴ Energy Consumption and Reliability Performance of Sustainable Passive Optical Converged Optical Networks. Public IT Case Study
⁶ C. Mas Machuca, L. Kellerer