FiberQ End-to-End Workflow Guide
Designing a GPON / FTTH Network (Underground + Aerial + In-Building)

A practical guide for building telecom fiber designs in QGIS using the FiberQ plugin

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1. Purpose and scope

This document explains how to design a GPON/FTTH access network in a neighborhood or city using FiberQ (an open-source QGIS plugin for telecom/fiber workflows). The workflow covers mixed infrastructure: underground ducts and manholes, aerial pole routes, and in-building distribution to end users.

The focus is on clean topology (connected routes), disciplined attributes (so exports work), and deliverables: an optical schematic, a Bill of Materials (BOM), and exchange formats (GeoPackage/PostGIS).

1.1 Outputs you will produce

- Connected physical design: poles/manholes/ducts, routes, cables, and elements (ODF, TB/OTB, patch panels, closures).
- Logical GPON structure: feeder, distribution, and drop segments, plus splitter locations/ratios.
- Optical Schematic View export (PNG/JPG/SVG) for QA and reporting.
- BOM export (XLSX/CSV) for quantities and lengths (including slack).
- Optional: shared PostGIS database and Preview Map for collaboration/review.

1.2 Standards and best-practice references (for design rules)

FiberQ is a GIS tool; the engineering rules come from standards and operator practices. Use local regulations and your operator's standards as the final authority. These references are a solid baseline:

- ITU-T G.984.1 and G.984.2 (GPON): architecture and physical constraints (including optical path loss budgets).
- FTTH Council Europe: FTTH Handbook (planning, design, build, and operations).
- FOA (The Fiber Optic Association): practical FTTH network design guidance and labeling conventions.
- BICSI FTTx materials: common design patterns and component roles.
- TIA-598: optical fiber color identification (useful for consistent labeling and documentation).

2. GPON/FTTH design model used in this guide

2.1 Network hierarchy (maps cleanly to layers and attributes)

- POP / Central Office (optional point feature): where the OLT sits.
- Feeder: POP/ODF to splitter aggregation (cabinet/closure/building entry). Higher fiber count.
- Distribution: splitters to local terminals (TB/OTB/closures closer to customers).
- Drop: terminal to customer premises (home, or building entry for MDUs).
- Indoor: building entry to floors/units (patch panels, risers, floor boxes).

2.2 Splitter strategy (conceptual)

GPON uses passive splitters. Typical split ratios in real ODN deployments commonly range from 1:16 up to 1:128, depending on reach, density, and power budget. Keep the splitter decision explicit in your data (location and ratio).

2.3 Optical budget (why accuracy matters)

Every splice, connector, splitter, and meter of fiber adds loss. GPON designs must stay within the optical path loss budget defined by the PON class you target (for example, class B+ is widely referenced). Track splitters, closures, and patch points accurately so later calculations and audits are trustworthy.

2.4 A tiny design-decision worksheet (fill once per project)

Decision	Your project choice
Target technology	GPON / XGS-PON / other
Target split ratio(s)	e.g., 1:32 (single stage) or 1:4 + 1:8 (two stage)
Target PON class / budget	e.g., B+ (check your operator standard)
Max feeder reach target	e.g., 10-20 km depending on class and split
Slack policy	e.g., end slack + mid-span slack at access points
Build phases / zones	e.g., Zone A / Zone B, subcontractor packages

3. Before you start in QGIS and FiberQ

3.1 Data you should have (minimum)

- Basemap/background layers (streets, parcels, buildings).
- Known infrastructure if available: existing poles, manholes/handholes, ducts, cabinets, building entrances.
- Customer/service points: addresses, parcels, or building centroids (planned ONT locations).
- Constraints: road crossings, restricted areas, rivers/railways, permitted corridors.

3.2 QGIS setup checklist (for clean geometry)

- Use a meter-based CRS for correct lengths.
- Enable snapping + topological editing (avoid tiny gaps in routes).
- Set reasonable snapping tolerance (based on your map scale).
- Validate geometries after imports (fix self-intersections, duplicates, overlaps).

3.3 FiberQ setup checklist

- Create a new FiberQ project (so required layers exist and are consistently named).
- Save your working layers to a GeoPackage frequently (or enable auto-save if you use it).
- Decide a naming convention for IDs and classes from day one (it will save you later).

4. Workflow overview and FiberQ tools map

This is the high-level sequence, plus the FiberQ toolbar modules typically used at each step.

Workflow step	Main FiberQ module/tools	Output layers (typical)
Place poles, manholes, ducts/pipes, transition points	Routing / Ducting tools	Poles, Manholes, Ducts/Pipes
Place network elements (ODF, TB, OTB, Patch Panel, Closures)	Element Placement tools	Elements layers
Digitize buildings/objects	Objects tools	Objects/Buildings
Create routes between points/elements	Routing tools (Create route, Manual route, Merge routes, Breakpoints)	Routes
Lay cables from-to along routes	Cable Laying tools	Cables
Add slack/reserve	Slack tools	Slack/Reserves (and cable totals)
Validate connectivity visually	Optical Schematic View + filters	Schematic export
Export deliverables	BOM Report, Export to GeoPackage, Publish to PostGIS, Preview Map	XLSX/CSV, GPKG/DB layers, web preview

5. Step-by-step instructions

Step 0 - Prepare and import data (including conversions)

FiberQ works best when your source data is already in the correct geometry type (points/lines/polygons) and CRS. Import from your source formats, clean them in QGIS, then append into the FiberQ layers.

0.1 Common inputs you can import

- CAD/DXF: poles, chambers, ducts, and existing routes (often need CRS assignment and cleanup).
- Shapefile/GeoPackage: parcels, buildings, address points, municipal assets.
- CSV/Excel: customer lists (load with coordinates or geocode first).
- PostGIS: existing asset inventory.

0.2 Convert imported features into FiberQ layers

- Reproject to your project CRS.
- Clean geometry (fix invalid geometries, remove duplicates).
- Snap and simplify lines so corridors are clean and connected.
- Copy/append features into FiberQ layers and standardize key attributes (ID, type, status).

Step 1 - Place infrastructure and network elements

1.1 Poles and manholes/handholes

- Place Poles for aerial corridors and Manholes/Handholes for underground access points.
- Keep IDs consistent and unique. Record status (planned/as-built) and any capacity fields you use.

1.2 Ducts, PE/transition pipes, and duct segments

- Digitize duct segments along streets/corridors. If you track capacity, record duct count and occupancy later.
- Place explicit transition points (underground-to-aerial and building entry).

1.3 Elements (ODF, TB, OTB, Patch Panels, Closures)

- ODF: POP/exchange or major aggregation.
- TB/OTB: distribution terminals (street, pole, cabinet, or building entry).
- Patch panels: inside buildings (basement/comm room/floor closets).
- Closures: splicing/branching points (manhole, handhole, pole-mounted).
- Record element type, capacity, and splitter ratio/count where applicable.

1.4 Buildings/objects

- Digitize building footprints and store attributes (name, address, floors).
- For MDUs/high-rise: define entry point(s) and internal distribution nodes (patch panels, riser points).

Step 2 - Create routes between points/elements

Routes are the physical corridors that cables follow. Keep them snapped and connected. Assign laying type so downstream filters and exports behave.

2.1 Create routes (automatic vs manual)

- Automatic routing is usually best for poles/manholes when the tool supports it.
- Manual routing is best for element-to-element routing (ODF to cabinet, TB to building entry, etc.) and for precise paths.
- Set route attributes: laying type (underground/aerial/indoor), duct reference (optional), status, and relation/zone.

2.2 Merge/split routes and run QA

- Merge segments to simplify the network graph (fewer, longer logical corridors).
- Split routes at construction phase boundaries or where you need independent reporting units.
- QA checklist: no gaps, no dangling ends, correct connection to nodes, correct laying type.

Step 3 - Lay cables (from-to) and assign class

3.1 Cable classes (recommended)

- Feeder: ODF/POP to splitter aggregation (often high fiber count).
- Distribution: splitters to terminals/cabinets/building entry (medium fiber count).
- Drop: terminal to end user/building unit (low fiber count).
- Indoor: within building (riser/floor distribution).

3.2 Laying cables in FiberQ

- Open Cable Laying and select start + end elements.
- Pick the intended route(s) and confirm laying type (underground/aerial/indoor).
- Enter: cable_id, class, fiber_count, status, relation/zone.
- Repeat for each segment. Keep splicing/branch points explicit (closures, cabinets, patch panels).

Step 4 - Add optical slack/reserve

Slack is what makes repairs possible. Model it so the BOM and cable totals reflect reality.

4.1 Typical slack placement (adapt to your operator rules)

- At both ends of each cable (near closures, cabinets, ODFs, TB/OTBs).
- At mid-span access points on long segments (handholes, poles), if maintenance policy requires it.
- At transition points (underground-to-aerial, building entry).

4.2 Slack in FiberQ

- Use automatic end-slack tools where available for selected cables.
- Add mid-span slack reserves at access points.
- Record slack length and type so BOM totals are correct.

Step 5 - Generate the Optical Schematic View and export

The schematic is your truth serum: it ignores geography and shows connectivity. Use it to catch wrong connections and missing nodes.

- Open Optical Schematic View.
- Use filters: Backbone/Distribution/Drop, and Underground/Aerial, to validate each layer separately.
- Use layout tools (Relax/Finalize/Center/Refresh) until it is readable.
- Export as PNG/JPG/SVG for reports and handover.

Step 6 - Generate and export BOM (XLSX/CSV)

- Open BOM Report.
- Review layer-by-layer totals (feature count, length, slack, total).
- Export to XLSX for cost estimation/procurement or CSV for integration.

Step 7 - Export or publish (GeoPackage, PostGIS, Preview Map)

7.1 GeoPackage exchange

- Export/save working layers to GeoPackage for sharing and archiving.
- Keep a clean structure: /data, /exports, /schematics, /bom, /maps.

7.2 PostGIS collaboration (optional)

- Publish layers to PostGIS for multi-user workflows.
- Use unique IDs and a status field; agree on edit conventions (who edits what).

7.3 Preview Map (optional web preview)

- Use Preview Map to validate and share results quickly with stakeholders.
- Regenerate after major edits to avoid stale outputs.

Step 8 - Create zones, relations, and regions (after design is stable)

Once the design is connected and validated, create logical groupings for rollout, reporting, and maintenance.

- Use Relations to tag cables/routes by zone, cabinet area, ring, or build phase (e.g., Zone A, Cabinet-12).
- Create a Regions polygon layer (or reuse Objects) to define build packages and serving areas.
- Generate per-region exports: BOM subsets, schematics, and map layouts.

6. Labeling and documentation tips (small things that prevent big confusion)

6.1 Fiber color order (TIA-598 baseline)

If you label fibers (or buffer tubes) in documentation, a widely used baseline order for the first 12 fibers is:

Fiber #	Color
1	Blue
2	Orange
3	Green
4	Brown
5	Slate/Gray
6	White
7	Red
8	Black
9	Yellow
10	Violet
11	Rose
12	Aqua

6.2 QA checklist before exporting

- Routes are connected (no tiny gaps).
- Every cable has: cable_id, class, laying_type, and endpoints.
- Splitters and closures are explicit (not implied).
- Slack is present where policy requires it.
- Schematic checks pass for feeder, distribution, and drop views.
- BOM totals look realistic (especially slack).

7. Suggested attribute schema (minimal but useful)

Below is a minimal attribute set that keeps designs searchable and export-friendly. Adjust to your operator's schema.

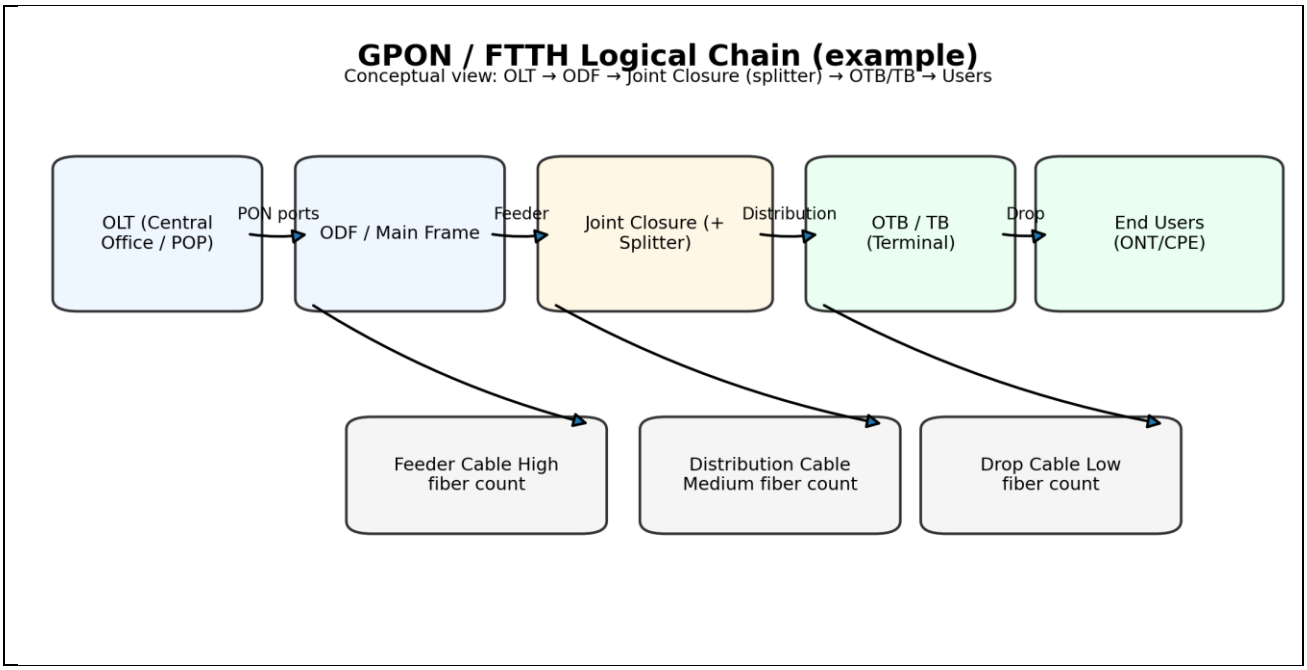
Layer / feature	Key attributes	Notes
Poles	pole_id, type, status, owner	Aerial corridors and attachment points.
Manholes/Handholes	mh_id, type, access_class, status	Good anchors for slack and splicing.
Ducts/Pipes	duct_id, type, capacity, status	Track duct capacity/occupancy if needed.
Routes	route_id, laying_type, status, relation	Keep geometry clean and connected.
Cables	cable_id, class, fiber_count, laying_type, relation, status	Feeder/Distribution/Drop/Indoor.
Elements (ODF/TB/OTB/etc.)	elem_id, elem_type, capacity, splitter_ratio, status	Splitters can be modeled here if needed.
Objects (Buildings)	obj_id, name, address, floors, status	Use entry nodes for in-building design.

8. References (human-readable)

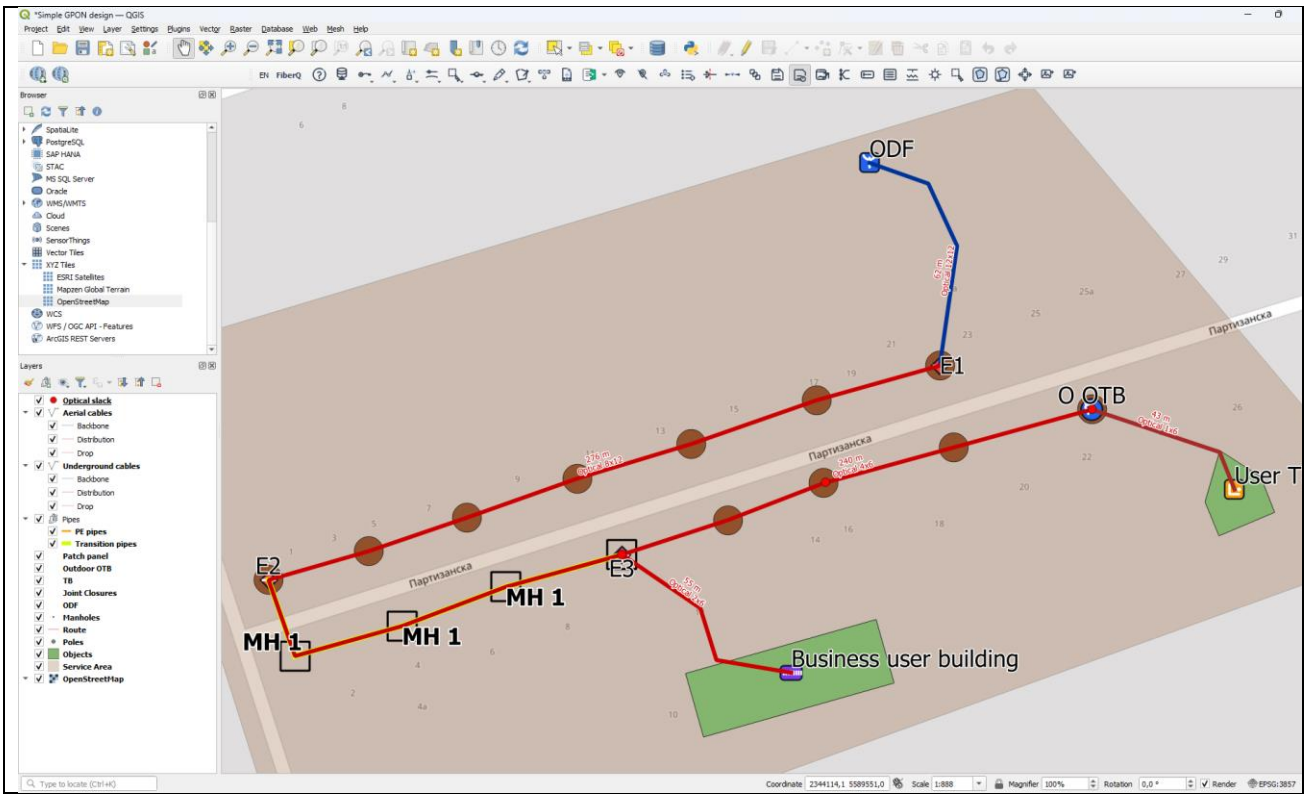
Recommended background reading for GPON/FTTH rules, budgets, and labeling conventions:

- ITU-T Recommendation G.984.1 - Gigabit-capable passive optical networks (GPON): General characteristics.
- ITU-T Recommendation G.984.2 - GPON Physical Media Dependent (PMD) layer specification (optical path loss budgets).
- FTTH Council Europe - FTTH Handbook (network planning, design, build, and operations).
- FOA (The Fiber Optic Association) - FTTH network design guidance and fiber optic color codes (TIA-598 baseline).
- BICSI - FTTx cabling design and solutions (training/presentation materials).

9. Deliverables Preview (Maps, Schematic, BOM)



Aerial + underground routes with feeder/distribution cables and slack points, also created objects and Service Area.



Tutorial Playlist (Video Walkthroughs):

https://youtube.com/playlist?list=PLL6BeSrtSQrOZvMD94tUEUW2iw0qjlHNO&si=i2Djk2xGUenQ2EqD