# Selecting an Affordable Last Mile Connectivity Solution

Session 3.1

# Introduction

**Why**

- Low availability of benchmark for designing middle and last mile connectivity networks
- Data/tools to support decision-making and assist designers when selecting technical solutions are often proprietary
- Importance to assess economic feasibility and cost of connectivity

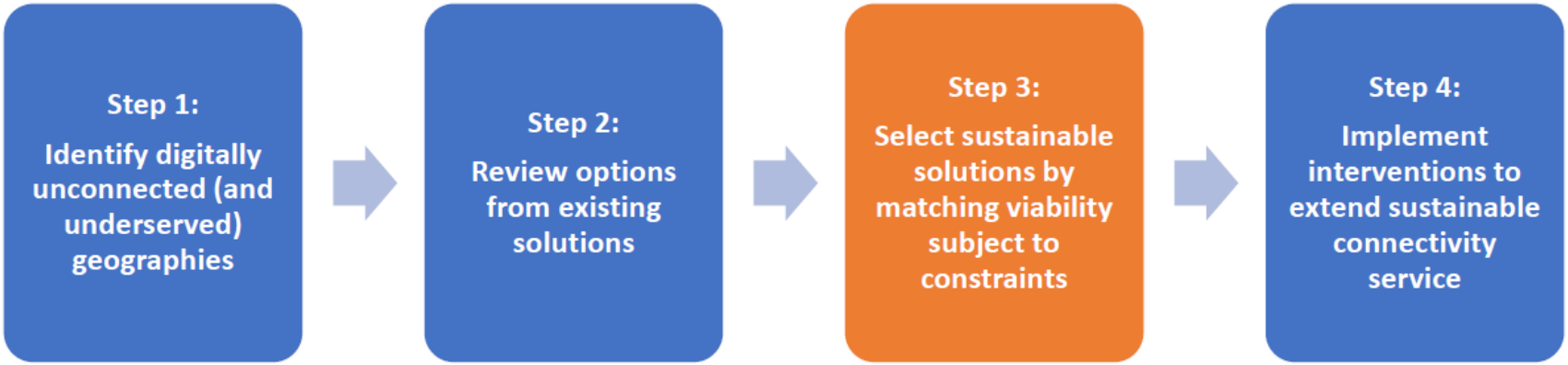
**What**

- Database of connectivity parameters
- Software tools to simulate design and cost of networks
- Methodologies for topology and cost estimation

**How**

- Model network technical and financial aspects
- Use open data and collecting data from countries
- Simulate projects using real data

# Step 3a: Select Sustainable Solutions by Matching Viability Subject to Constraints




**Step 3 activities to select sustainable solutions by matching viability subject to constraints:**

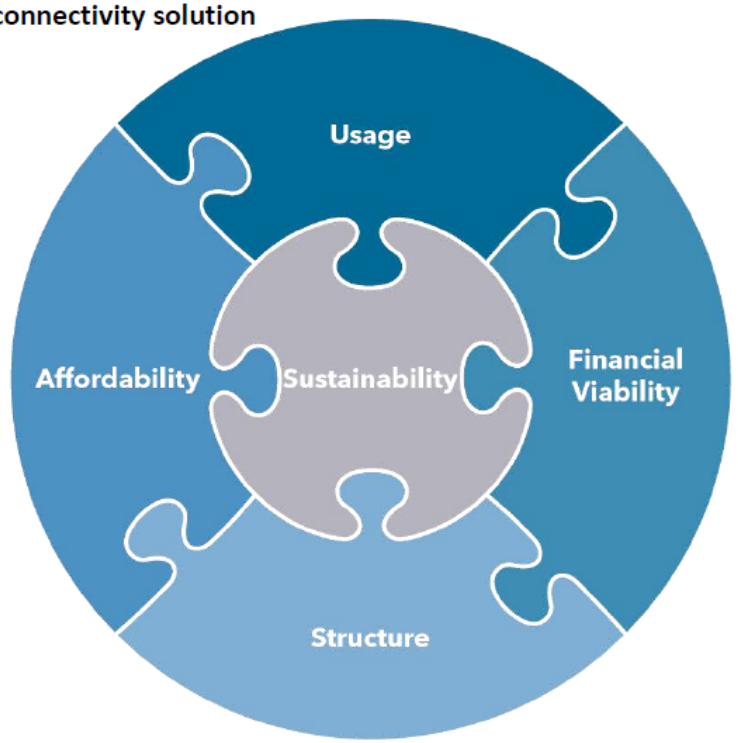
**3a** – Select an affordable last-mile connectivity solution
**3b** – Identify the components of an appropriate last-mile connectivity solution
**3c** – Draw up the decision matrix for feasible solutions
**3d** – Consider additional tools to assess solutions

# Selection Step 3a: Selecting a suitable Last-Mile Connectivity Solution

**To identify suitable last-mile connectivity interventions, after a specific unconnected geography / locality has been selected, it is necessary to first determine the five main aspects of a given situation that serve as binding constraints and can provide direction for any possible solution. These are depicted in the figure to the right, which demonstrates that identifying the most feasible and affordable last-mile Internet connectivity solution is a matter of fit between different aspects and can be considered an iterative process that requires identification and refinement of the options and selections made within the dimensions of the following factors:**

1) **Affordability** – Ensuring that connectivity service user pricing falls within a given affordability threshold, such as the 2 per cent of monthly GNI per capita for 1GB of mobile broadband data discussed above.
2) **Usage** – Identifying the applications and services that need to be available to the locality, and the level of QoS that those applications and services require.
3) **Financial viability** – This includes measuring the economic viability for private investment of the connectivity service, based on estimates of ARPU, availability of backhaul / middle-mile connectivity, options for different local access technologies and the potential level of the service's QoS.
4) **Structure** – This involves articulating the service delivery business model and identifying any regulatory constraints on the model and technologies utilized.
5) **Sustainability** – This requires an understanding of the service's revenue model and of any potential subsidy (one-time and/or recurring).

**Figure 32: Components in selecting a suitable last-mile connectivity solution**

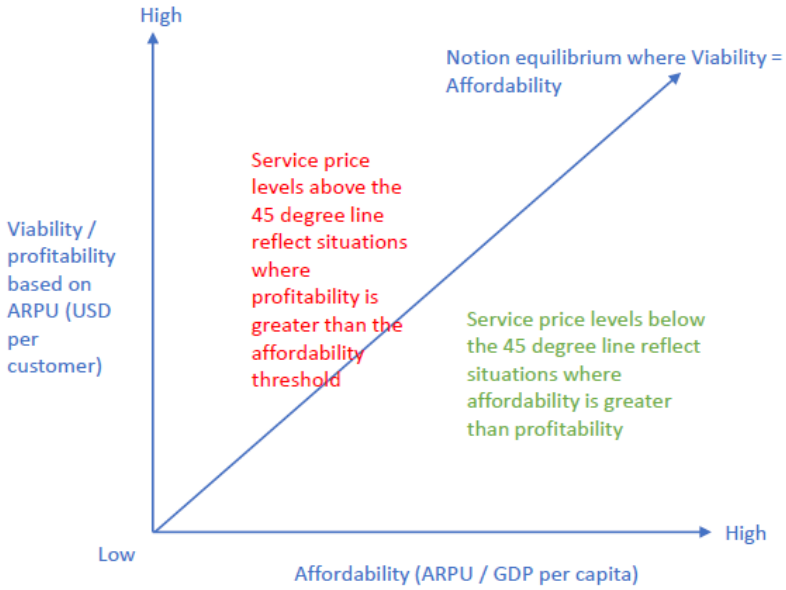


# Selection Step 3a: Selecting an Affordable Last-Mile Connectivity Solution

**Financial viability versus affordability:** It is worth stressing that the financial viability of establishing service (considered from the point of view of the investor, whether the project is a commercial investment or a subsidized deployment) is different from the affordability of the service provided (considered from the point of view of individuals in the prospective underserved locality). While financial viability is dependent on revenue generation, presumably from paying consumers, it is irrelevant – in terms of financial viability – whether these customers are higher or lower income, or if they are businesses and organizations instead of users. What matters is that the revenues generated can cover the costs of deployment. Affordability, particularly broadband affordability gauged on the basis of 2 per cent of monthly GNI per capita, on the other hand, is shaped by the consumer profile. So, whereas a deployment may be financially viable from the perspective of a service provider, in that it provides connectivity to higher-income consumers (or businesses), that particular deployment would not be serving an affordability goal.

The difference is depicted in the notional figure to the right, which shows that a service may be highly viable / profitable (in the eyes of a service provider), but low in affordability (for the average consumer).

**Figure 34: Financial viability versus affordability**



# Selection Step 3c: A Decision Matrix for Appropriate Solutions

The range of options facing any single intervention are extensive and the process of filtering the characteristics of the constraints can be linear (e.g. a decision tree) or iterative (determines a good fit on the basis of all of the inputs and constraints unique to each situation).

**Table 33: A decision matrix for appropriate solutions**

| | | Commercial MNO | Commercial ISP | Not-for-profit local mobile network | Not-for-profit local ISP network |
|---|---|---|---|---|---|
| **Affordability** | | Ex-ante measure of affordability threshold (such as 2 per cent of monthly GDP per capita for 1 GB of mobile broadband data) applied at national or local level; determination whether this will govern selection process or used just as an external measure of progress | | | |
| **Usage** | | Ex-ante determination of usage requirement: will usage be determined by what the market (and financial viability) support, or are there specific services and applications (such as e-government, health or education) that require meeting specific QoS thresholds? | | | |
| **Financial viability** | **Estimating demand and financial viability** | Small population/low income<br>Small population/higher income<br>Larger population/low income<br>Larger population/higher income | Small population/low income<br>Small population/higher income<br>Larger population/low income<br>Larger population/higher income | Small population/low income | Small population/low income<br>Small population/higher income<br>Larger population/low income |
| | **QoS options (backhaul)** | High capacity and competitive pricing<br>Low capacity and high pricing | High capacity and competitive pricing | Low capacity and high pricing | Low capacity and high pricing |
| | **Access network characteristics** | Small area/flat terrain<br>Large geographic area/flat terrain | Small area/flat terrain<br>Small area/mountainous terrain<br>Large area/flat terrain<br>Large area/mountainous terrain | Small area/flat terrain;<br>Small area/mountainous terrain;<br>Large area/flat terrain | Small area/flat terrain<br>Small area/mountainous terrain<br>Large area/flat terrain<br>Large area/mountainous terrain |
| **Structure** | | Commercial telecom operation licences required; licensed spectrum rights required | Commercial ISP licence required | Licensed spectrum rights required (except partnerships with an MNO); telecom licence may be required | ISP licence may be required |
| **Sustainability** | | Commercial operation that must break even (or provide coverage as a corporate social responsibility endeavour or coverage obligation requirement) | Commercial operation that must break even (or provide coverage as a corporate social responsibility endeavour or coverage obligation requirement) | Usage fees may have to be supplemented with in-kind contributions (network installation and operation) or ongoing community or government subsidies | Usage fees may have to be supplemented with in-kind contributions (network installation and operation) or ongoing community or government subsidies |

# Selection Step 3d: Additional Tools to Assess Solutions

**Table 34: Additional tools for assessing solutions (decision support and investment modelling)**

| Tool type | Tool name | URL | Applicability |
|---|---|---|---|
| Decision support | European Union Investment Modelling | https://ec.europa.eu/digital-single-market/node/77755 | Business model selection process |
| | World Bank Innovative Business Models | http://documents.worldbank.org/curated/en/674601544534500678/pdf/132845-7-12-2018-17-20-11-InnovativeBusinessModels.pdf | Determining public support for core network infrastructure |
| | Rural Telecommunications Infrastructure Selection | https://pdfs.semanticscholar.org/1b90/b5db52b035292c06d35f95d13cb4ba1e9e5e.pdf | Various criteria for rural last-mile connectivity |
| | "Closing the Access Gap" report, with key considerations and access models | https://www.usaid.gov/sites/default/files/documents/15396/Closing-the-Access-Gap.pdf | Identifying last-mile connectivity access models |
| Investment modelling | ITU ICT Infrastructure business planning toolkit | https://www.itu.int/en/ITU-D/Technology/Documents/Publications/ICT%20Infrastructure-business-toolkit.pdf | Network investment requirements |
| | "Connecting Africa Through Broadband" report model | https://www.broadbandcommission.org/Documents/working-groups/DigitalMoonshotforAfrica_Report.pdf | Modelling national universal access investments |
| | Internet for All Investment Tool (World Economic Forum) | http://www3.weforum.org/docs/IFA_models_for_year.xlsx | Demonstrates an investment modeling tool used for East Africa |
| | Last-mile Connectivity Business Modelling Tool (USAID) | http://inclusion.digitaldevelopment.org/resources/last-mile-connectivity-business-modeling-tool | Financial modelling of last-mile connectivity interventions |

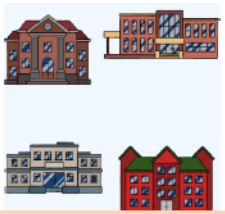
# Broadband Connectivity Toolkit

*set of methodologies, software tools and parameters that allows decision makers, network designers or infrastructure owners to support their decisions about connecting of unconnected*

## Methodologies

- **Part 1:** Identification of Required Bandwidth for a specific object (locality's access network, school, hospital etc.)
- **Part 2:** Methodology for selecting affordable technology for connecting a locality to broadband transport backbones
- **Part 3:** Methodology for choosing the best network topology for the multiple objects network (network of localities, schools, hospitals etc.)
- **Part 4:** Methodology for technology selection for implementation broadband access networks in localities
- **Part 5:** Determination of the cost of LAN organization, including the cost of solar energy generator

## Software



Broadband Calculation Tool: Schools

Broadband Calculation Tool: Countries

Bandwidth Calculator

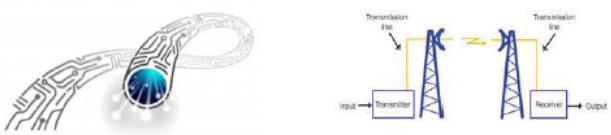

- **109 global parameters with 259 values**
- **46 regional parameters with 828 values**
- **10 national parameters with 2316 values**

**Localities database of 192 countries is provided based on the analysis of latest authoritative source (https://simplemaps.com/) and open source of GEO data (https://www.geonames.org/) and Open Street Map (www.openstreetmap.org).**

# Middle-Mile: possible options

**Connecting to existing coverage (building new network infrastructure)**

***Fiber-Optic*** ***Radio-bridge***



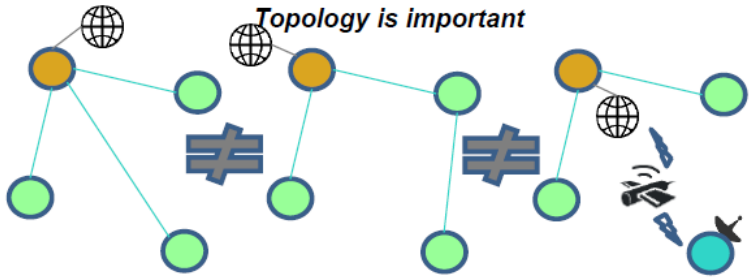
Could generate additional revenue from extra-resources (dark fibers, not-used bandwidth, passive infrastructure etc.)
Allows to organize more bandwidth then required

**Using of existing coverage (using existing network infrastructure)**

***Satellite*** ***Mobile broadband*** ***Fixed broadband***

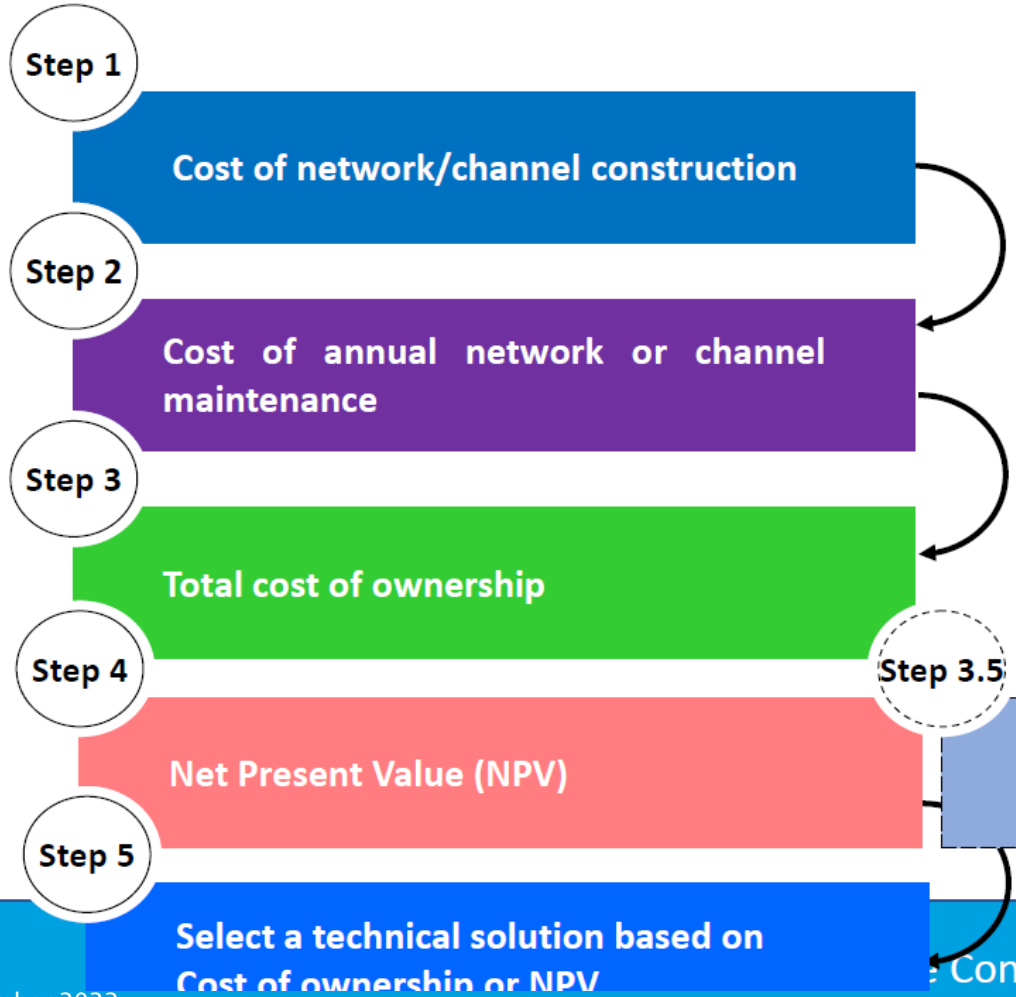
Zero revenue principle: expenses only
CAPEX & OPEX depend on Required Bandwidth

***Topology is important***



Exponentially high possible combinations

# Algorithm for selecting cost-effective middle-mile technology




Given algorithm comprises simultaneous calculations for each of the following technology :

- Fiber optic communication line (FOCL)
- Microwave (RTS)
- Cellular
- Satellite

Identification of potential income from providing extra resources optionally for FOCL and RTS

Step 3.5

Identification of potential income from providing extra resources to the rent (FOCL, RTS)