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"Bridging the ICT standardization gap in developing countries"

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Telecom Solutions for Rural and LD Areas

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Strategic Planning and Assessment

Telecom Solutions for Rural and LD Areas
Content

- Geo-characterization and challenges for Rural and LD areas
- Network solutions per technology or combined technologies
- Solution mapping per scenario

Telecom Solutions for Rural and LD Areas
Geo-characterization

Large variety of geo-scenarios by combination of following key factors:

- **Topology with 3 main types:**
  - **Nucleus of population or villages,**
  - **Rural clusters,**
  - **Dispersed settlements**
- **Density:**
  - **up to 5 inh./km2 for dispersed rural,**
  - **up to 50 inh./km2 for rural clusters and**
  - **up to 200 inh./km2 for Low Density areas and villages**
- **Infrastructure availability:**
  - **Civil infrastructure, roads and urbanization level**
  - **Energy**
  - **Telecom infrastructure or Outside Plant**
- **Services demand and economic level:**
  - **Basic services and payment capability**
  - **Tourist resorts and development settlements**
  - **Context-specific per country: political, cultural, etc.**

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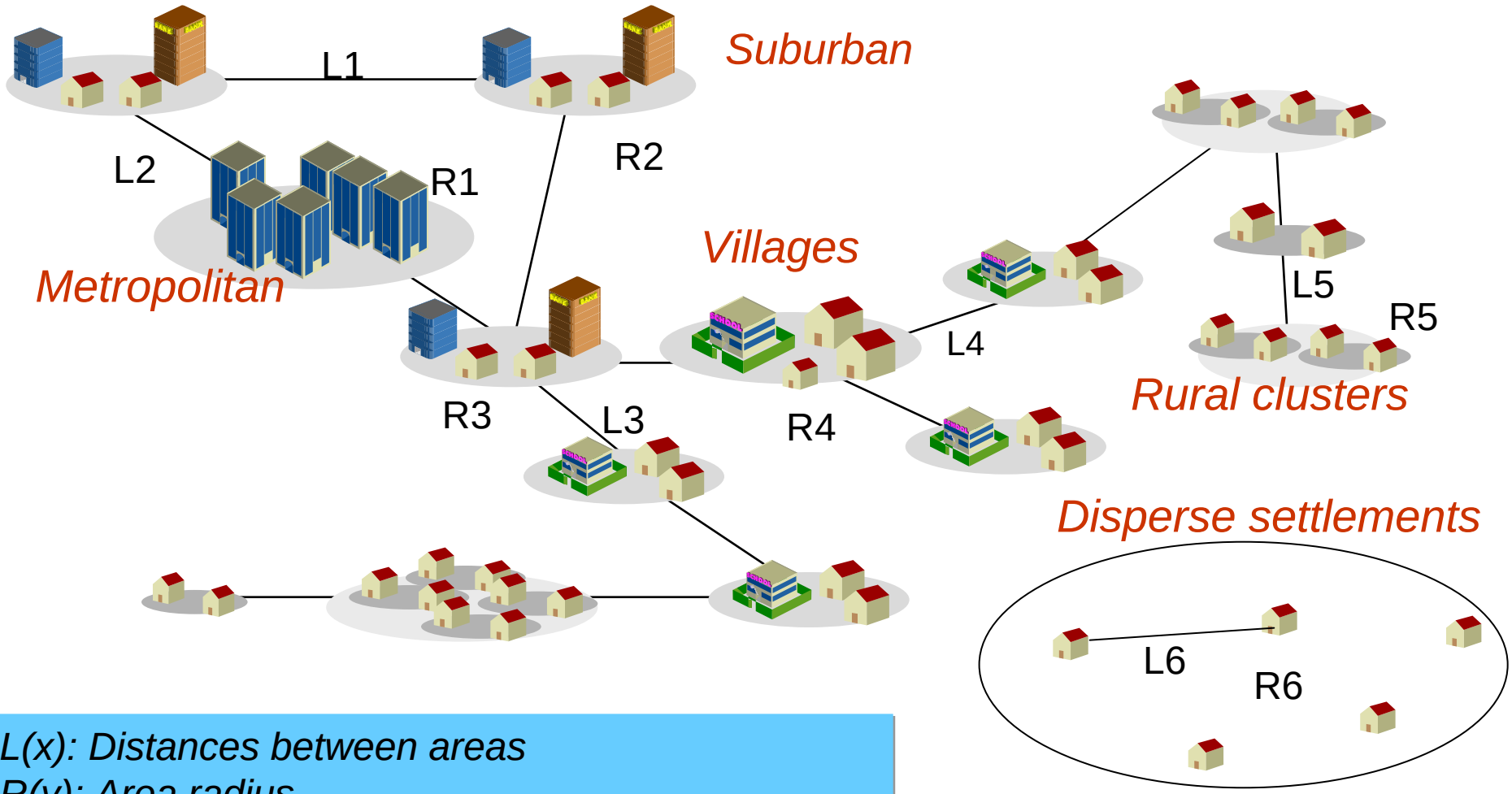
Example of Geo Scenarios modelling



L(x): Distances between areas
R(y): Area radius

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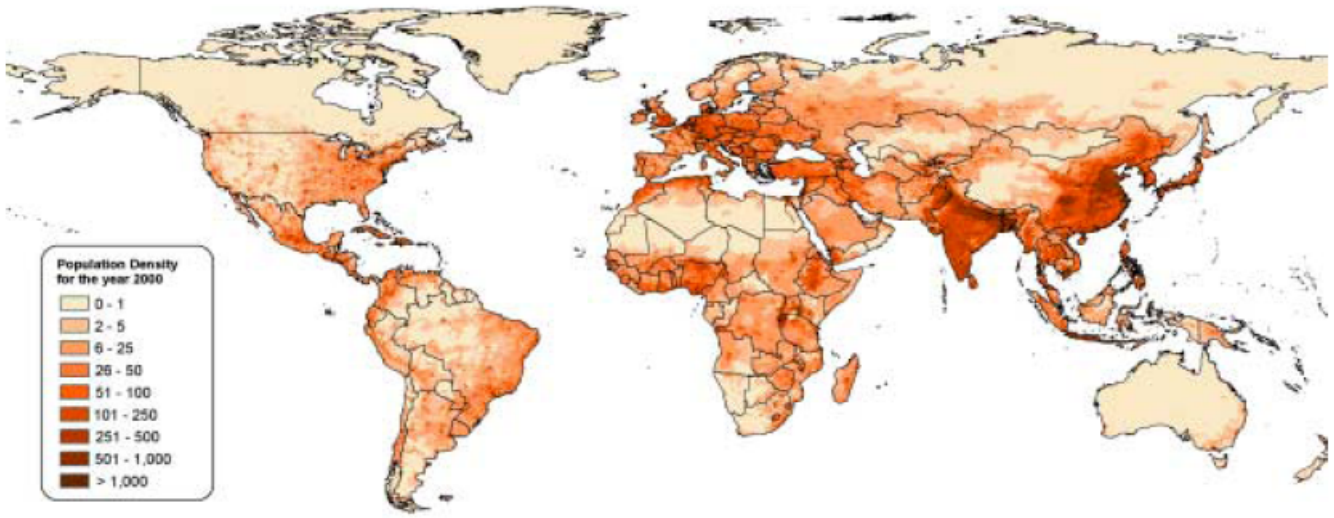
Involved population and location

MAP 3.1

Population density in 2000 from GPWv3 adjusted to UN totals



Source: Center for International Earth Science Information Network (CIESIN), Columbia University and Centro Internacional de Agricultura Tropical (CIAT)

Between 40% and 60% population live in Rural and LD areas

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Challenges

- **Main challenges for the planners, designers and development experts are highlighted:**
  - **Scarce resources availability**
  - **Higher costs than urban areas and increasing with lower density following a quadratic rule**
  - **Low Traffic and Services demand generating low revenues**
  - **Difficult business feasibility with very long recovery time for investments**
  - **Regulatory constraints with rules and tariffs designed for urban areas and not appropriate for Low Density requirements**
  - **Technology solution mapping needed to select most economic solution as big differences exist among alternatives**

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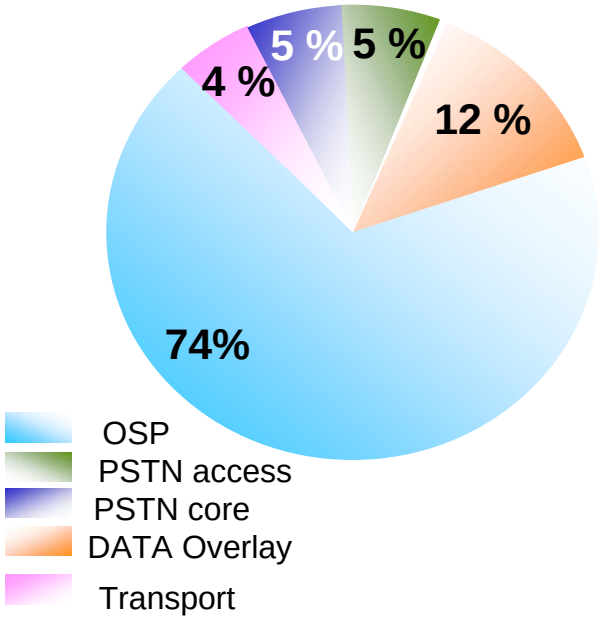
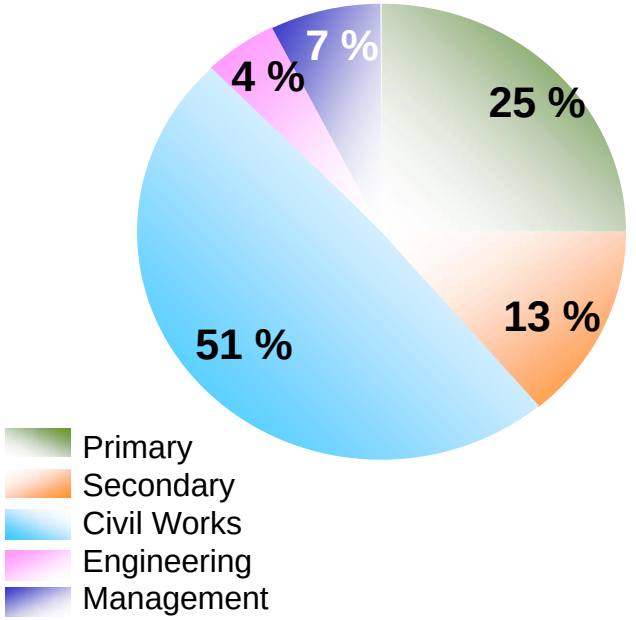
Investment Distribution in Greenfield Access

Network Cost Composition for traditional PSTN and Data
(Villages 1 node Ducts+ Aerial)



Infrastructure (OSP) Cost Composition
(Villages 1 node Ducts+Aerial)



Dominant Outside Plant component compared to Electronic Equipment for traditional WL technologies

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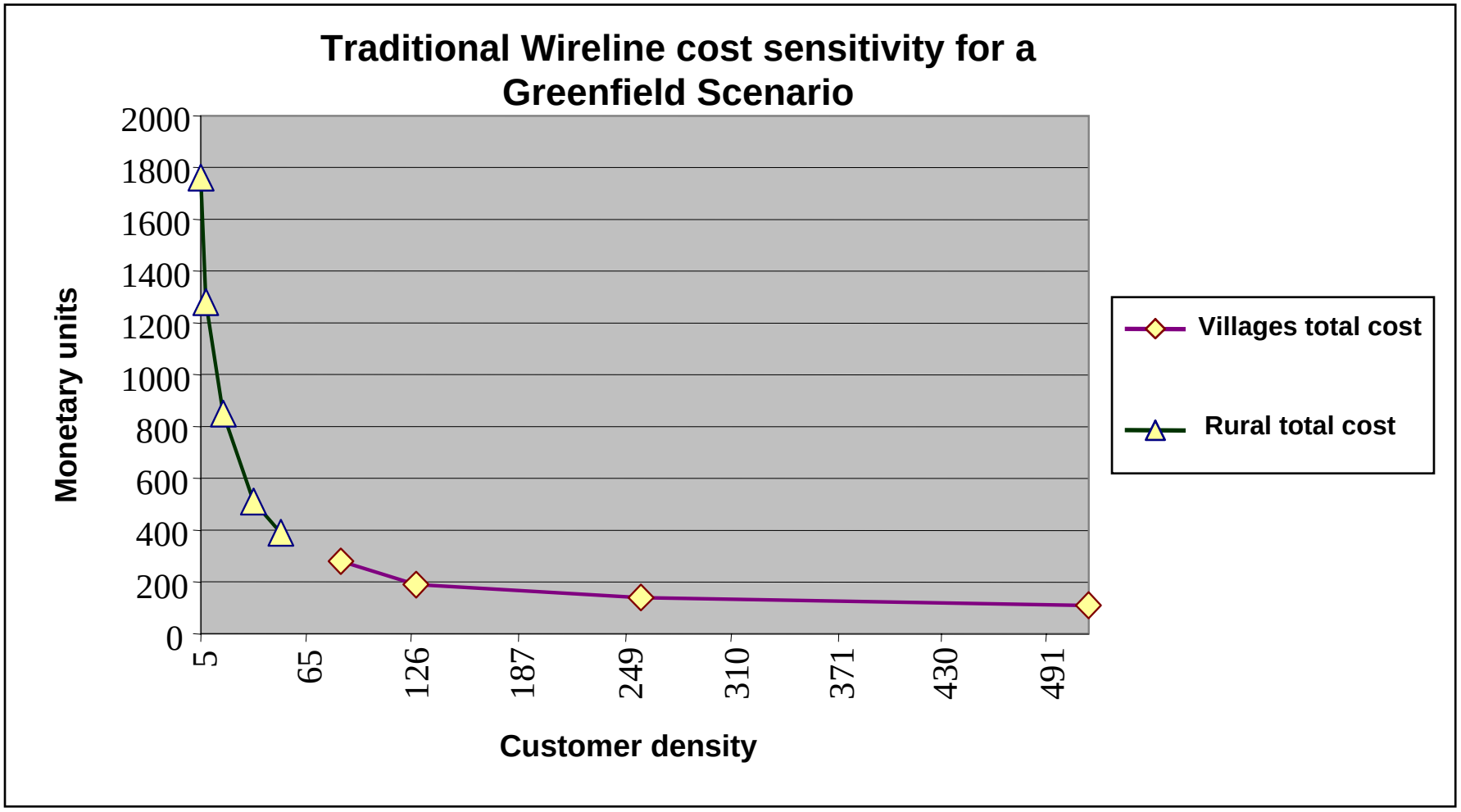
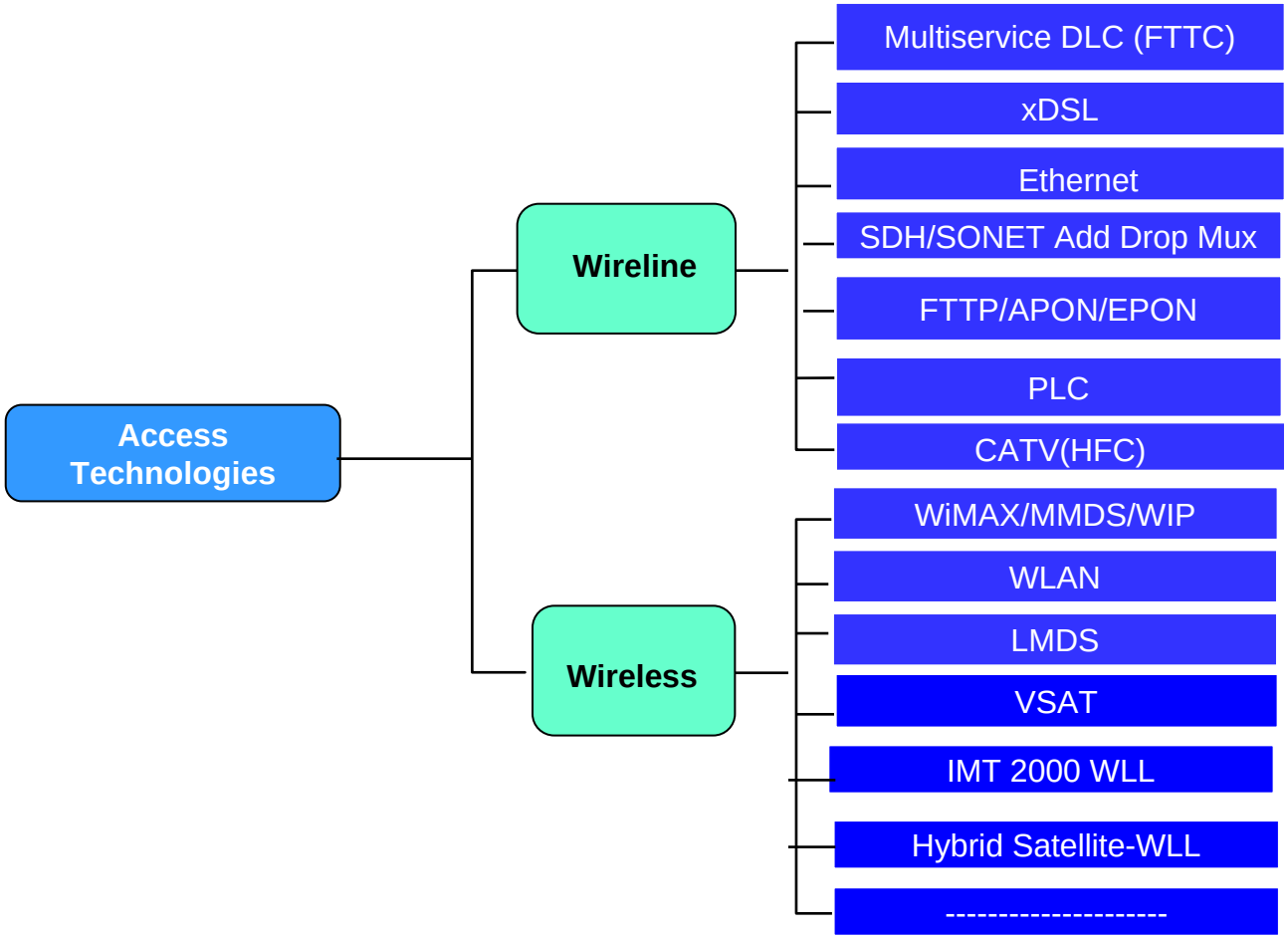
Investment Sensitivity to customer density



Telecom Solutions for Rural and LD Areas
Content

- **Characterization and issues for Rural and LD areas**
- **Network solutions per technology or combined technologies**
- **Solution mapping per scenario**

Telecom Solutions for Rural and LD Areas
Multiple technology alternatives at access



- Multiple existing options and growing with time and research efforts

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Frequent applicability mapping at access

Technology Solution	Scenario Type			
	LD Villages	LD resorts	Rural Clusters	Disperse settlements
WL-DLC/xDSL	✓✓	✓✓	✓ (if OSP available)	
WL-PLC			✓	✓
FTTx	✓ FTTC	✓✓ FTTP		
WiMax	✓✓	✓✓	✓	✓
IMT 2000- WLL			✓✓	✓
Satellite			✓	✓✓
Mobile	✓✓	✓✓	✓✓	✓

Most frequent applicability is illustrated per solution category

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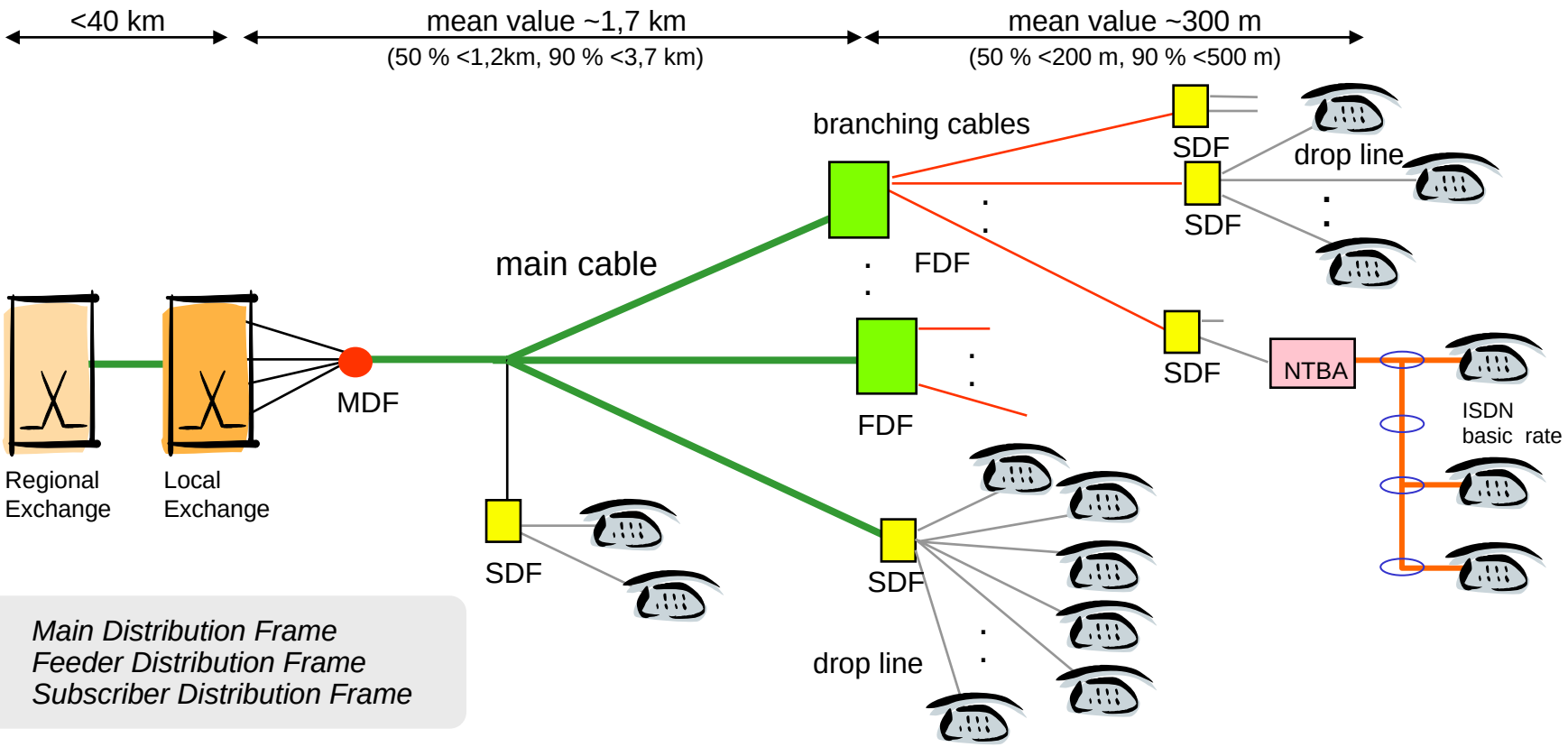
Access Network Architecture: Wireline

Typical Access Network structure: (classical)



MDF *Main Distribution Frame*
FDF *Feeder Distribution Frame*
SDF *Subscriber Distribution Frame*

Frequent average distance values for EU networks

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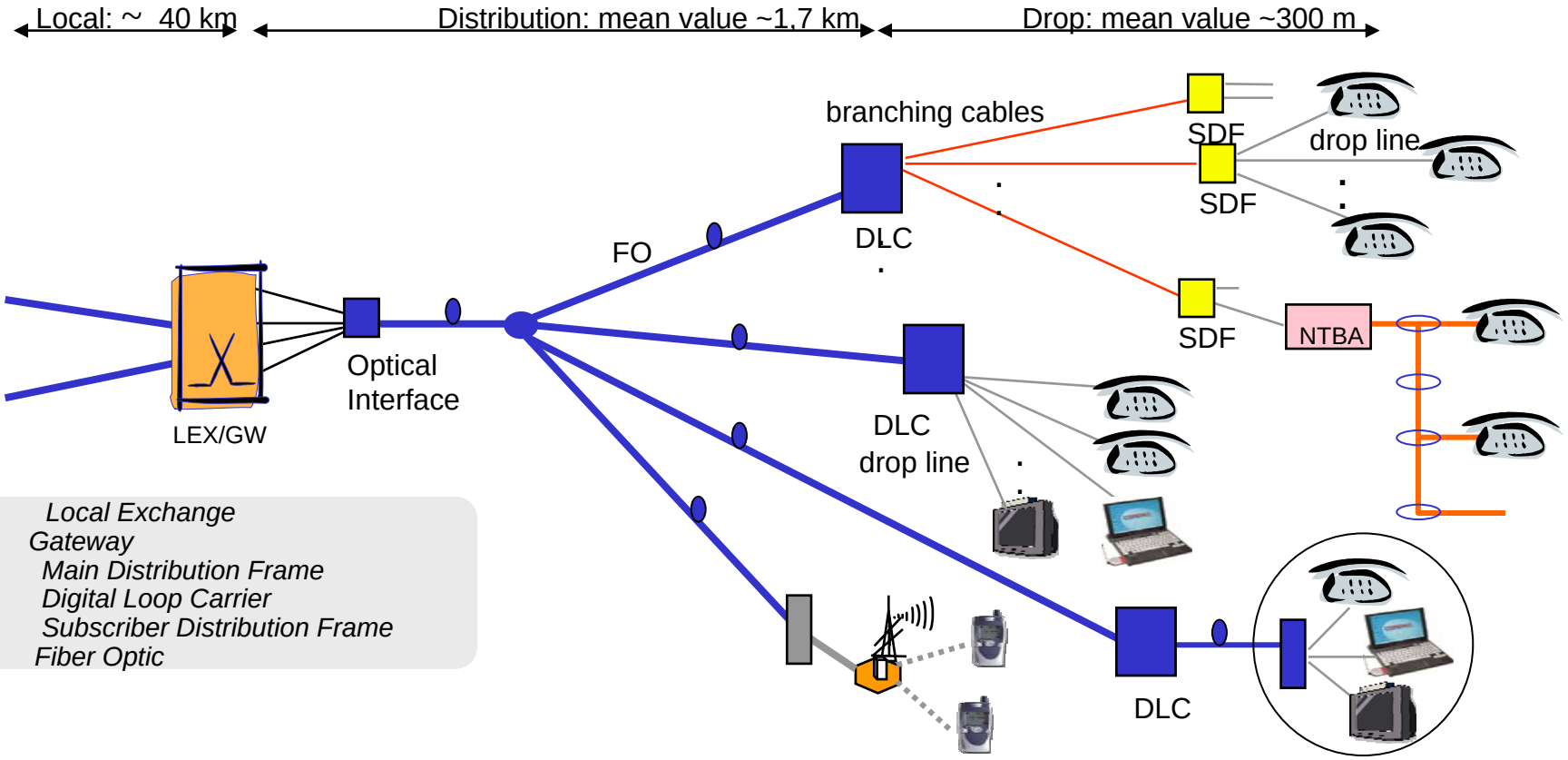
Access Network Architecture: Wireline Evolution: FTTx

Typical Access Network evolution towards BB and Convergence



FO deployed closer to subscriber premises at required investment pace

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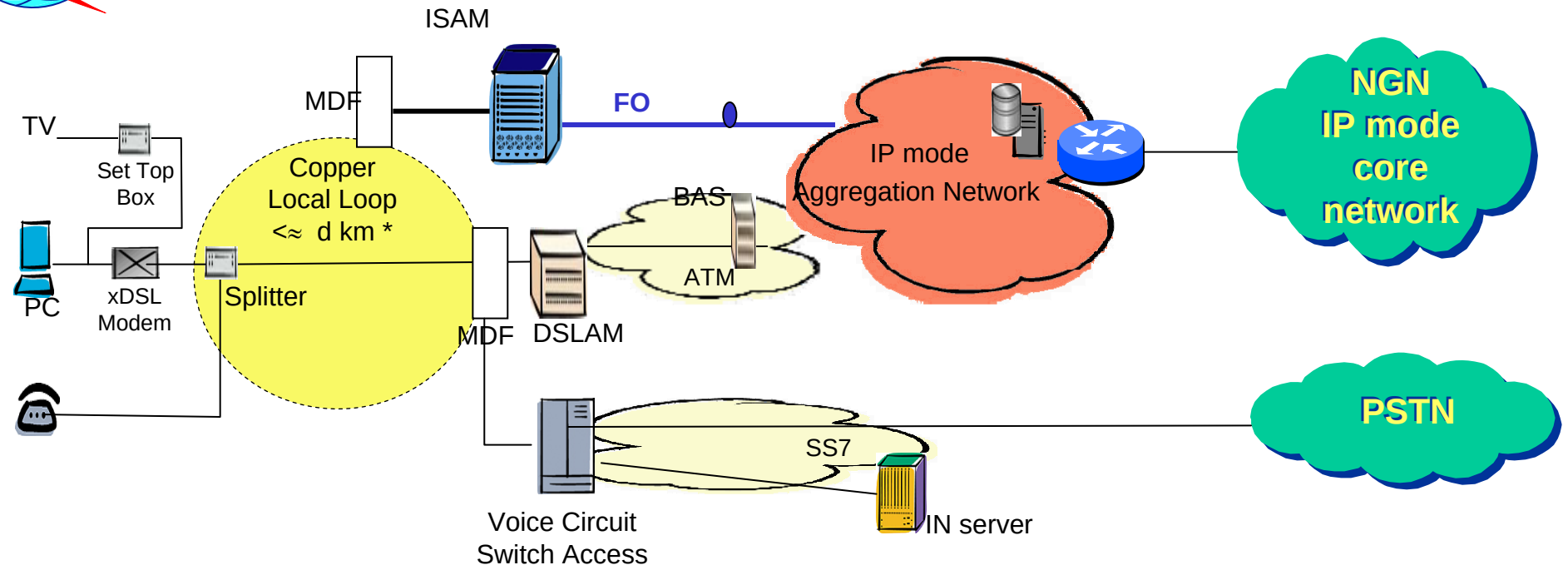
Access Network: xDSL



*** Bandwidth/distances per solution**

- ADSL: up to 4/8 Mbps/800 kbps d <= 3/1,5 km

- ADSL plus: up to4/ 8 Mbps/800 kbps d <= 4.5/2,1 km

- SHDSL: up to 2.3 Mbps symmetric d <= 1.8 km

- VDSL: up to 52 Mbps Assym/ 26 Mbps Sym d <= 300m

(higher distances imply less bitrate following bandwidth shape curve)

MDF: Main Distribution Frame
DSLAM: Digital Subscriber Line Access Multiplexer
ISAM: IP mode Subscribes Access Multiplexer
IN: Intelligent Network Server
BAS: Broadband Access Server

- Capacity range per customer between 4 Mbps and 52 Mbps
- High reusability of existing infrastructure and equipment

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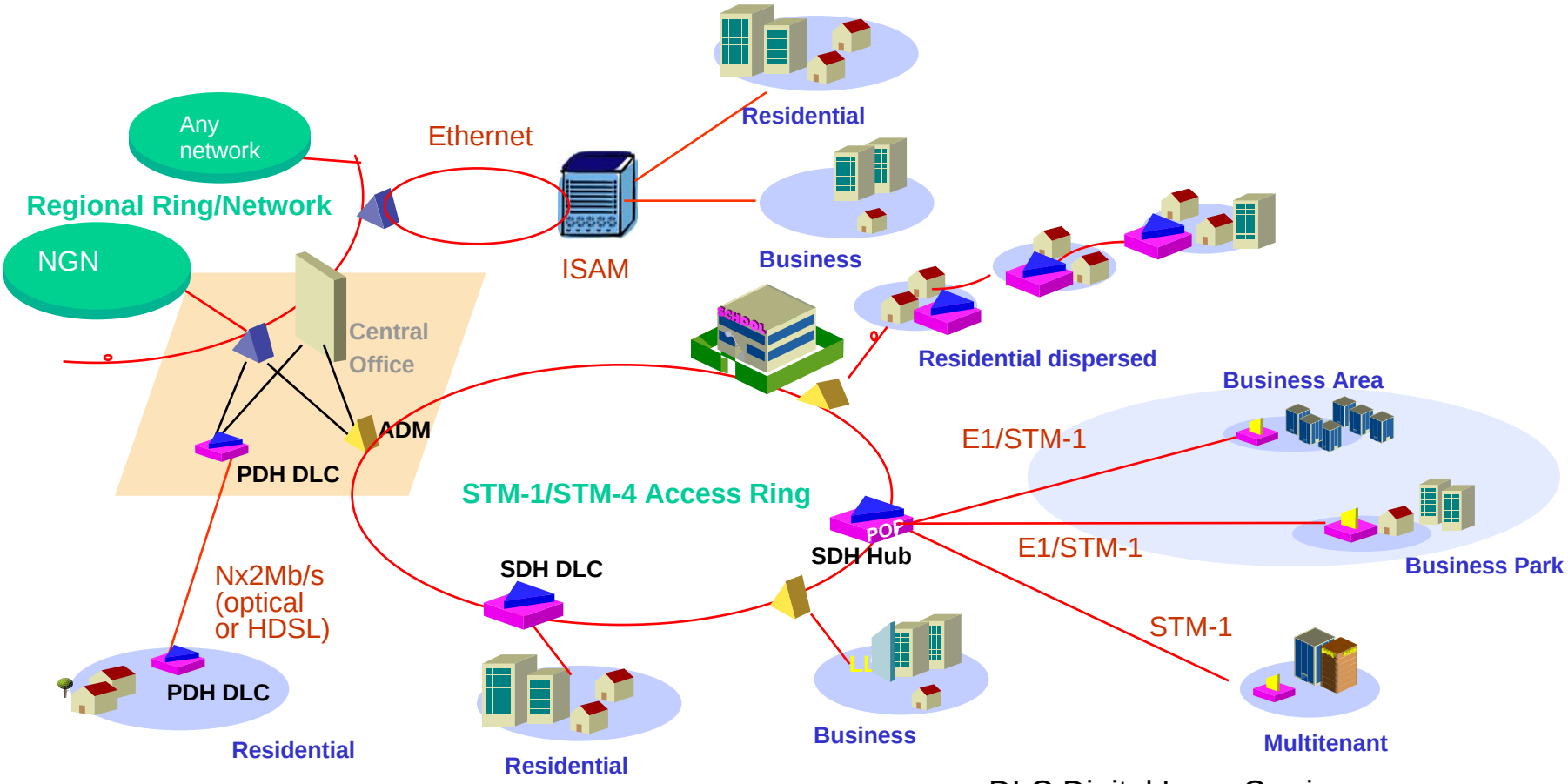
Example for Multi-scenario Access Network Architecture



DLC:Digital Loop Carrier

- High variety of geo-scenarios and capacities covered with a product family

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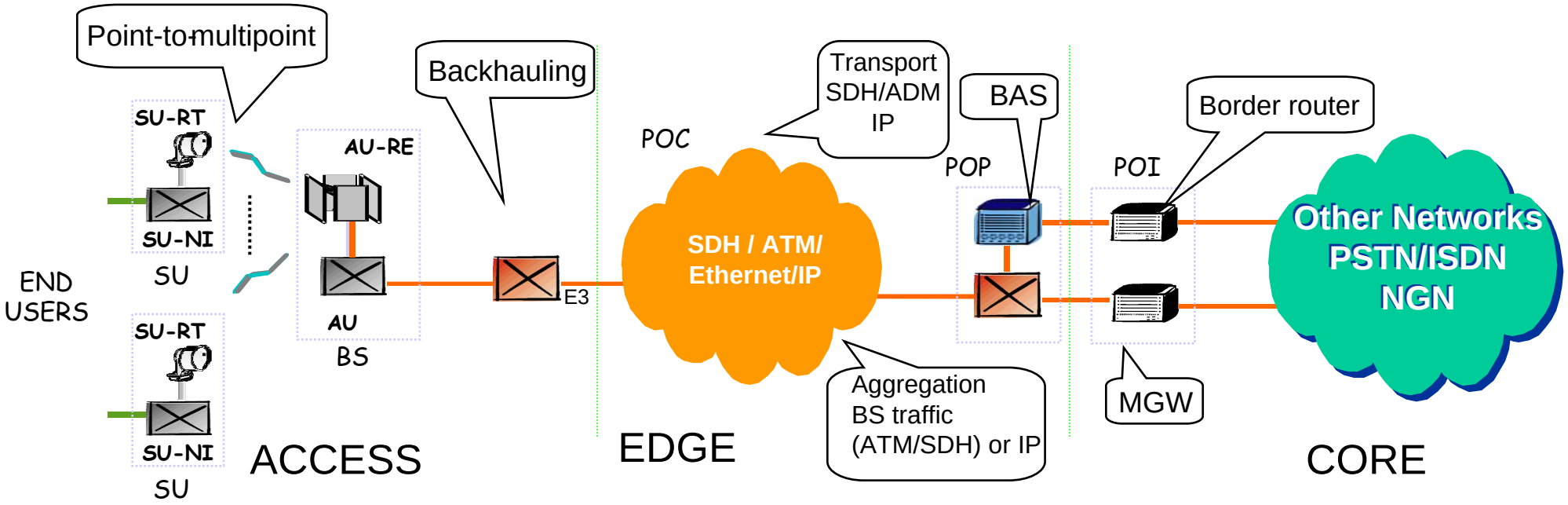
Access Network Architecture: WiMax & WLL category



SU: Subscriber Unit
SU-RT: Subscriber Unit Outdoor Unit
SU-NI: Subscriber Unit Indoor Unit

BS: Base Station
AU: Access Unit
AU-RE: Radio Front-end
MGW: Media Gateway

POC: Point of Concentration
POP: Point of presence
POI: Point of Interconnection
BAS: Broadband Access Server

Note: BAS is needed for an ATM approach but not for an NGN solution

- Point to multipoint solutions with shared capacity among customers in the same BS

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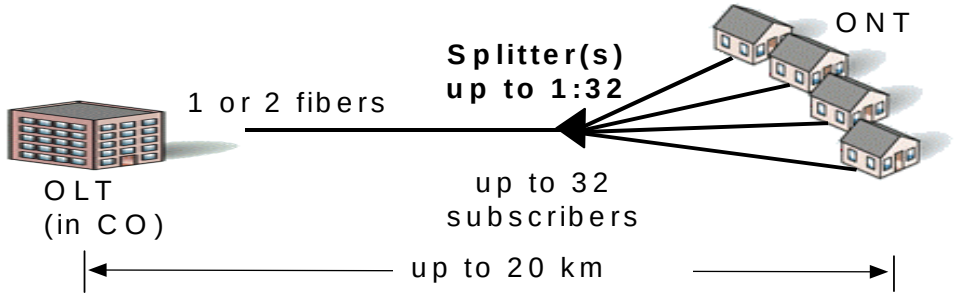
Access Network Architecture: FTTP

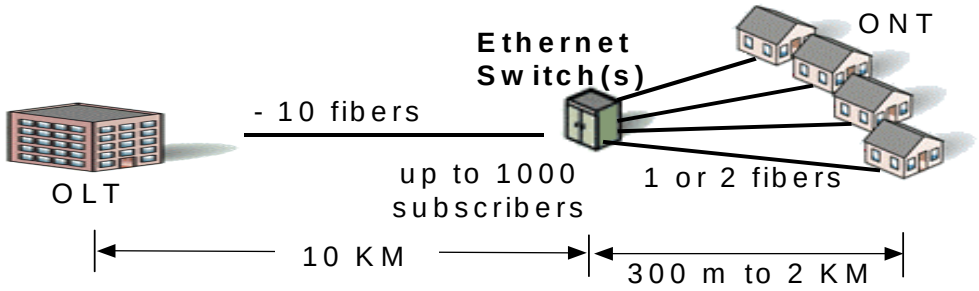
Passive Optical Network (PON)



+ No remote actives
+ 50% fewer ports needed
+ Lower life cycle cost
+ Voice, Video, Data easy
- Higher port cost
- Lower data bandwidth than P2P

ONT: Optical Network Termination
OLT: Optical Line Termination
CO: Central Office

Point to Point (P2P) Switched Ethernet



+ Higher bandwidth
+ Possibly lower first cost
+ Greater security
- Less reliable?
- Higher maintenance?
- Voice and Video over IP unproven

- Future oriented solution with a trend to decrease costs with economy of scale production

- Capacity range per customer between 100 Mbs and 1000 Mbps

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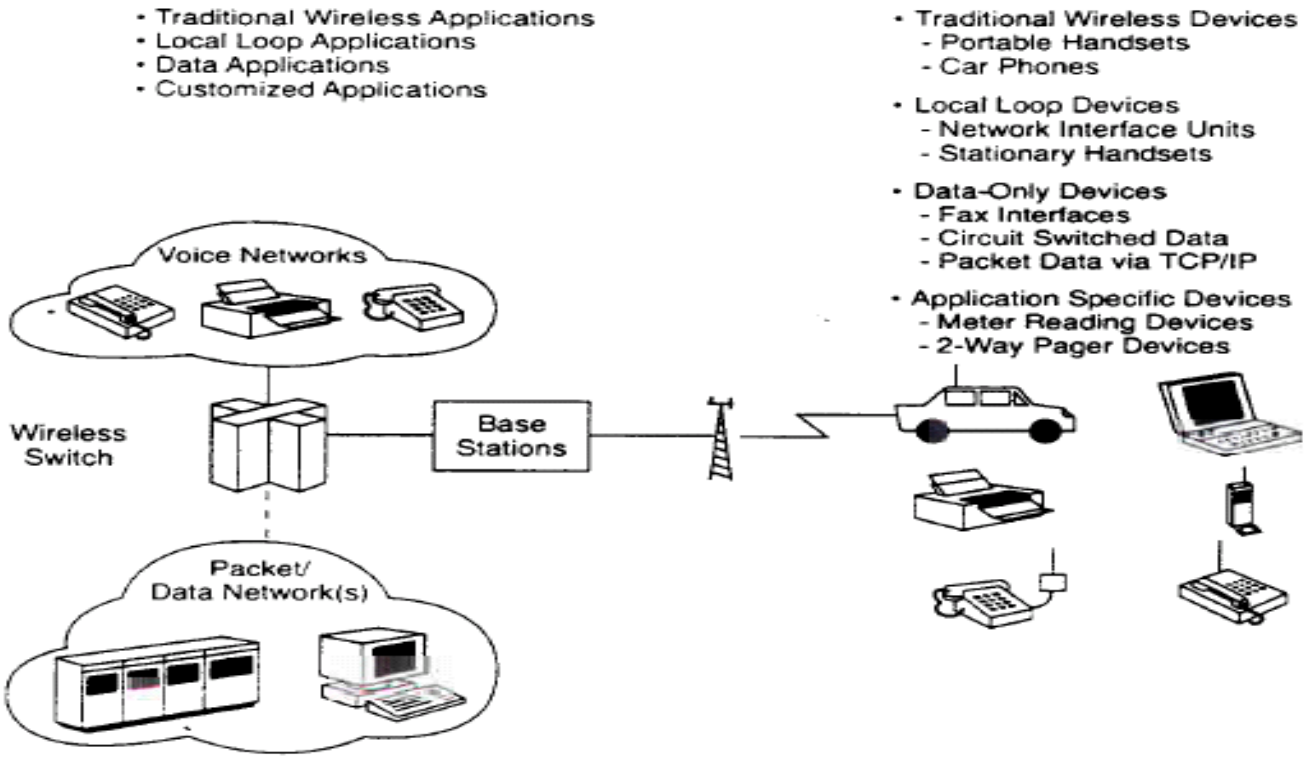
Access Network : IMT 2000 WLL or FWA

Example for access architecture based on CDMA 2000



- Easy to reuse existing infrastructure from mobile networks or start from scratch
- Provides capability for both voice and data related services
- Allows evolution in parallel to NGN and IMS functionalities

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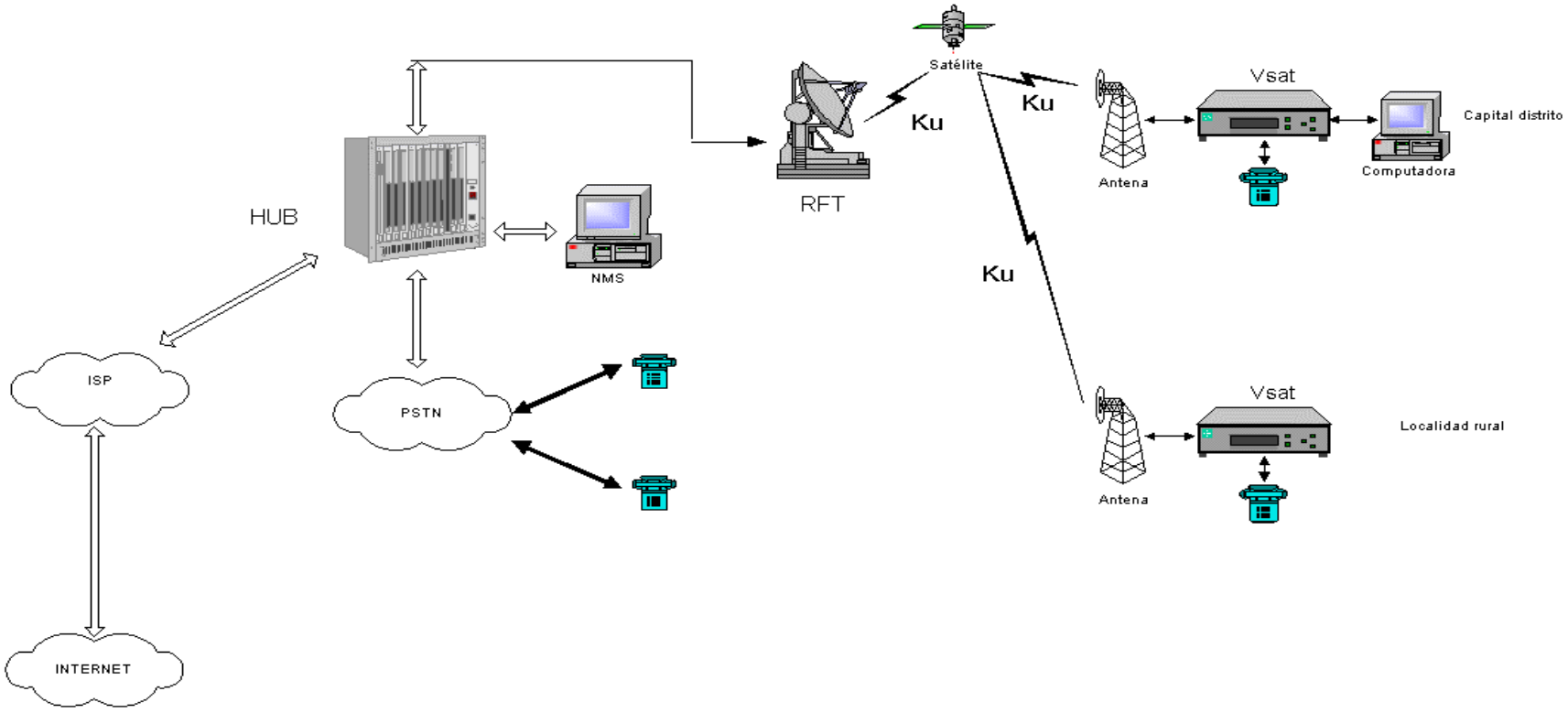
Access Network Architecture: VSAT



-Provides wide area coverage with a star like topology from a hub to the multiple remote stations

-Typical capacities up to 256 kbps per customer

- High start-up system costs but marginal costs with advantage at areas without infrastructure

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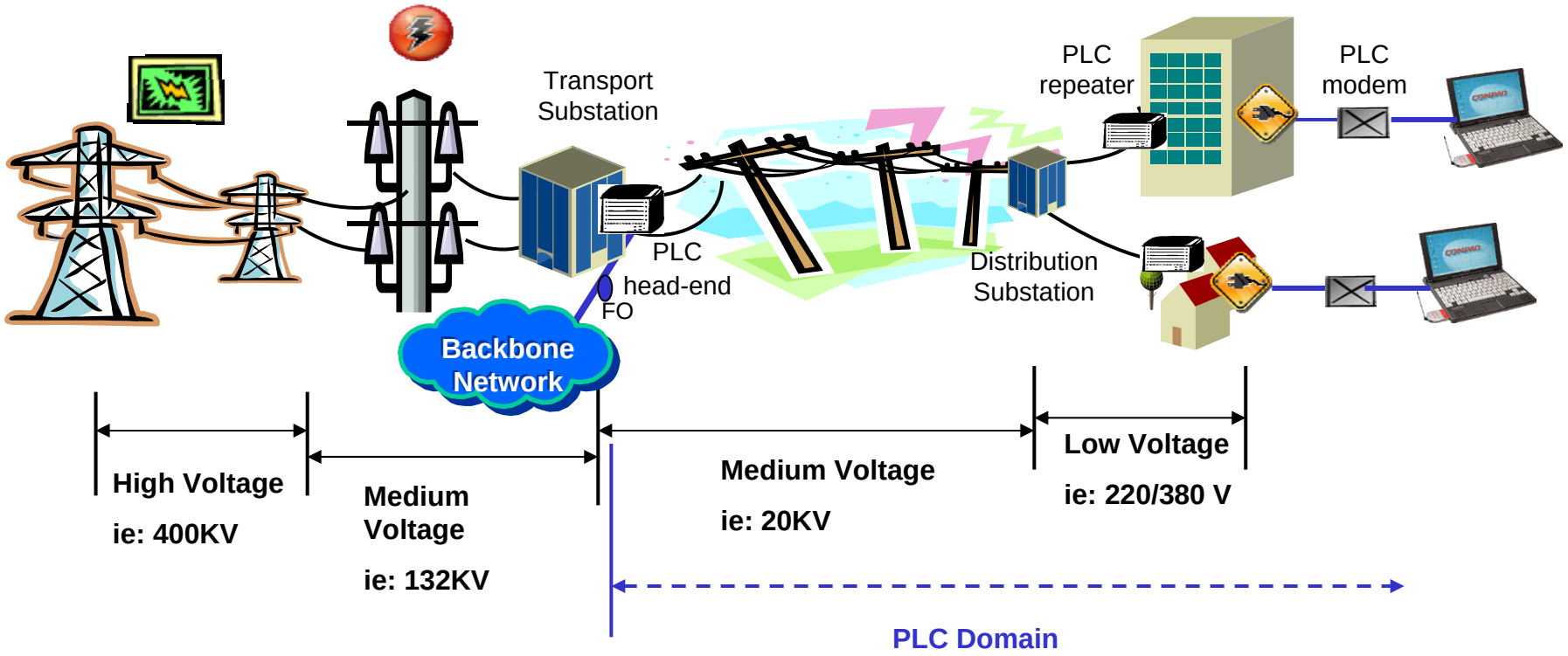
Access Network Architecture: PLC



- Capacity of the Power Line Communication (~ 45 to135 Mbps with OFDM) shared among customers reached from same substation. Frequency ranges: 1,6 to 10 Mhz and 10 to 35 Mhz

- Solution quality highly dependent on historical installation electricity cables and topology

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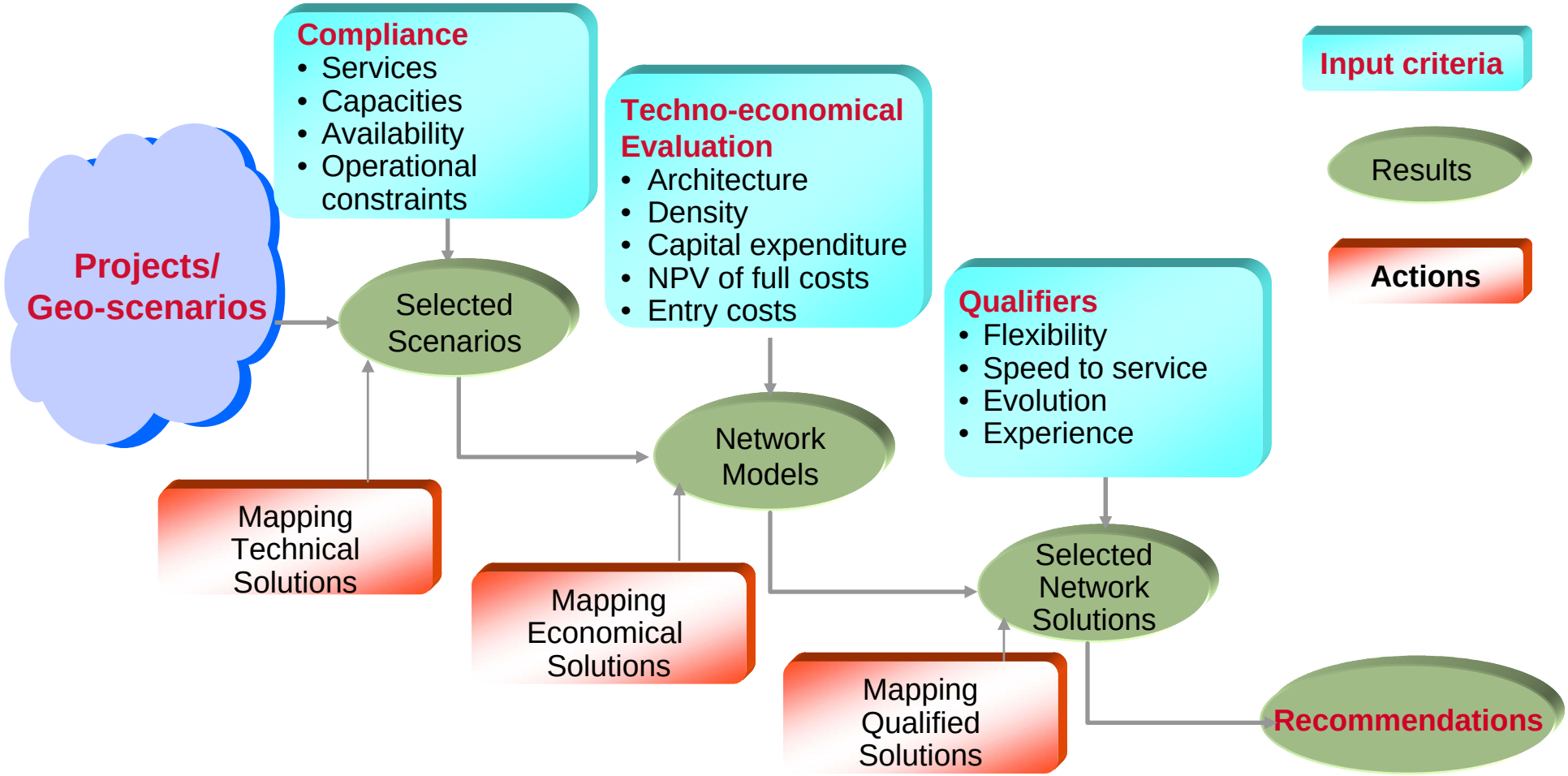
Methodology to map best solutions per scenario



- Sequential planning activities to quantify solution behavior per geo-scenario type

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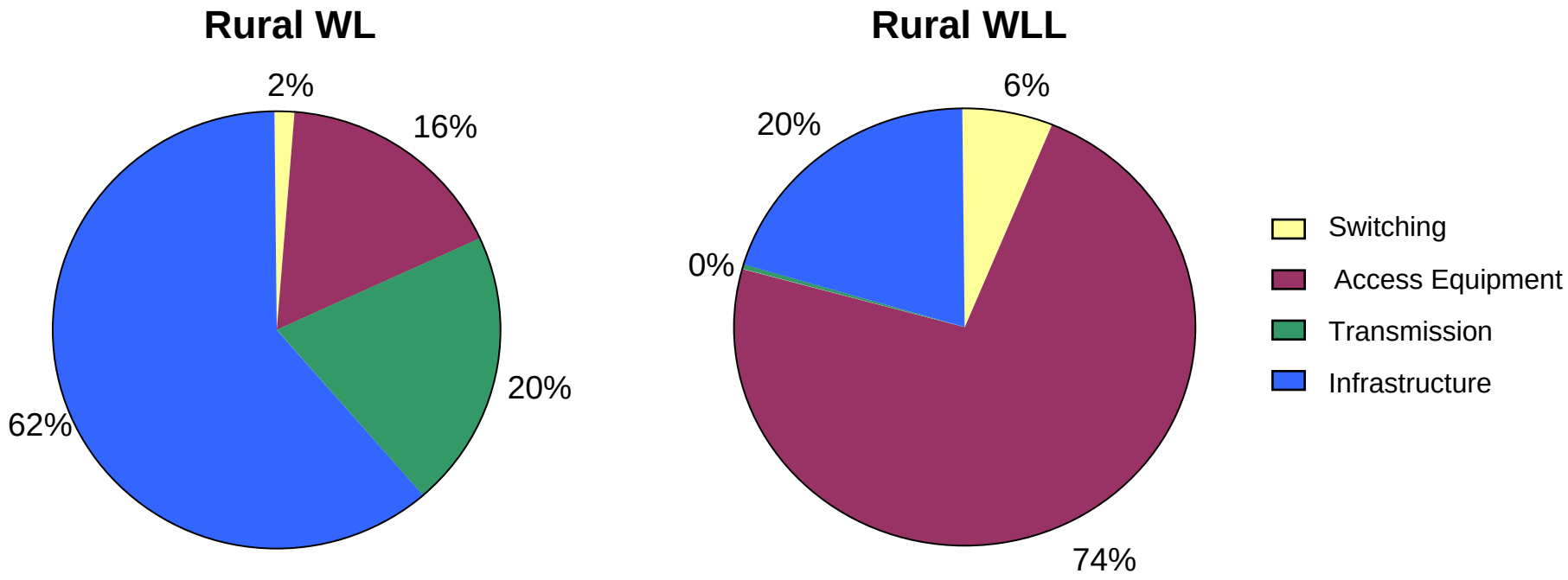
Example for Composition of prices: WL vs WLL cases

Solutions for Greenfield scenarios (excluding Backhauling)



Major differences appear in the cost distribution per network layer:

- WL more intensive in Infrastructure and density dependent
- WLL more intensive in Electronic equipment and traffic demand dependent

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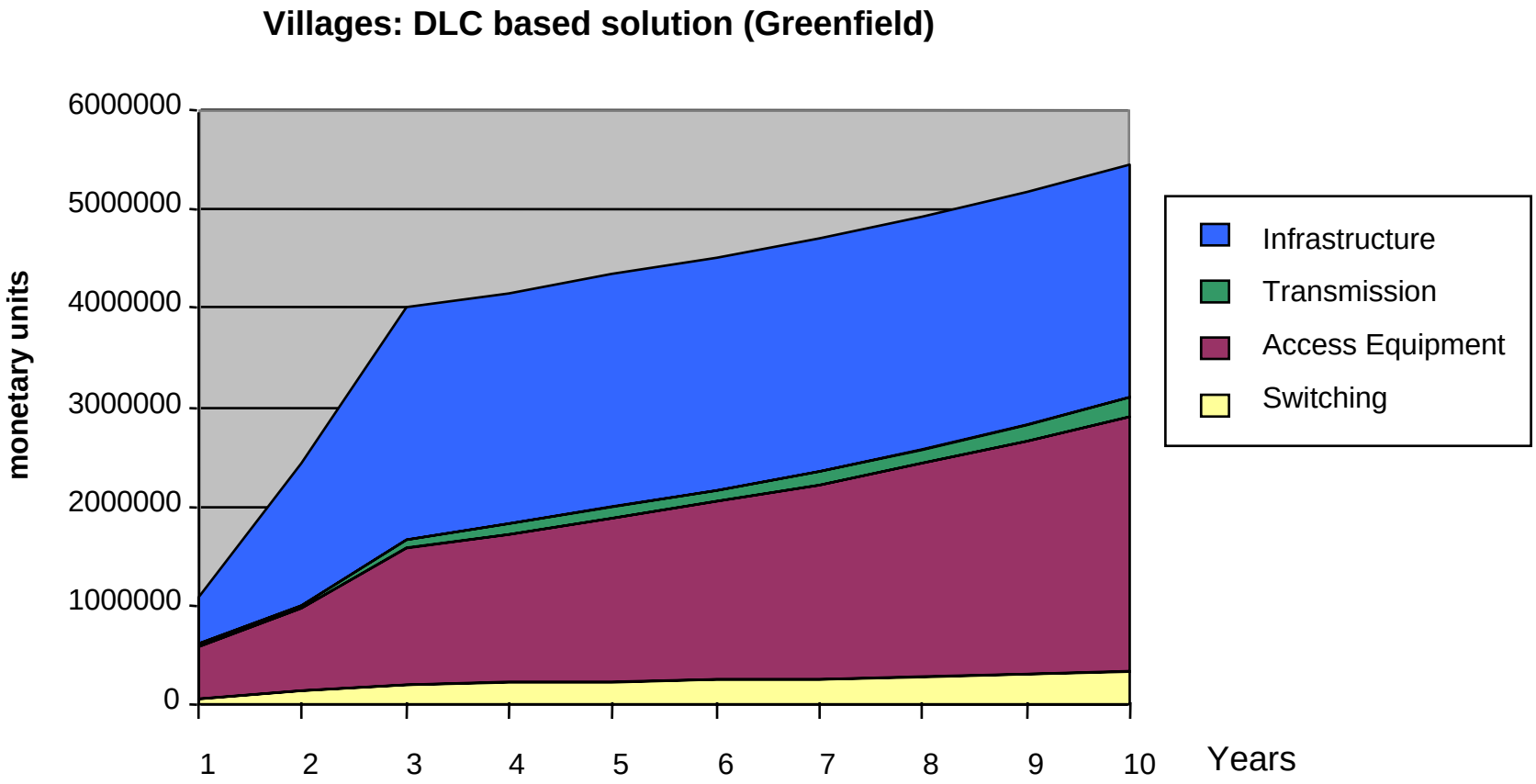
Example for Cumulated Capex by layers: DLC case



- High investment at launching phase with dominant contribution by Infrastructure and access equipment by geo-coverage and customer volume

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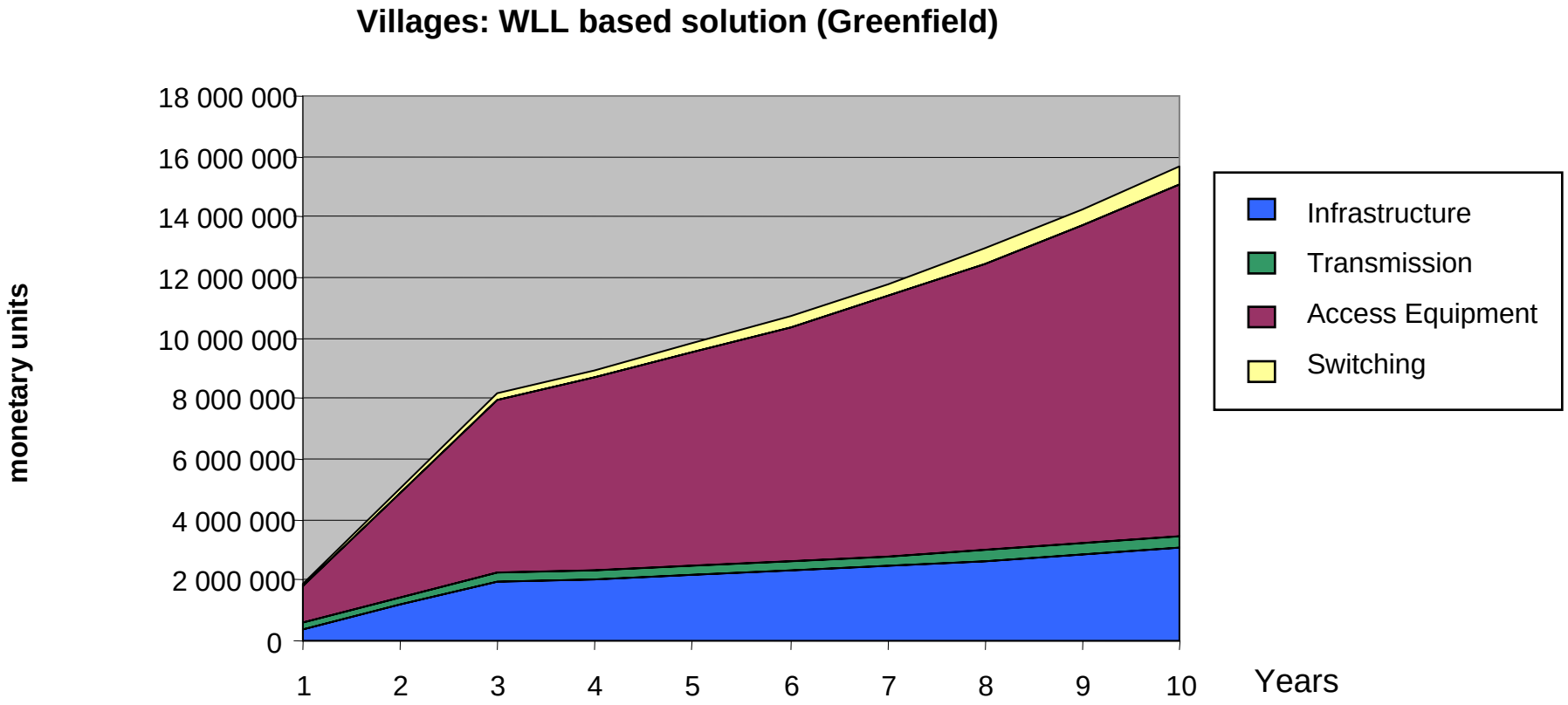
Example for Cumulated Capex by layers over time: WLL case



- High investment at launching and growing phases with dominant contribution by access equipment both for geo-coverage and traffic demand

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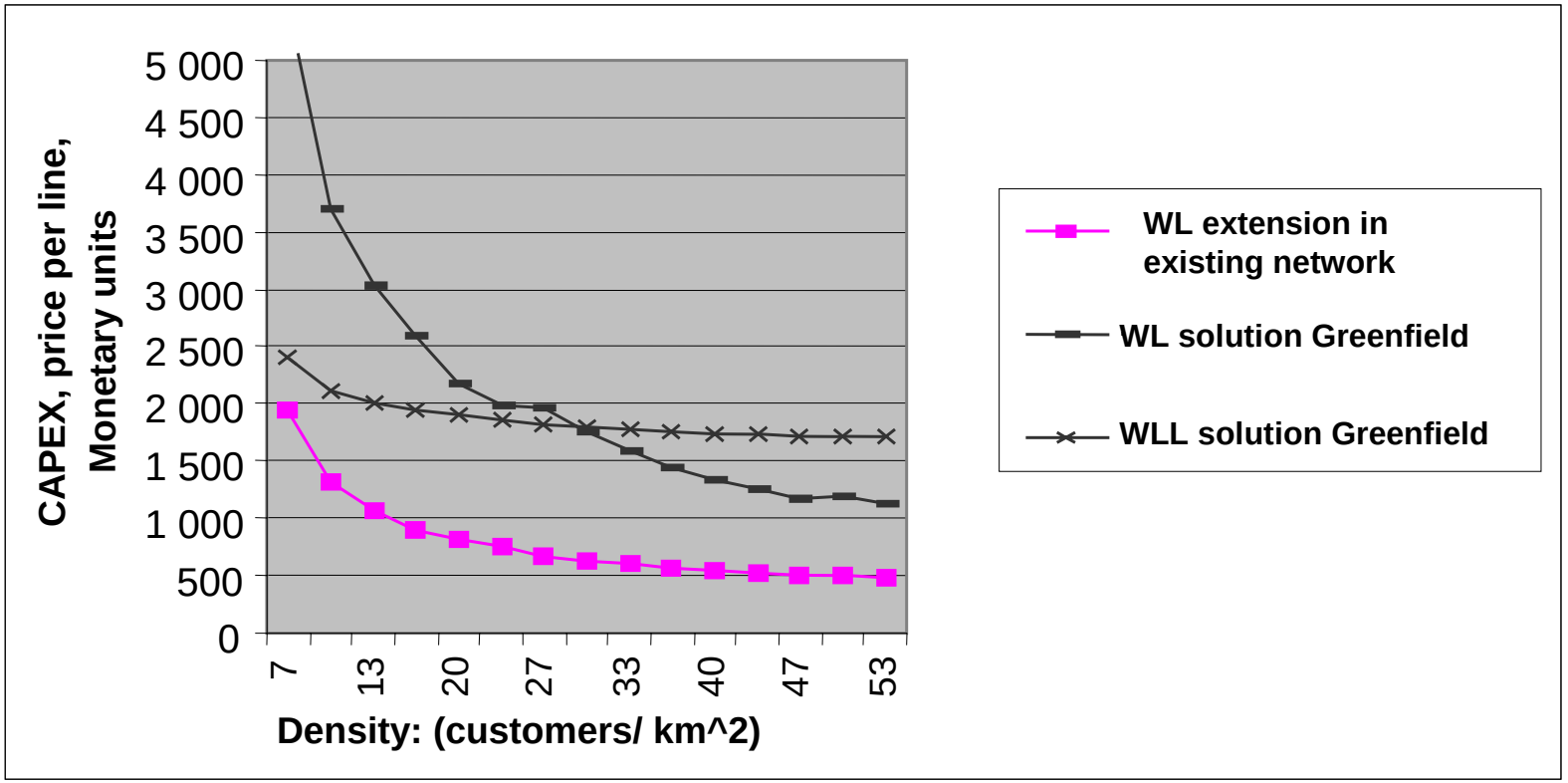
Cost sensitivity to customer density per type of solution



- Clear cross-point between WL and WLL solutions as a density function
- Important impact of existing network reusability

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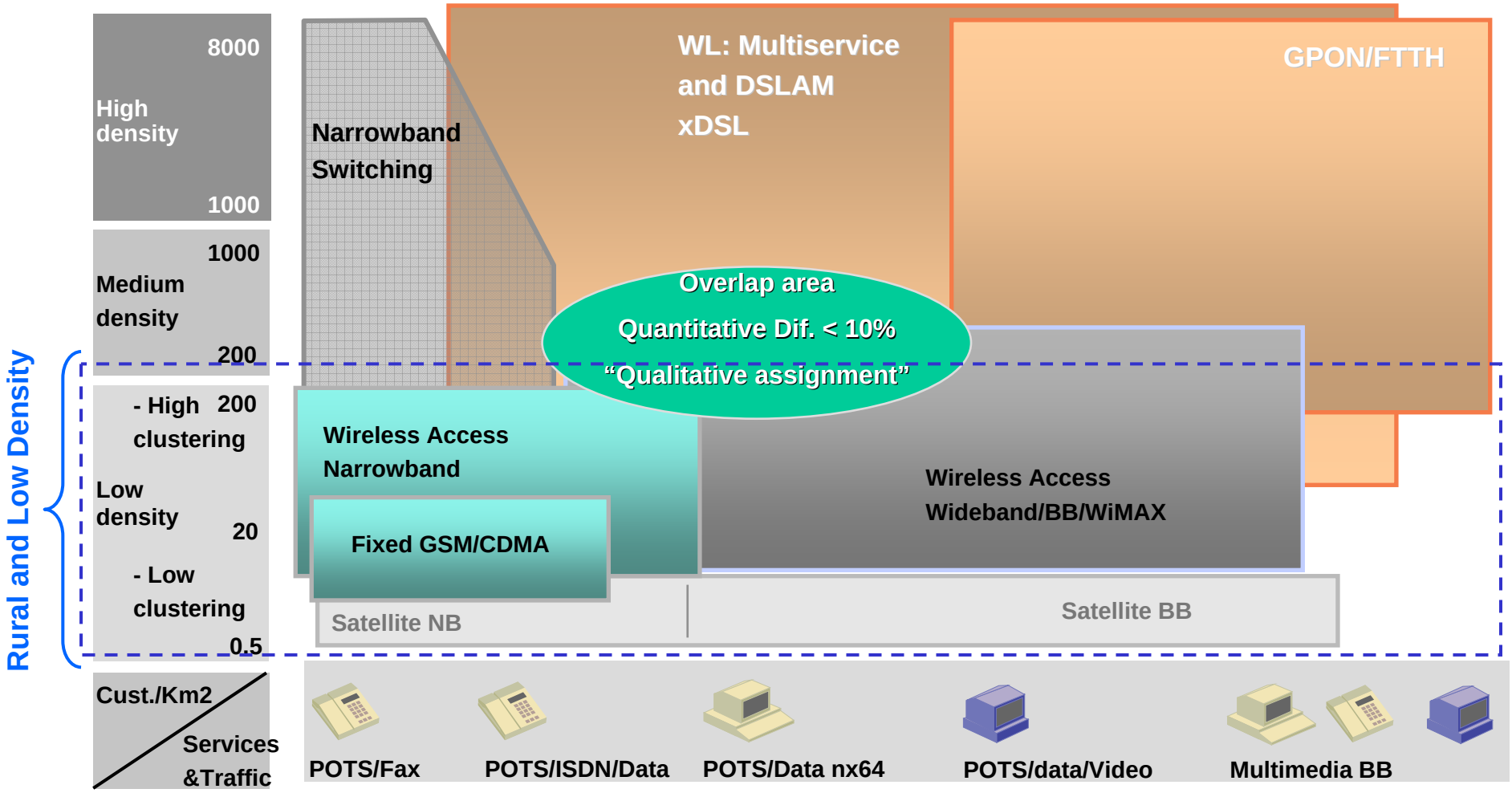
Example of mapping recommendation



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Mapping Recommendations for Access

Large economic differences between solutions (ie: between 20% and 200%)

- Deployment of DSL and Multimedia Services when existing Outside Plant infrastructures and villages or resorts

- FO closer to customer (FTTP) when implementing new outside plant or renovating existing one in nucleus of villages

- New Wireless technologies: WiMAX for low density customer scenarios and rural areas.

- Satellite or combined Satellite + WiMax for dispersed areas

- Mobile solutions for most scenarios with lower bandwidth et LD areas

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Gap reduction recommendations for Rural and LD areas

- **Characterize country LD geo-scenarios** to allow best mapping of most economical solutions
- **Develop a specific regulatory strategy** for LD areas to facilitate property management, right of way rules and leased media to decrease infrastructure costs
- **Develop public-private infrastructure** ownership at municipal level to reduce impact of civil investments
- **Use nation level purchasing power** and regional agreements to get benefits of economy of scale for best telecom solutions