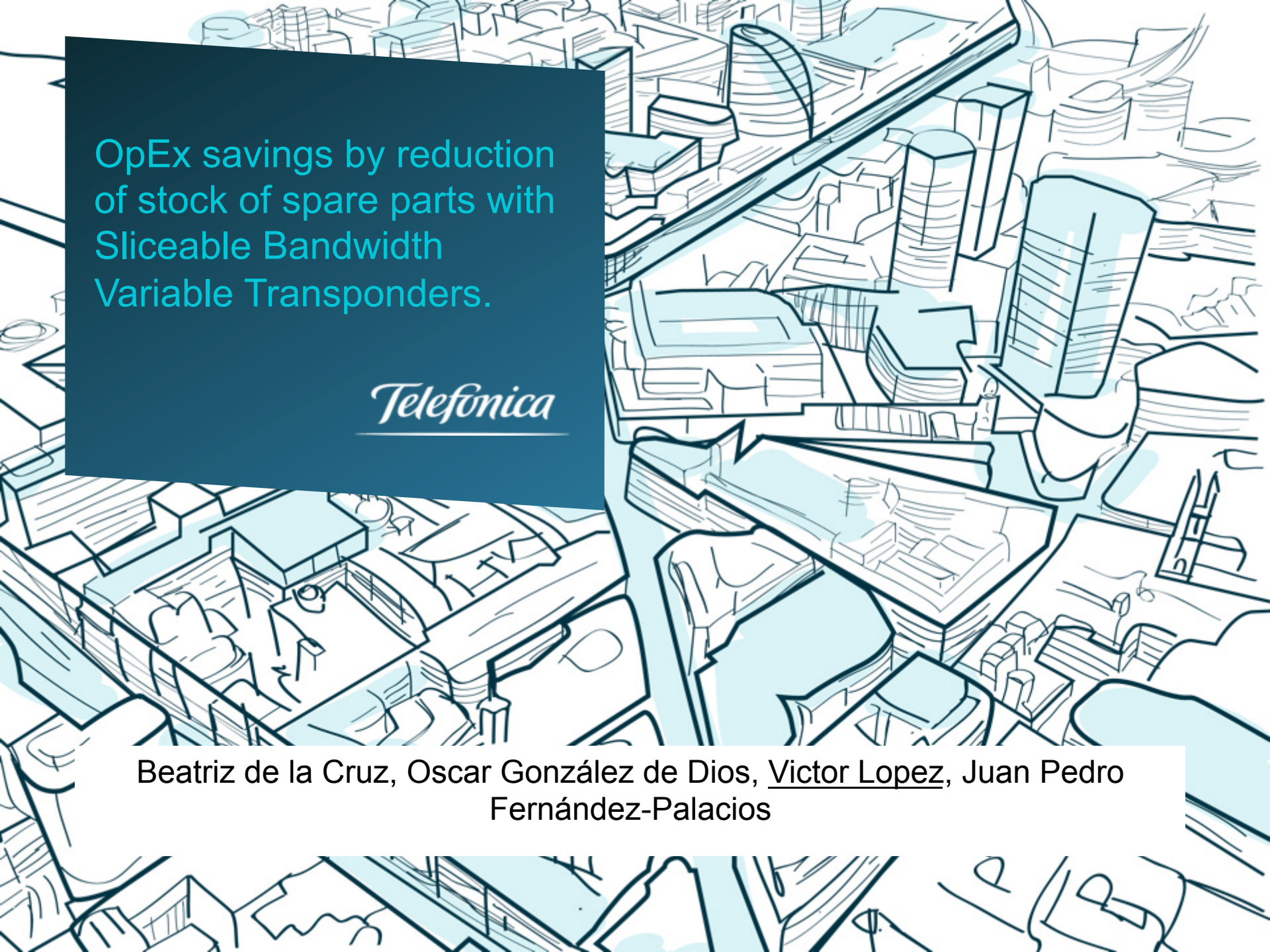

OpEx savings by reduction of stock of spare parts with Sliceable Bandwidth Variable Transponders.

Telefonica

Beatriz de la Cruz, Oscar González de Dios, Victor Lopez, Juan Pedro Fernández-Palacios

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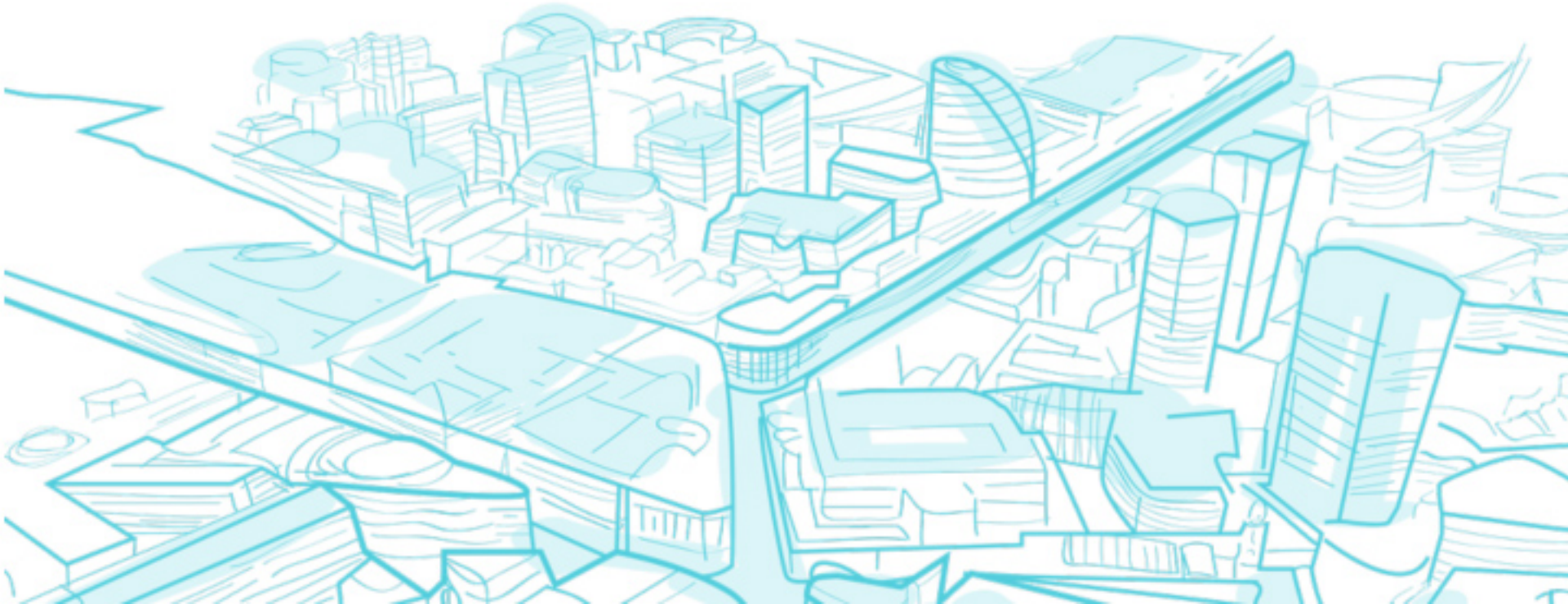
Overview



Overview

Stock Management

Rationale	The importance of having the suitable equipment at the right time.
Objective	Reducing operational expenditures by an optimal stock study, based on centralized model.
Results	• Minimum stock number required in order to keep the service. • Stock number for each kind of transponder • Percentage of time which a certain stock number keeps the service
Expected benefits	Reducing expenditures related network maintenance and reparation increasing thus indirectly the benefits.

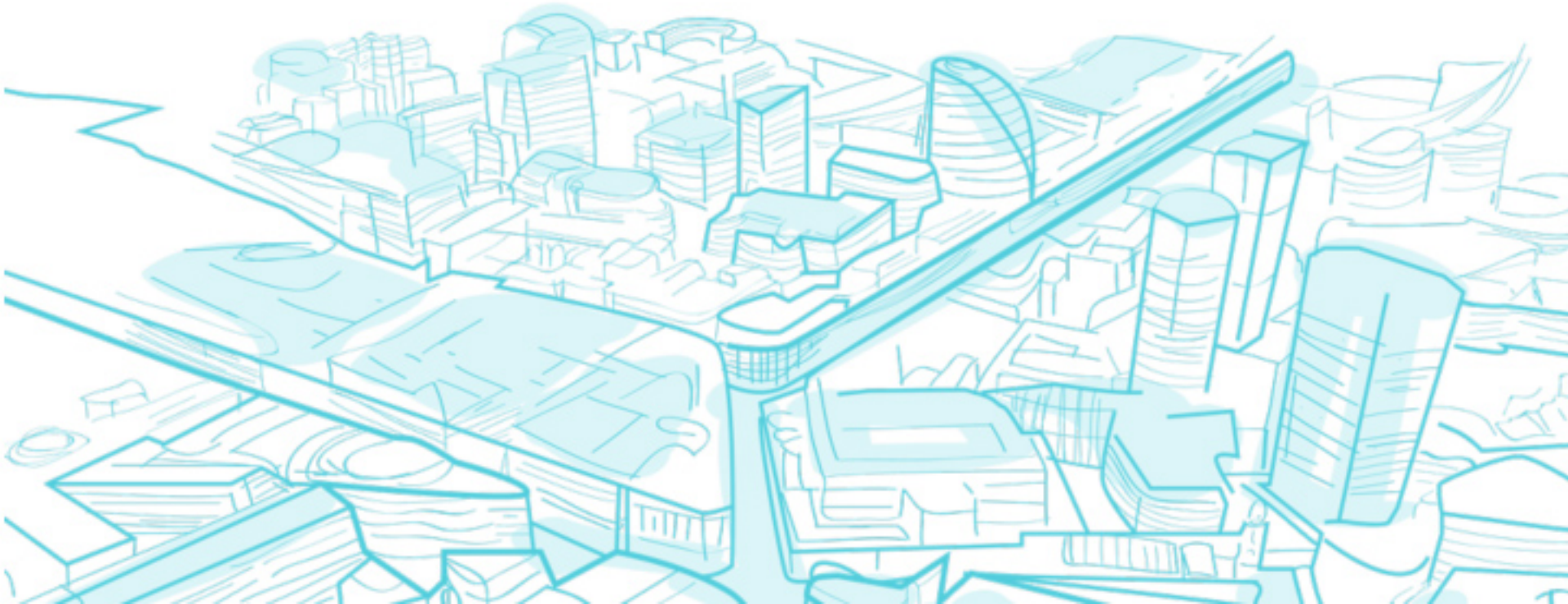
Stock of spare parts with SBVT problem

Problem definition.

- Emerging technologies can help to deal with the ever-increasing demand:
  - Elastic Optical Network (EON).
  - Sliceable Bandwidth Variable Transponder (SBVT).
- Different studies conclude SBVT allows a reduction in CAPEX.
- Our work: quantify the reduction of network maintenance and reparation related OpEx by using SBVT.
  - Focused on cost related to keeping a stock of spare parts.
    - Stock of spare parts for replacement needs to be maintained in case of a failure in a network element.
    - Centralized stock model.
- Analyze how equipping a network with Sliceable Bandwidth Variable Transponders instead of fixed rate transponders of multiple rates reduces the maintenance cost.

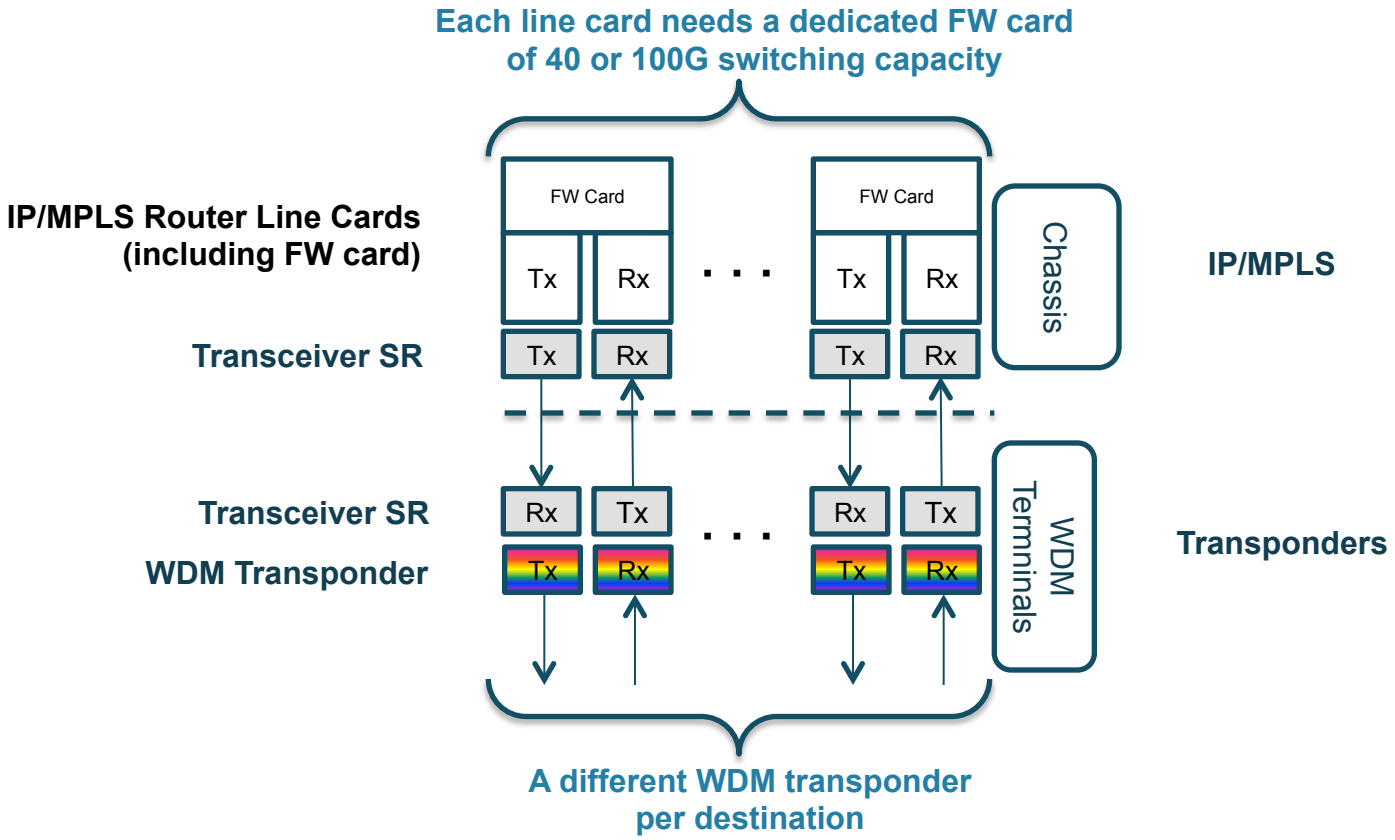
02

SBVTs



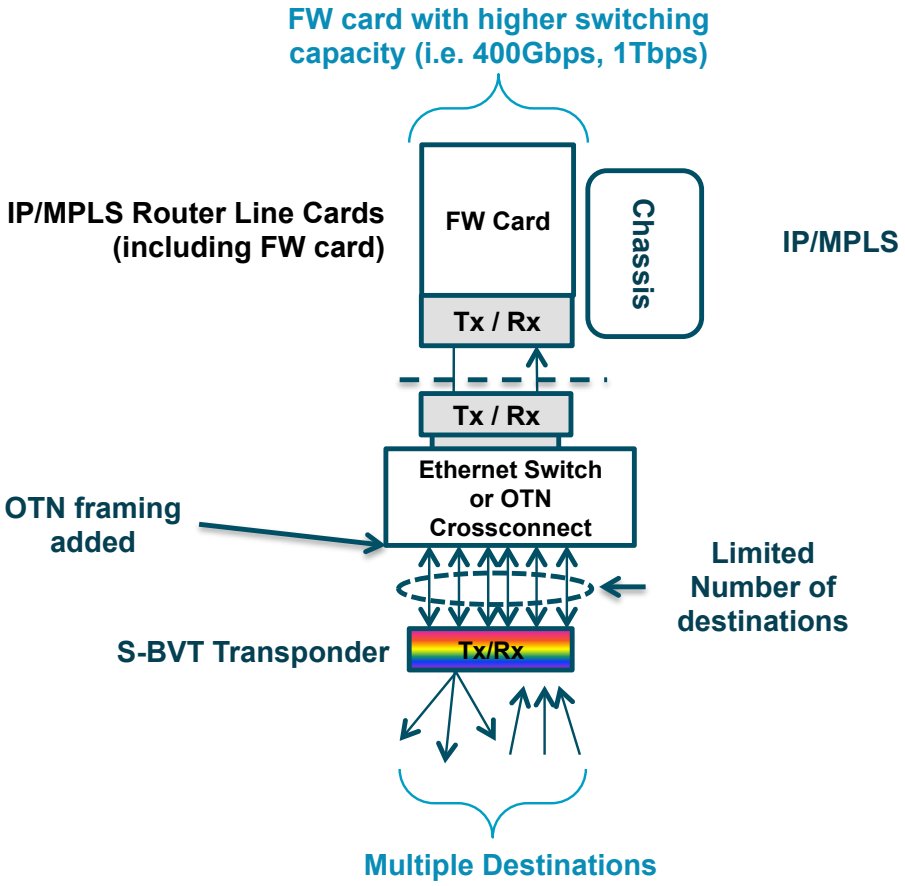
Current node structure without SBVTs

- Node model for the study:



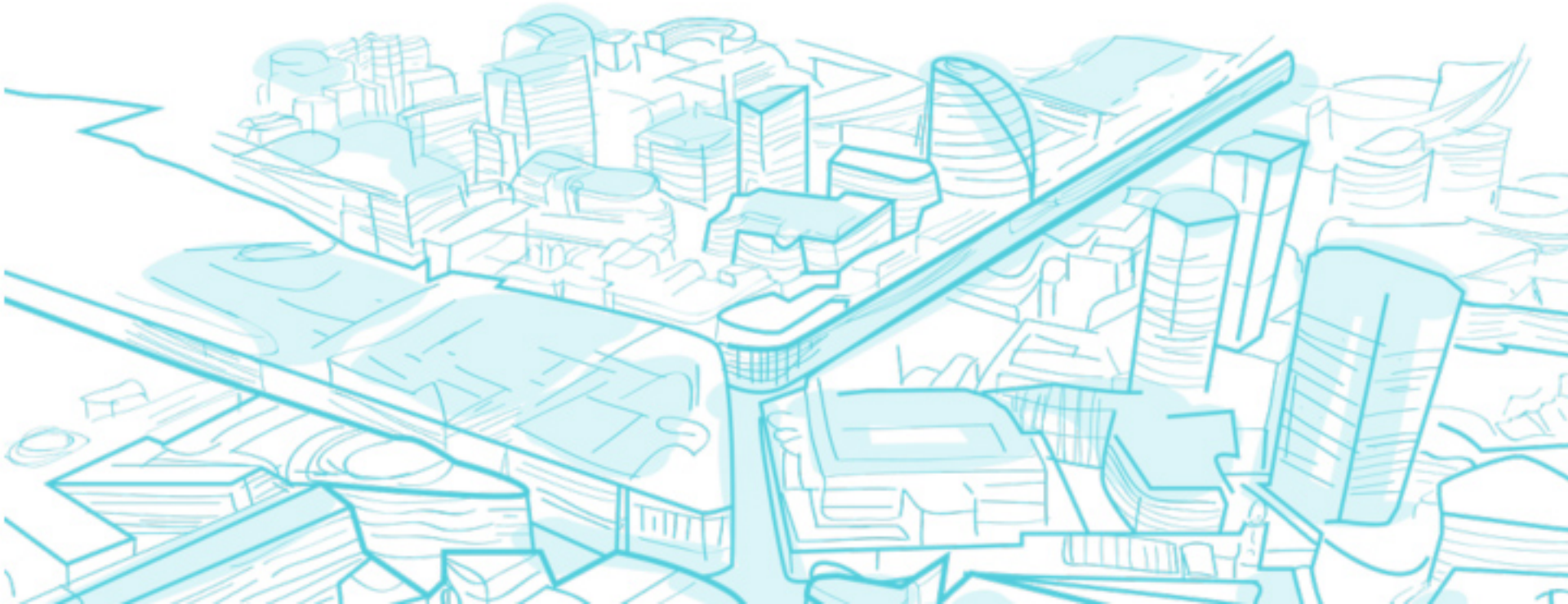
Node structure with SBVTs

- Node models for the study:

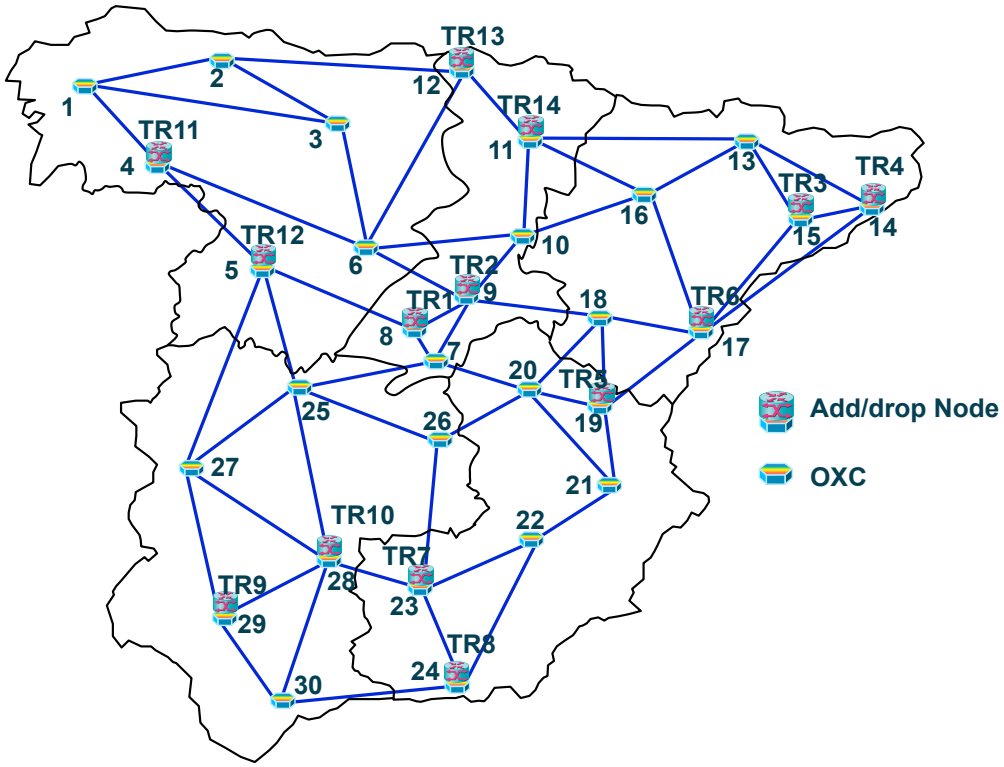


03

Case Study

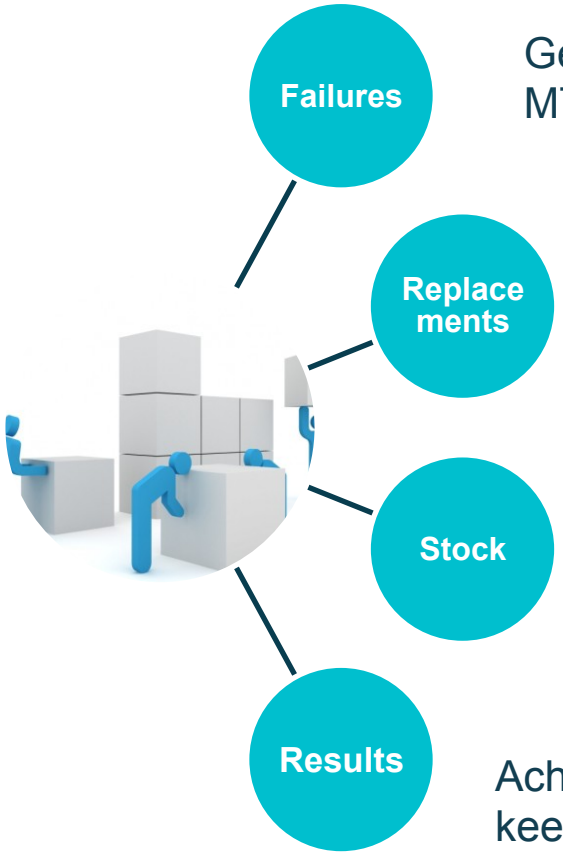


Case Study



- Spanish National Network:
  - Scenario 1: Full Mesh Topology.
  - Scenario 2: IP Top. Shortest path
- IP nodes: TR1-TR14.
- Optical nodes: 1-30
- Each IP node is attached to an optical node.
- Studied cases:
  - Case 1: Fixed traditional transponders.
  - Case 2: SBVTs.

Procedure



Generate random failures in time, based on MTBF and following an exponential distribution.

Get replacement information, knowing the necessary time to replace one transponder.

Stock counter: +1 if a fail happens, -1 if a replacement happens. Obtain peak value → minimum stock number

Achieve the percentage of time which a certain stock number keeps the service, knowing the peak value of minimum stock.

Input Data

What is the required information?

- Transponders:
  - Number of transponders
    - Fixed grid transponders:
    - Sliceable Bandwidth Variable Transponders
  - Cost

	Cost
40Gb/s, 2500km, 50 GHz	6
100Gb/s, 2000km, 50 GHz	15
400Gb/s, 75GHz, 500km	22

- Time:
  - Reposition time → 3 months
  - Operational time → 10 years
- Failures:
  - Mean Time Between Failures → 5 years

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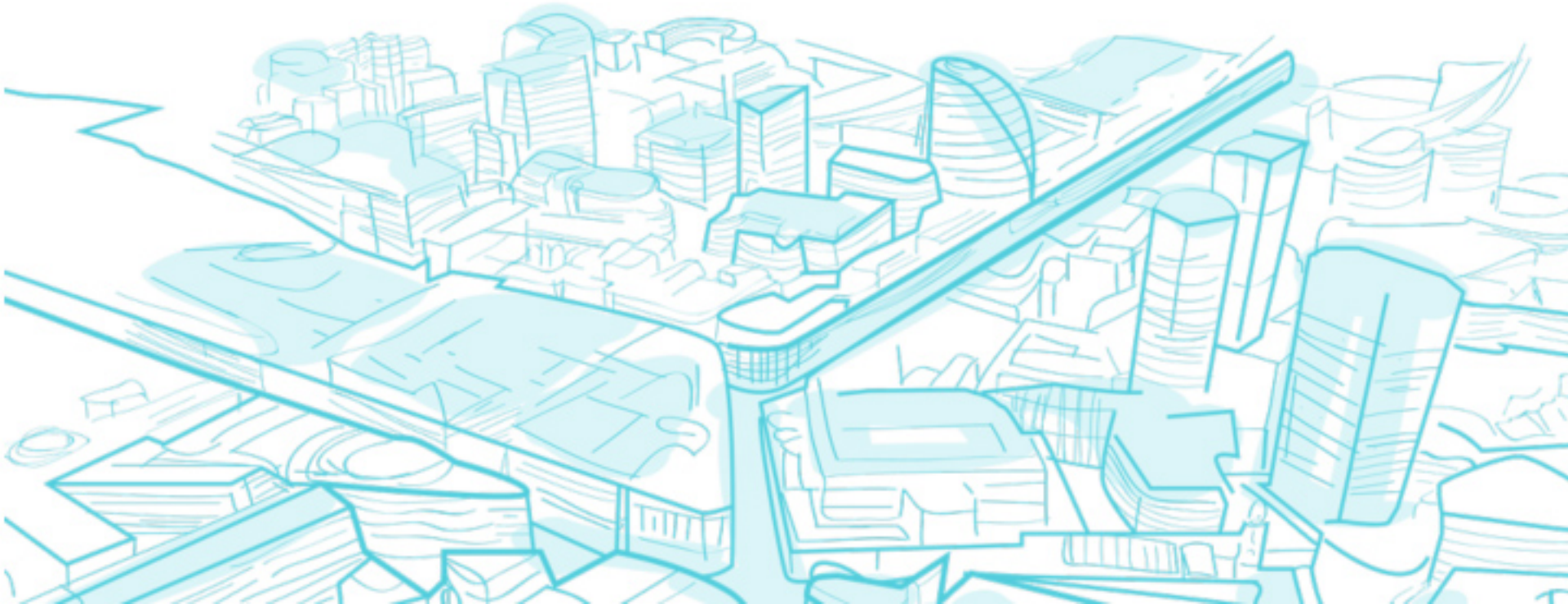
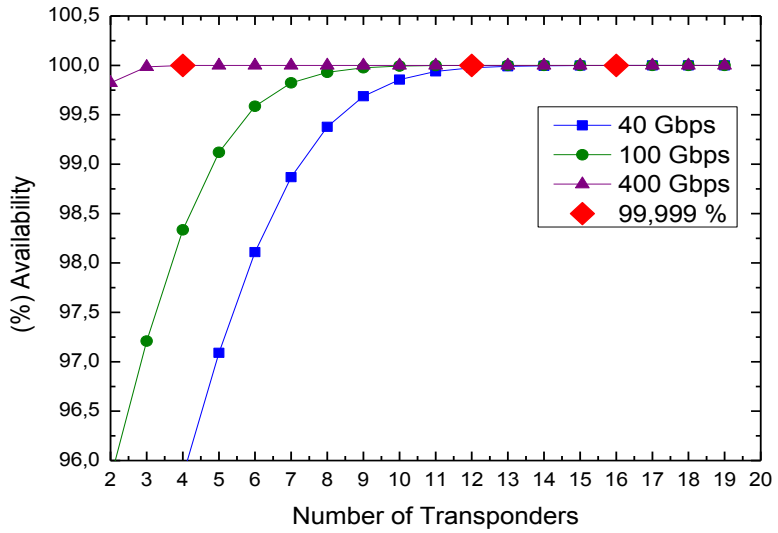
Results



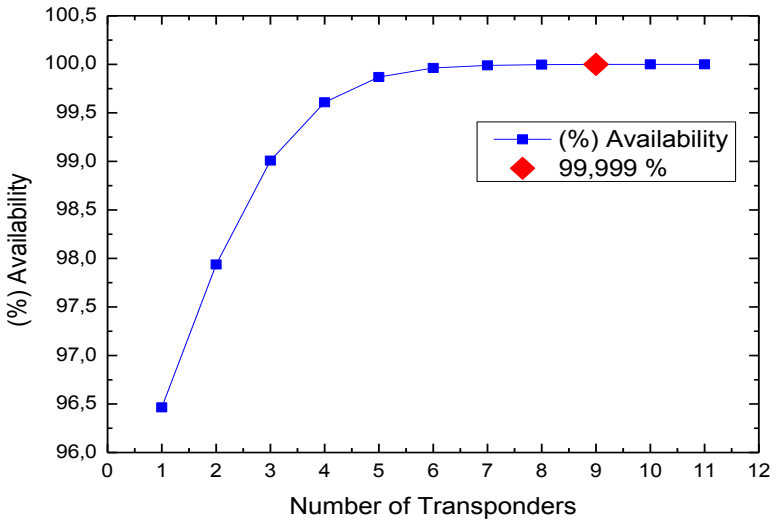
Number of spare transponders

Percentage of failures that can be repaired maintaining a certain number of spare transponders in a Full Mesh scenario for year 2014.

Non-sliceable transponders



SBVTs



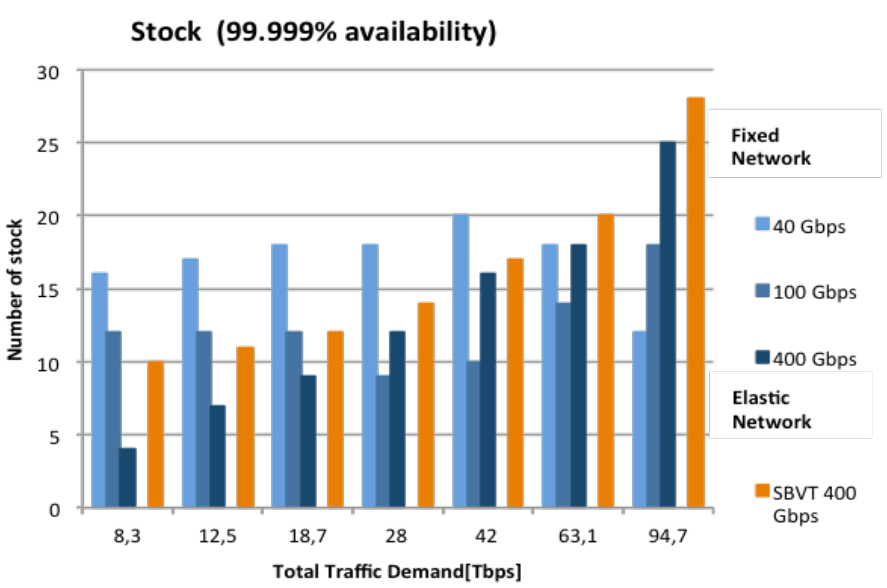
30 Fixed **Vs** **9 SBVTs**

Lower number of spare transponders are necessary in the case of using SBVT to keep 99.999% availability.

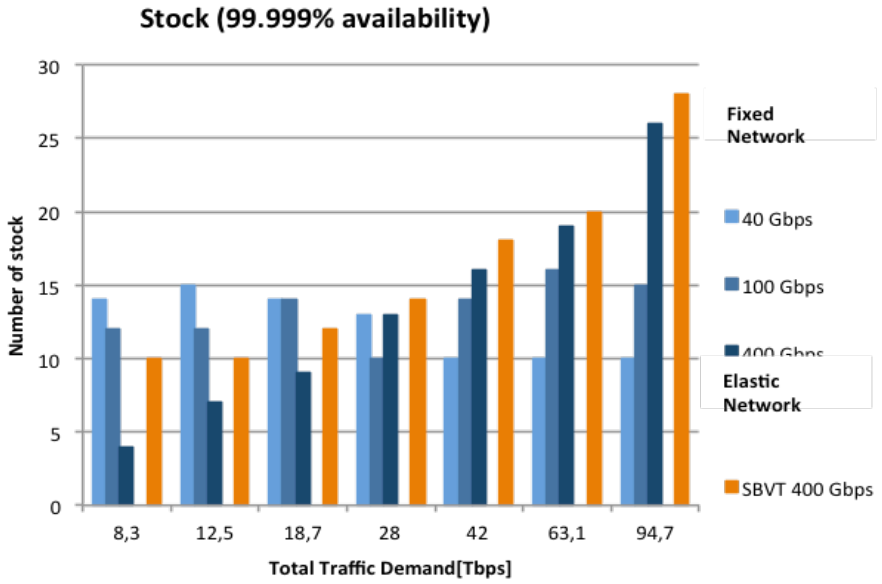
Service availability from 2014 to 2020

Number of Stock required to keep 99.999% of availability

❖ **Full Mesh**



❖ **IP Topology**

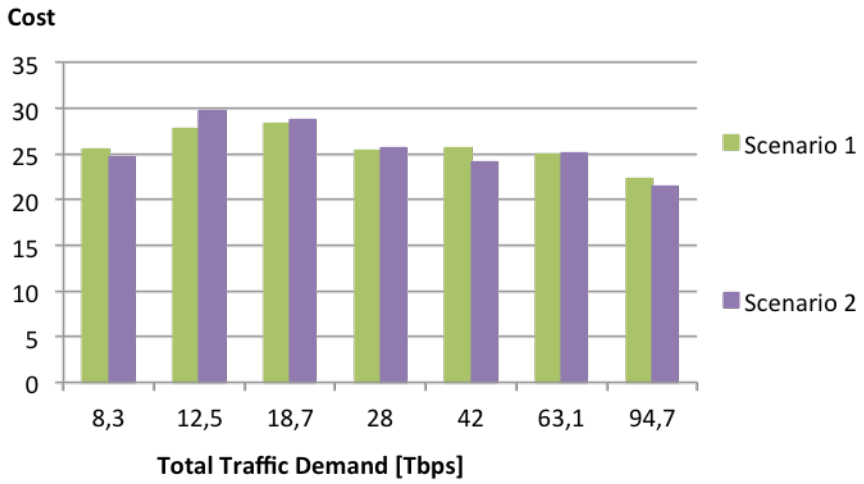


In both cases (Full mesh and IP) along the years higher number of total fixed, transponders are needed versus SBVT to keep 99.999% of availability.

SBVT Target Cost

Full Mesh and IP Topology

Target cost of SBVT to save 30% operational expenditures.



- Possible cost of SBVT can vary between 22 and 30.
  - 22 is the cost of 400Gbps fixed transponders
  - 30 imply an increase to 36% in the cost of the non sliceable transponder.
- The peak target cost value is reached in 2015 (12.5 Tbps)

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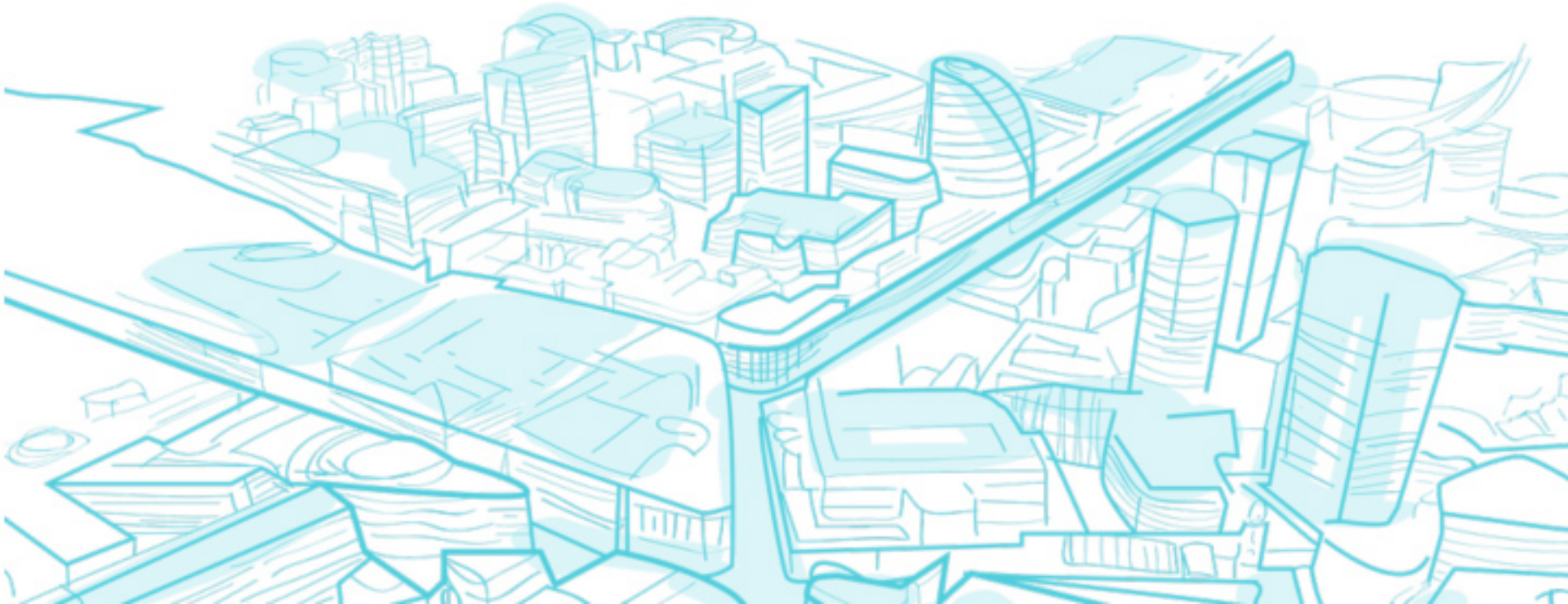
Conclusions



Conclusions

Summary of obtained results.

- Operational Expenditures can be reduced base on the previous results obtained:
  - Lower number of spare transponders are necessary in the case of using SBVT to keep 99.999% availability
  - In both cases (Full mesh and IP) along the years higher number of total fixed keep being necessary versus SBVT.
  - Possible cost of SBVT can vary between 22 and 30 which implies an increase to 36% in the cost of the fixed transponder.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