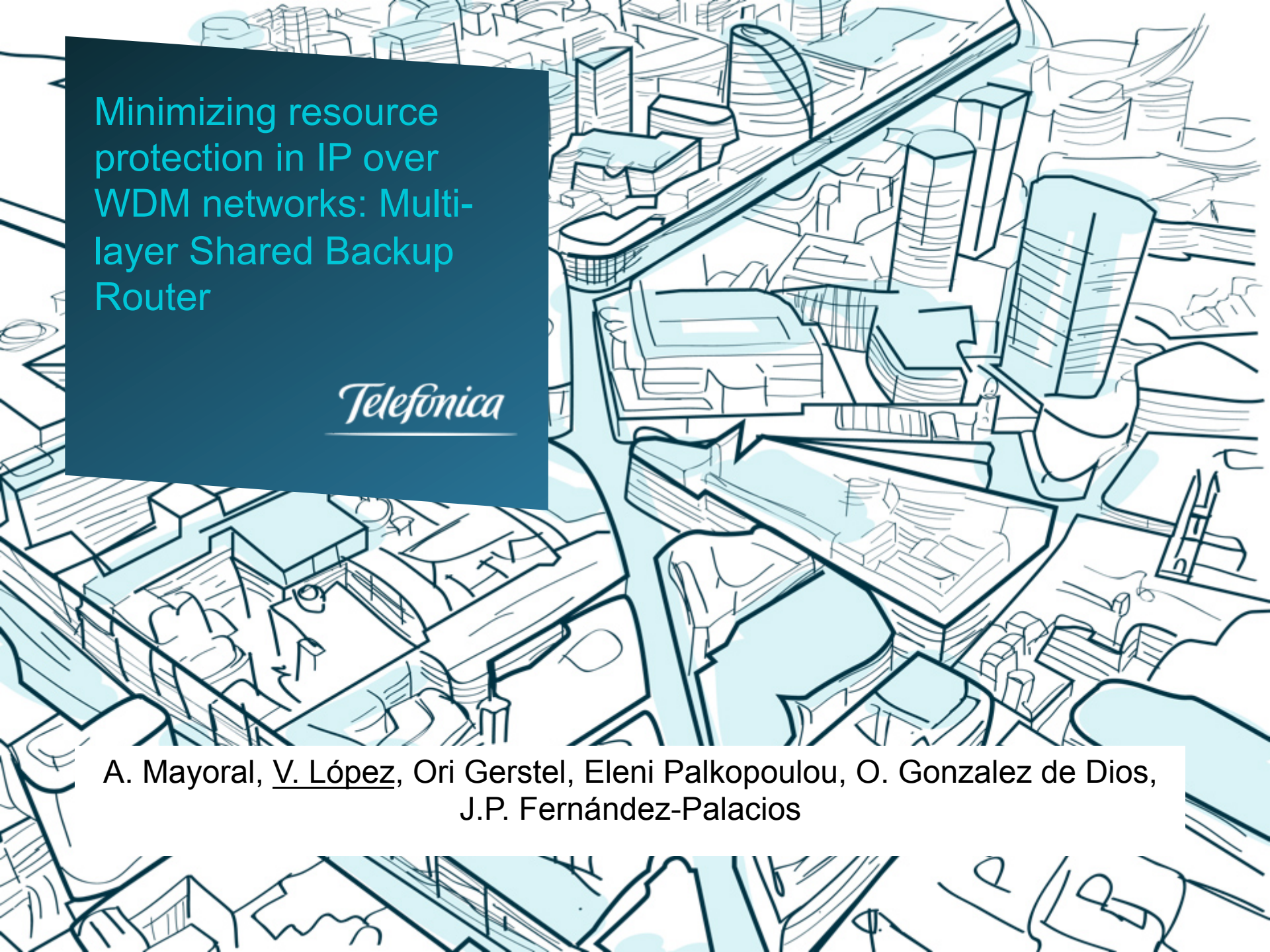
# Minimizing resource protection in IP over WDM networks: Multi-layer Shared Backup Router



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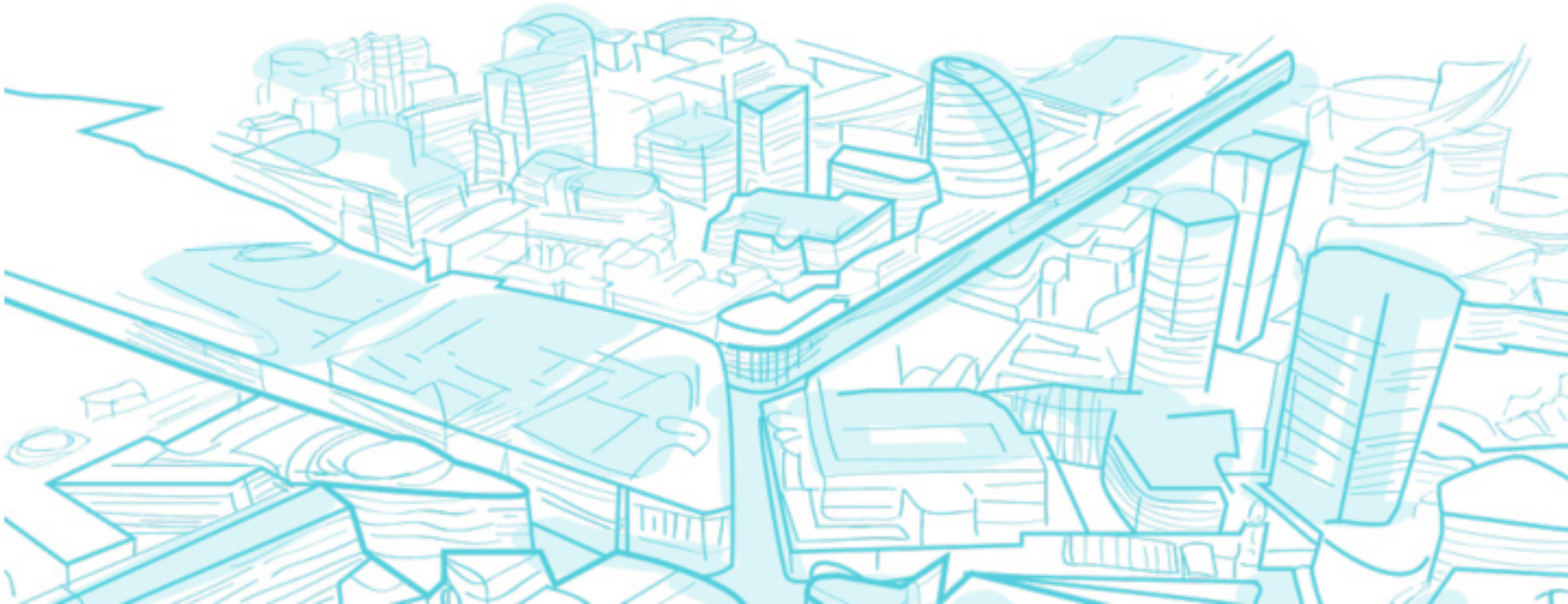
# 01

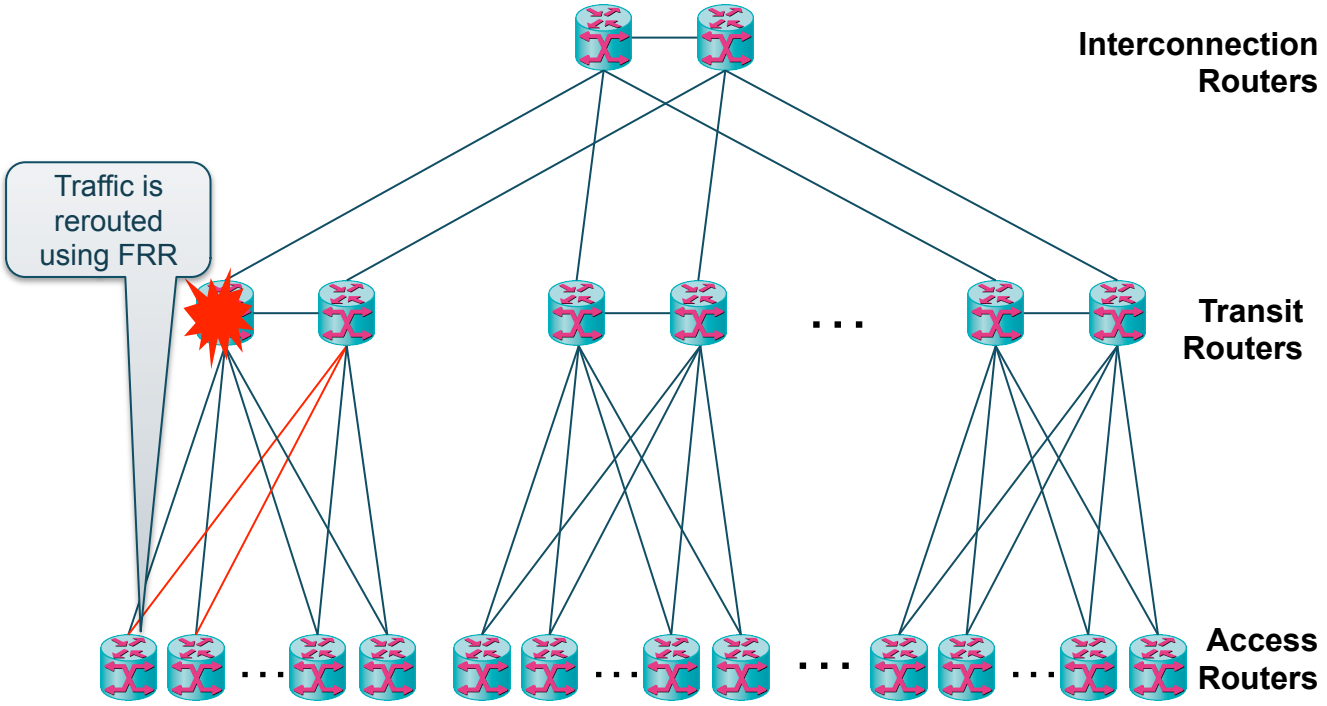
# Introduction



# Introduction

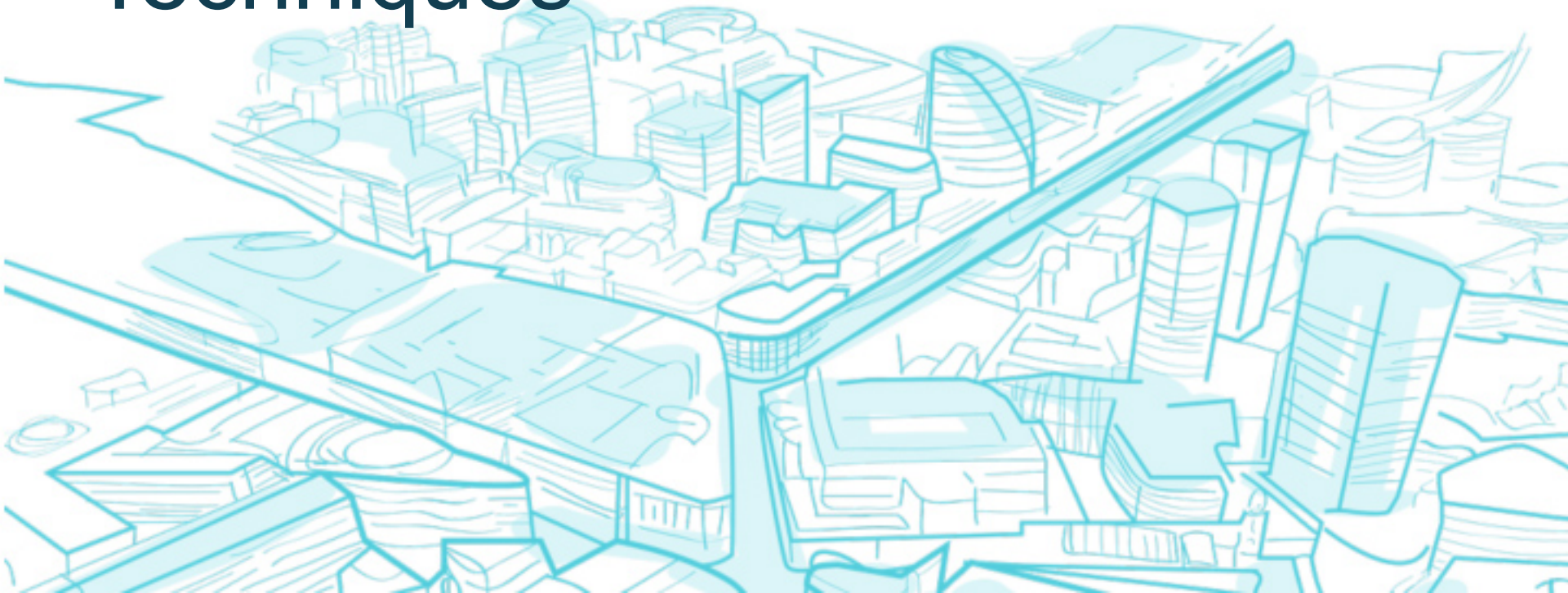
- Current networks operate with separated layers survivability mechanisms
  - 1+1,  1:1 or M:N Protection
  - Restoration

- Hierarchical Networks



# 02

# Multi-layer Restoration Techniques



# Multi-layer Restoration Techniques

- Failure in the optical layer:
  - GMPLS restoration of “alien” lambdas generated by IP colored ports.
  - Without alien wavelength, other scenarios are hidden to the IP.
- Failure in the IP layer:
  - Multi-layer Restoration after a port failure.
  - Multilayer Shared Back-up Router after a node failure

**Trials with vendors**

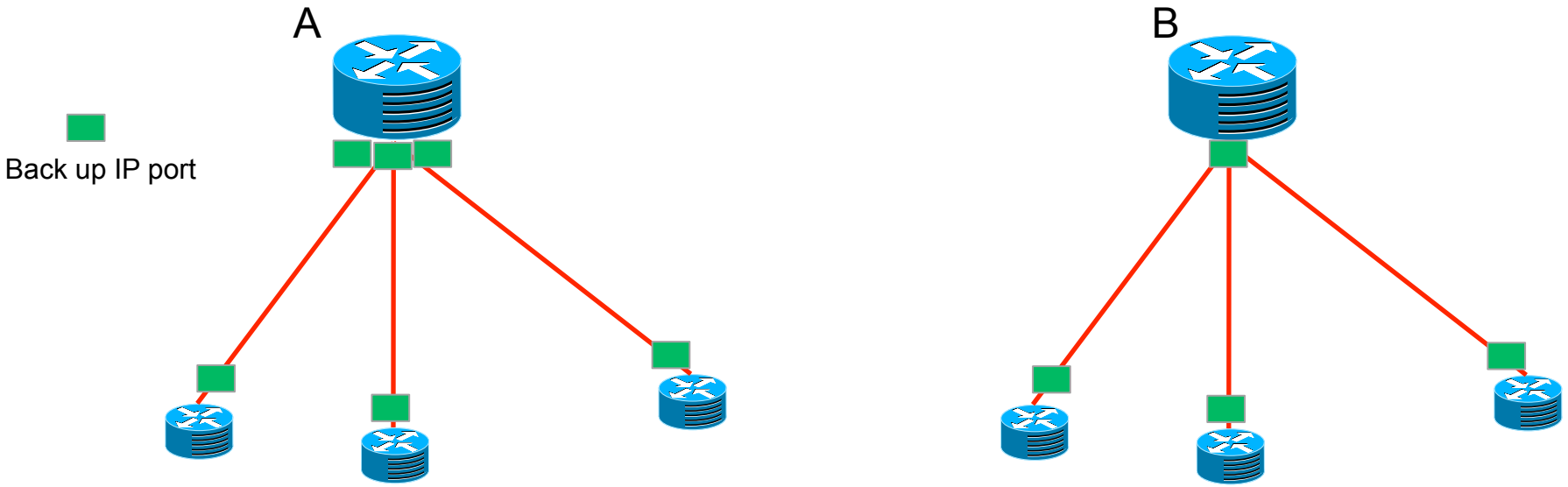
**ComMag Paper Jan 2014**

**This work**

# IP port failure restoration

A. Without Multilayer Control: One back-up port per link (optical connection preconfigured)

B. Multilayer control: One back-up port per node (dynamic optical connection provisioning)



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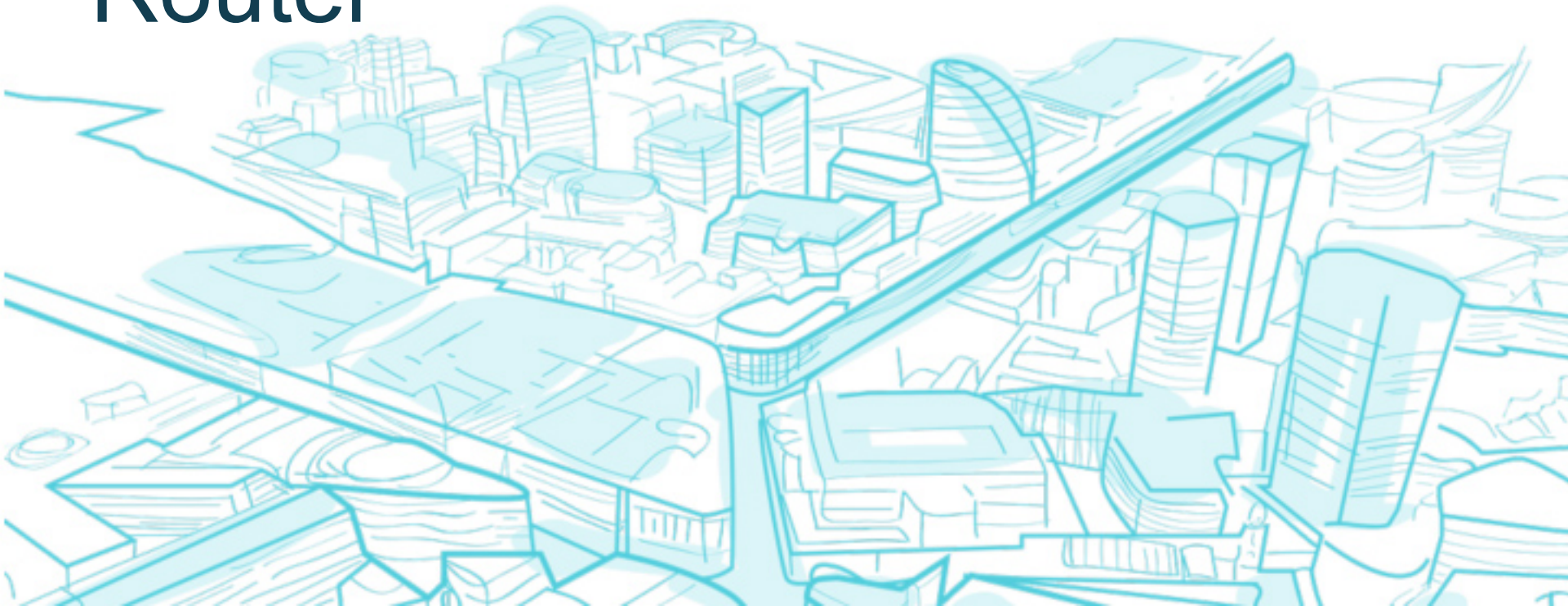
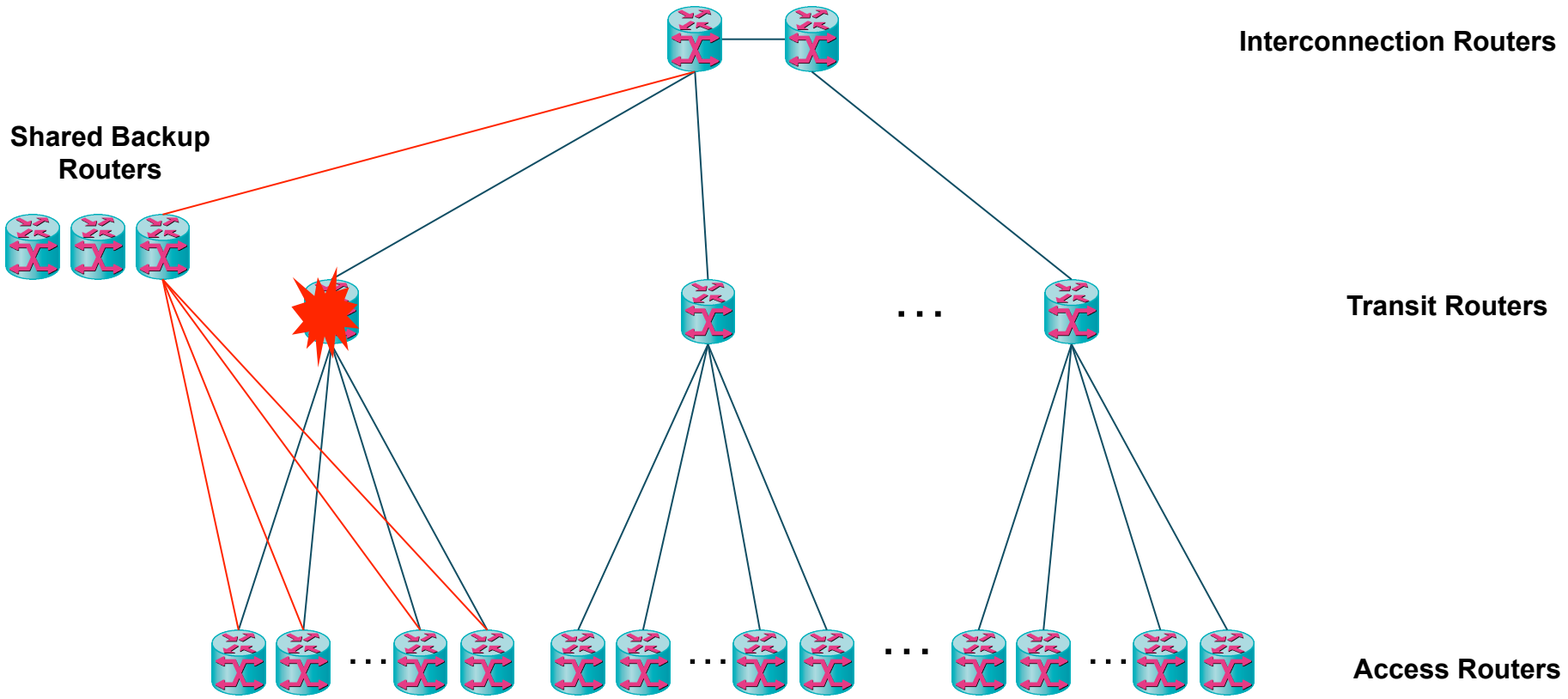
# Multi-layer Shared Back-up Router

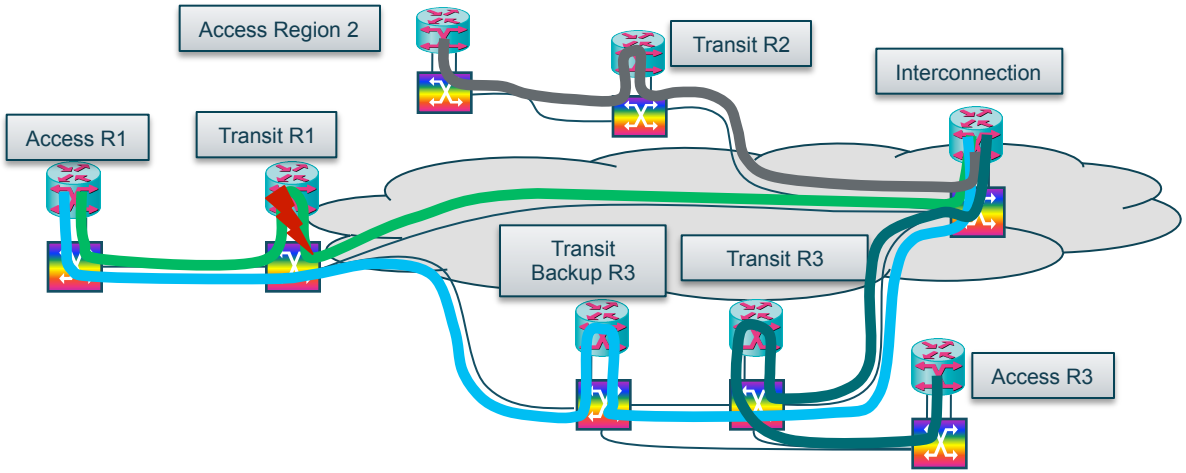


# Multi-layer Shared Backup Routers



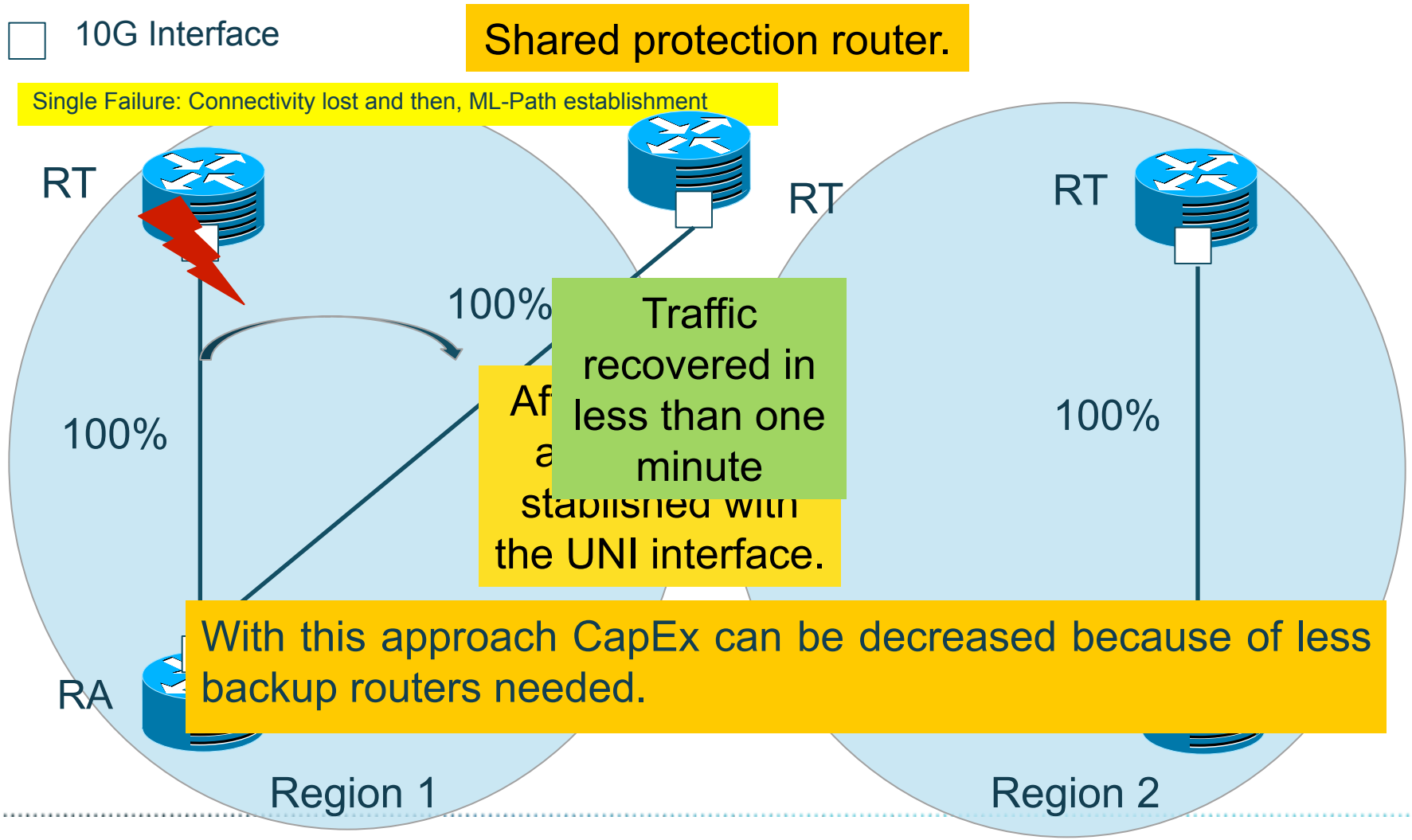
# Multi-layer Shared Backup Routers

- Multi-layer restoration consist on using the increased DWDM layer connectivity and dynamicity to recover both layer failures.
- Multi-layer restoration allows to increase availability due to the higher number of resources to drive traffic available.



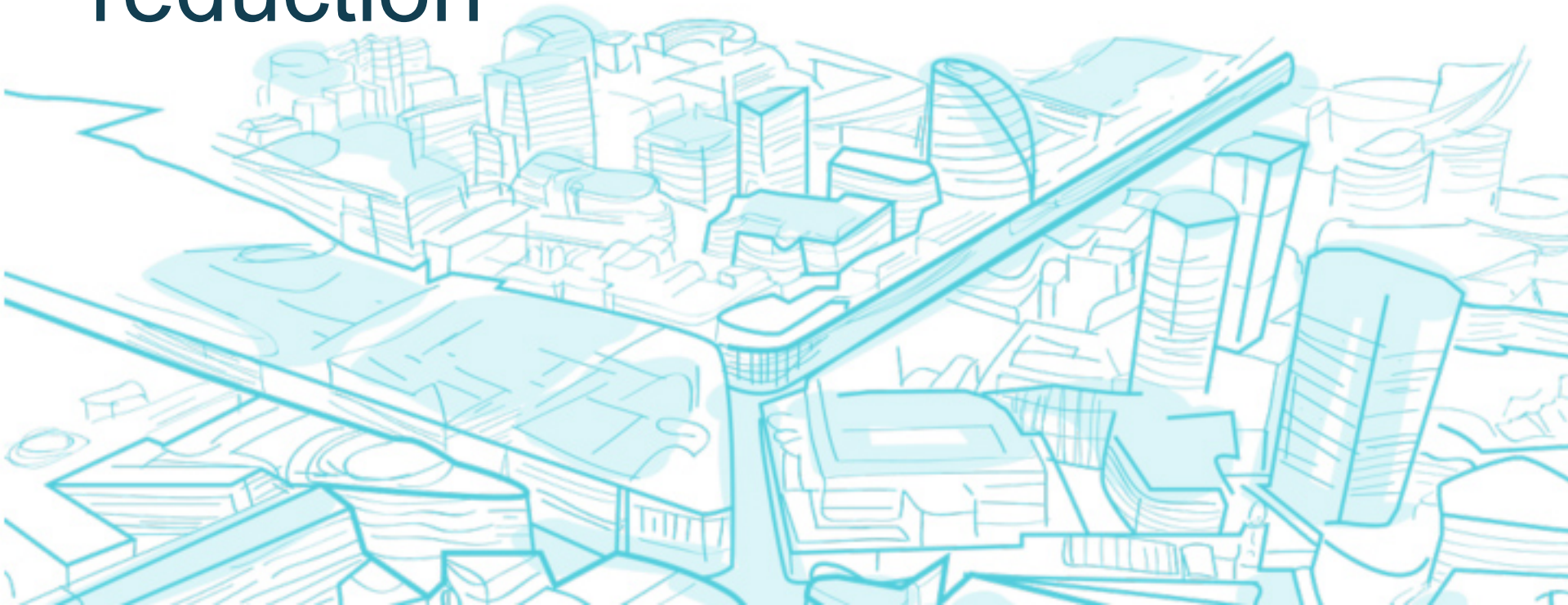

Currently, MPLS survability only can be done using pre-stablished links. (Fixed neighbours).

# Multi-layer Shared Backup Routers

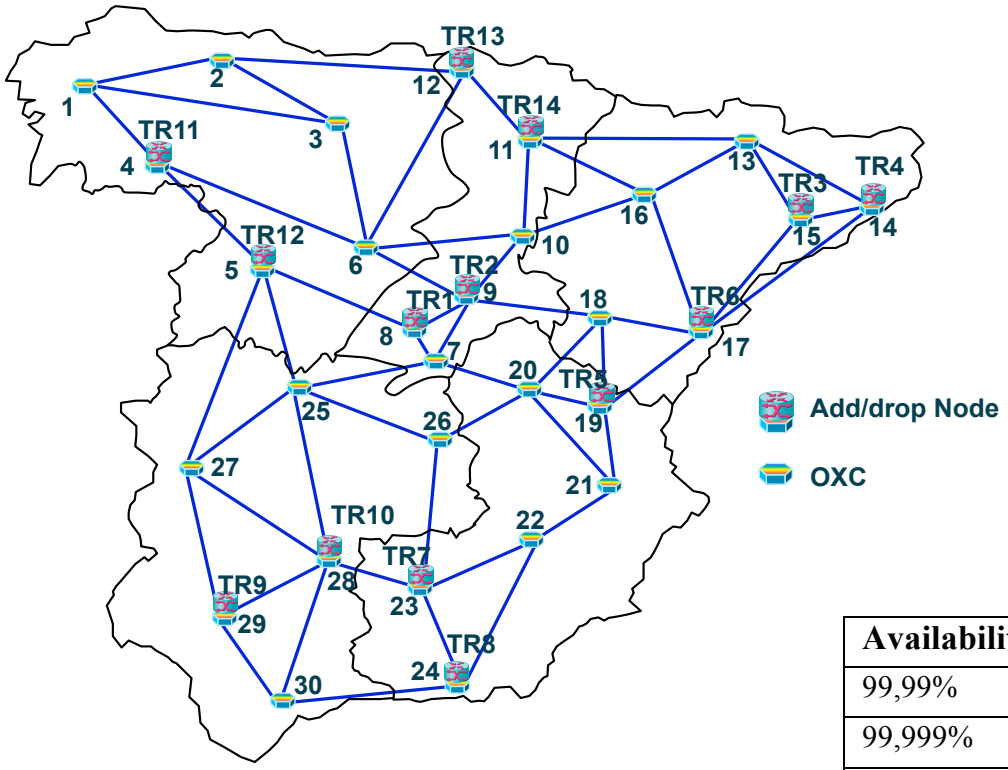


# 04

# Impact on CAPEX reduction



# Case Study



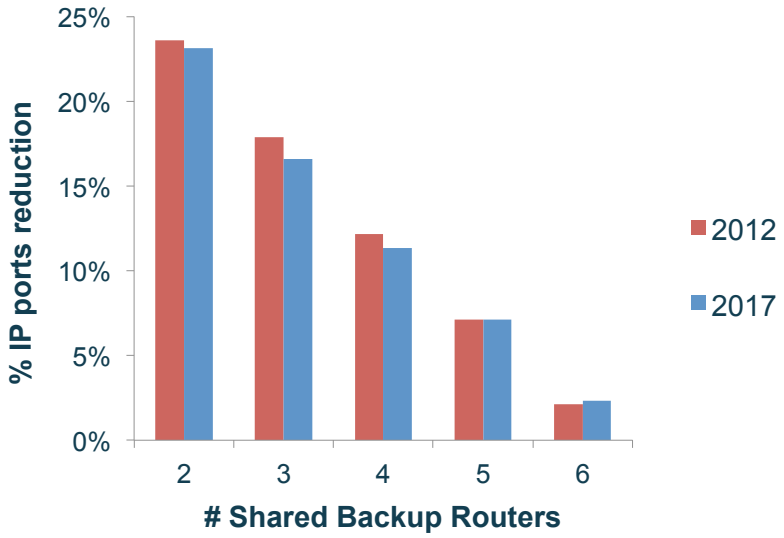

- Table 1 shows the MTTR for protection and MLSBR schemes assuming a MTBF of 3 years.
- **OPEX** can be reduced using this protection scheme as MTTR is greater for the same availability.

| | Number of Backup Routers | | | | | |
|---|---|---|---|---|---|---|
| **Availability** | **2** | **3** | **4** | **5** | **6** | **Protection** |
| 99,99% | 33,0 | 59,2 | 86,6 | 110,7 | 132,6 | 11,1 |
| 99,999% | 14,3 | 31,9 | 51,6 | 72,4 | 91,0 | 3,4 |
| 99,9999% | 6,7 | 17,6 | 31,9 | 47,2 | 63,6 | 0,1 |

Table 1: Comparison between MLBSR and Protection in terms of MTTR (days)

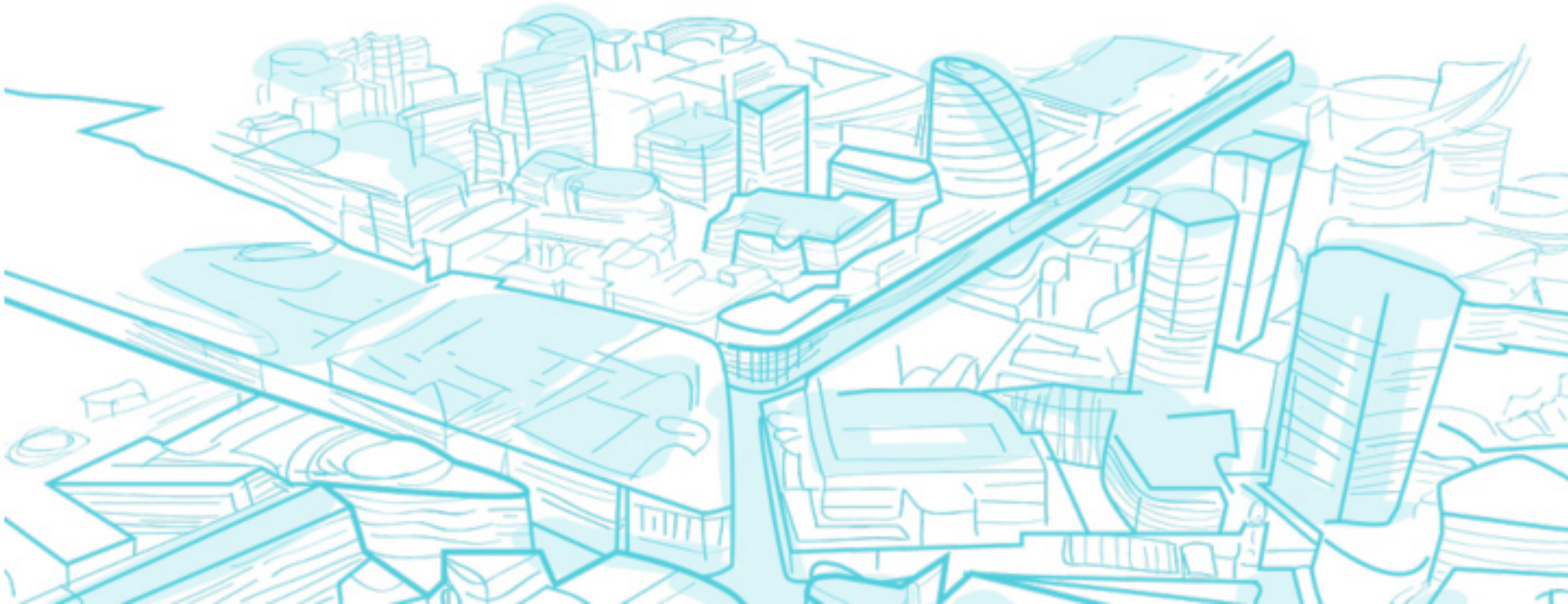
# CAPEX savings

- IP layer is dimension with a maximum occupation of 80% for 1+1 protection.
- The number of shared back-up router can vary.
- Two SBRs → 24% of savings in the number of IP ports.
- The percentage decreases conforms the number of SBR grows, but savings are conserved in 2017.



# 05

# Conclusions



# Conclusions and next Steps

- MLSBR can reduce up to 24% the number of IP ports in the network and it can increase the MTTR.
- Following table summarizes the advantages, disadvantages of both approaches and defines requirements to take into account to deploy the solution.

| | Advantages | Drawbacks | Requirements |
|---|---|---|---|
| **Original planning** | • Simple operation<br>• Traffic restoration in less than 50ms with FRR. | • Resource duplication.<br>• Small MTTR | • By-pass selection is required to reduce the cost of this approach.<br>• FRR to minimize restoration time. |
| **MLSBR** | • Minimize routers investment in chassis and ports.<br>• Extend MTTR and reduce OPEX | • MLSBR takes around 1 minute. It is limited by optical restoration time. | • Optical mesh<br>• GMPLS enabled in the optical mesh.<br>• UNI enabled.<br>• Back-up routes pre-loaded in routers.<br>• Configuration pre-loaded in transit back-up routers.<br>• FRR to minimize restoration time. |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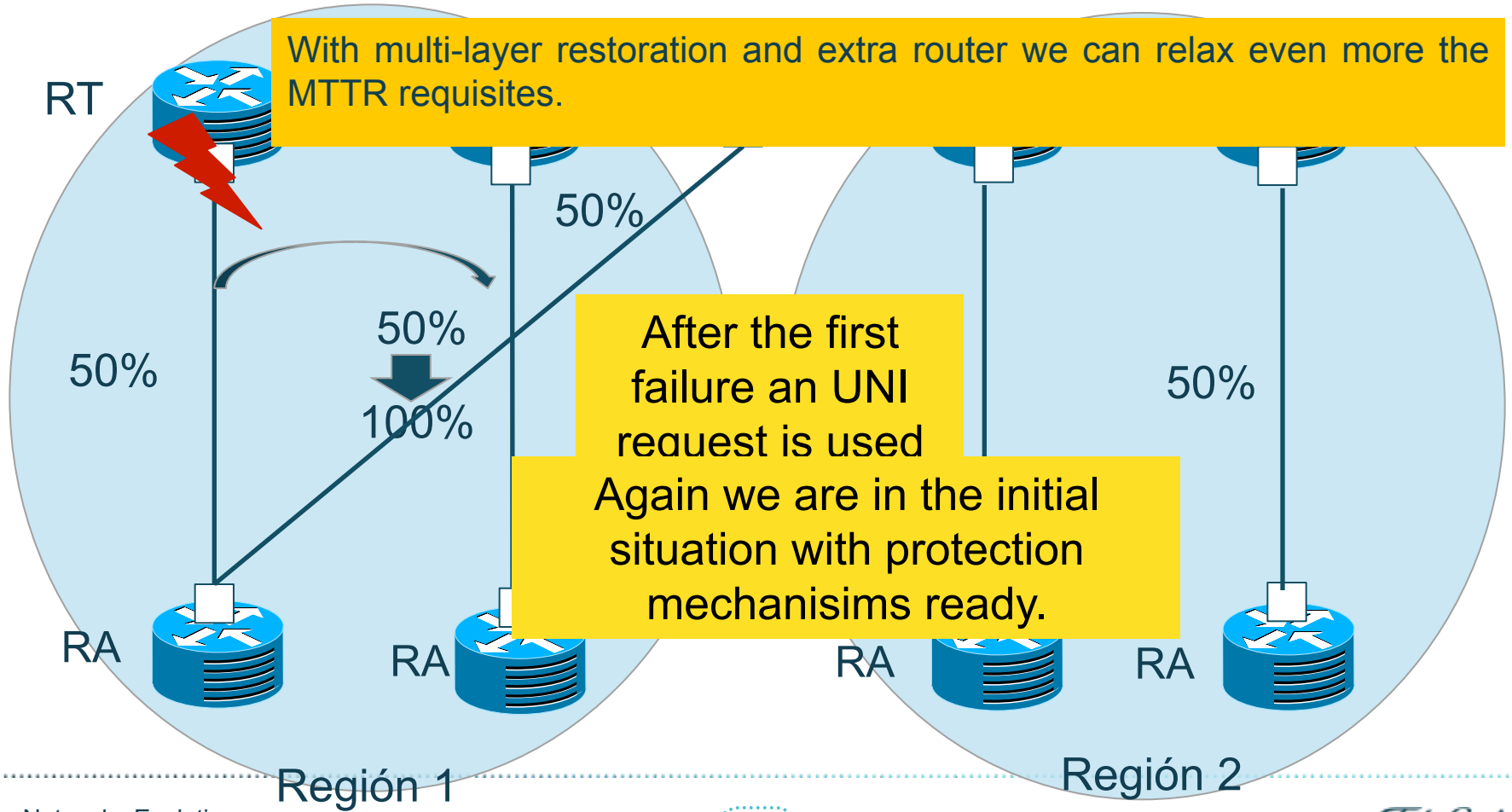
# Multi-layer Shared Backup Routers

1+1 IP Protection with an additional router

- 10G Interface

Single Failure: Typical Operation: Traffic is moved to backup router.

With multi-layer restoration and extra router we can relax even more the MTTR requisites.




After the first failure an UNI request is used
Again we are in the initial situation with protection mechanisims ready.