Interoperator fixed-mobile network sharing

Ireneusz Szcześniak, Piotr Chołda, Andrzej R. Pach
Department of Communications
AGH University of Science and Technology

Poland

Bożena Woźna-Szcześniak
Institute of Mathematics and Computer Science
*Jan Długosz University*

Poland

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Introduction

- Fixed-mobile networks are wide-spread, and expensive.
- Operators need to share, but sharing is limited.
- Sharing of physical infrastructure: buildings, masts, etc.
- Roaming and virtual operators are about leasing, not sharing.
- Operators can build joinly a single network and use it together.
- Sharing can improve performance and bring resiliency.
- Performance improvement is so needed for 5G.
- Currently, fixed-mobile networks are not resilient.

Novel idea

The novel idea of interoperator fixed-mobile network sharing, and the evaluation of the benefits the sharing brings in terms of resiliency.

The hallmark of our proposed sharing is the interoperator communication in access networks.

Interoperator fixed-mobile network sharing in general
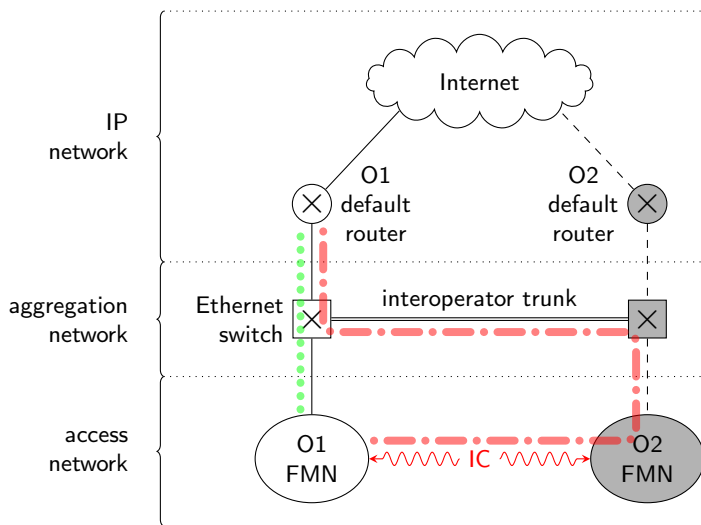
Interoperator sharing in passive optical networks
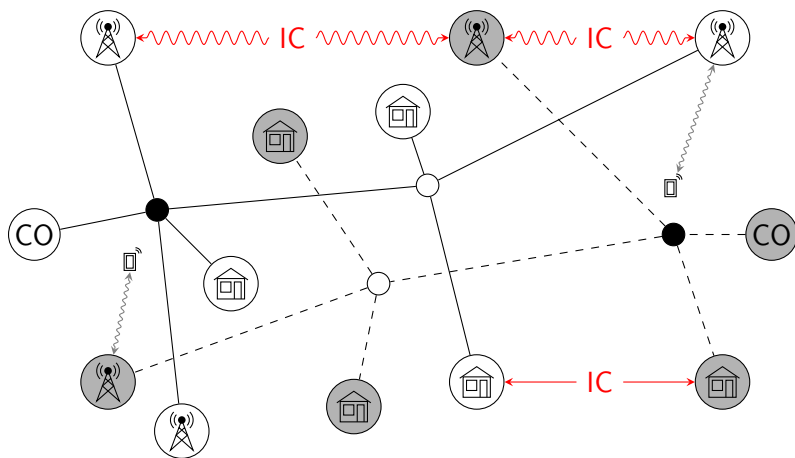
Disclaimer: we need active nodes

- In the proposed sharing we need active remote nodes.
- Active, not passive, nodes can diverge traffic to a backup path.
- But it's hard to argue for active nodes in passive optical networks...
- So active nodes are also needed for:
  - longer reach,
  - better performance,
  - inter-ONU communication,
  - inter-base station communication,

Evaluation scenarios

- How does the proposed sharing improve the service availability?
- An ONU is capable of the interoperator communication or not.
- We studied two scenarios:
    - in the first, the locations of active remote nodes are given,
    - in the second, the active nodes are randomly distributed.

First scenario, and second too
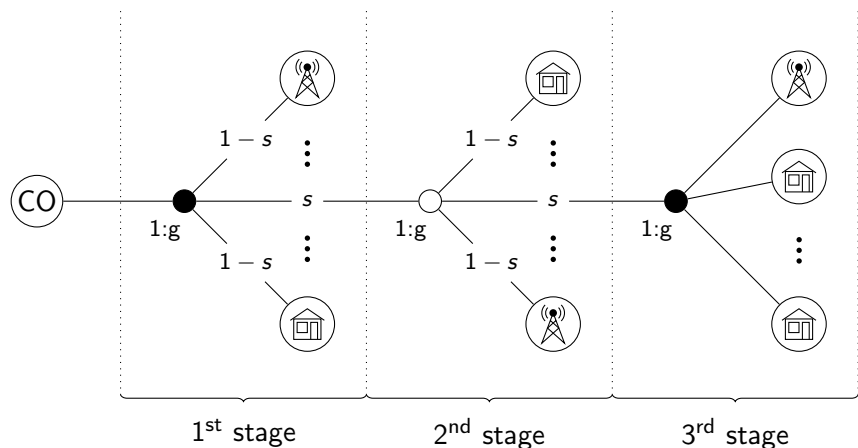
Service availability calculation

- Numerical evaluation: a mix of analysis and Monte Carlo simulation.
- We analytically evaluate a given, concrete network.
- We randomly produce a sample of concrete networks from the populations with the given probabilities:
  - r - an ONU is capable of inter-operator communication,
  - q - a remote node is active.
- We produced 87400 concrete networks, and averaged the results.

Service availability calculation - continued

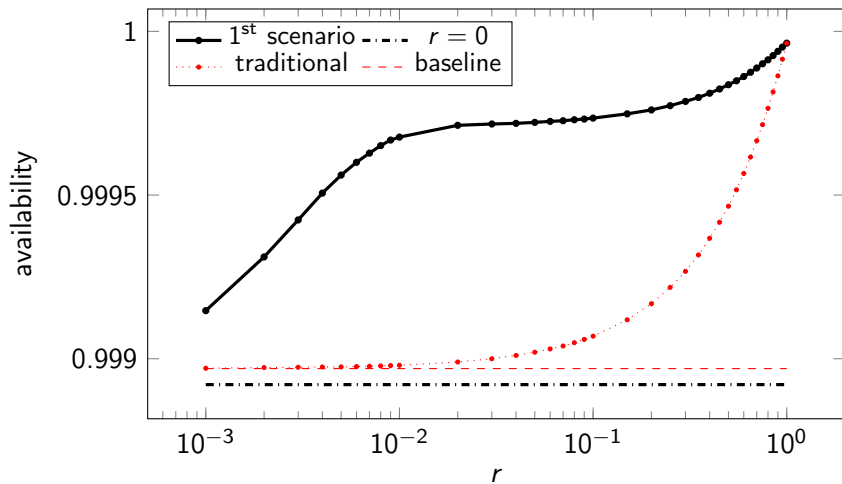Calculations: traversing the reliability block diagram.
The availability is calculated using this recursive function:

$$f(c,p) = \begin{cases} a_c a_{u_c \to c} f(u_c, c) & 1^{\text{st}} \text{ case} \\[2ex] 0 & 2^{\text{nd}} \text{ case} \\[2ex] a_c & 3^{\text{rd}} \text{ case} \\[2ex] a_c(1 - \prod_{\substack{i \in N_c \\ i \neq p}} (1 - a_{i \to c} f(i, c))) & 4^{\text{th}} \text{ case} \\[2ex] h_c(1 - \prod_{v \in V_c} (1 - d_{c,v})) & 5^{\text{th}} \text{ case} \end{cases}$$

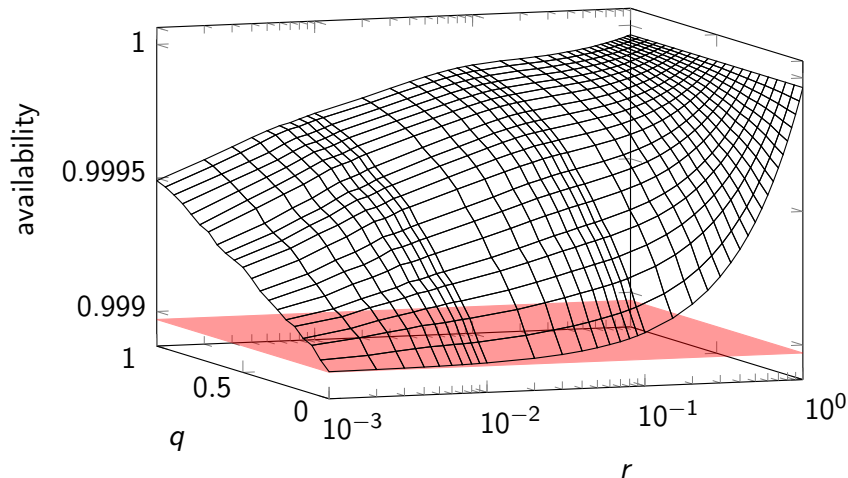## Service availability calculation - an interesting case

IC-ONU1   NIC-ONU   IC-ONU2
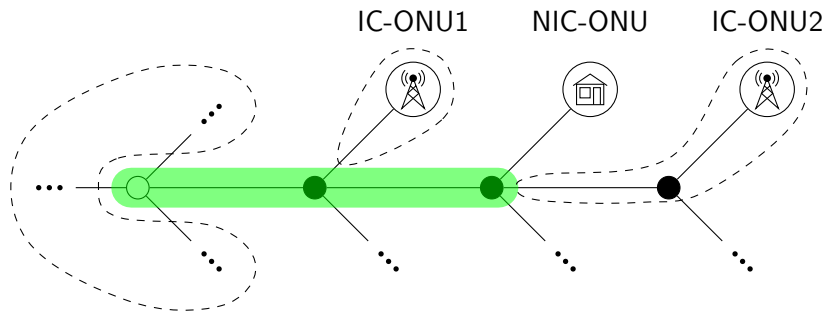
Results for the first scenario

Results for the second scenario

Conclusions

- We proposed the interoperator fixed-mobile network sharing.
- We evaluated the benefits the sharing brings in terms of resiliency.
- Downtime can be significantly reduced with little network upgrades.
- Upgrades can be rolled out in stages and where needed most.
- The proposed sharing should improve performance too.
- There are many problems to solve, for instance:
  - performance studies,
  - optimization,
  - implementation details.