ORCHESTRA

Optical peRformanCe monitoring enabling dynamic networks using a Holistic cross-layEr, Self-configurable Truly flexible appRoAch

CROSS-LAYER, DYNAMIC NETWORK ORCHESTRATION, LEVERAGING SOFTWARE-DEFINED OPTICAL PERFORMANCE MONITORS

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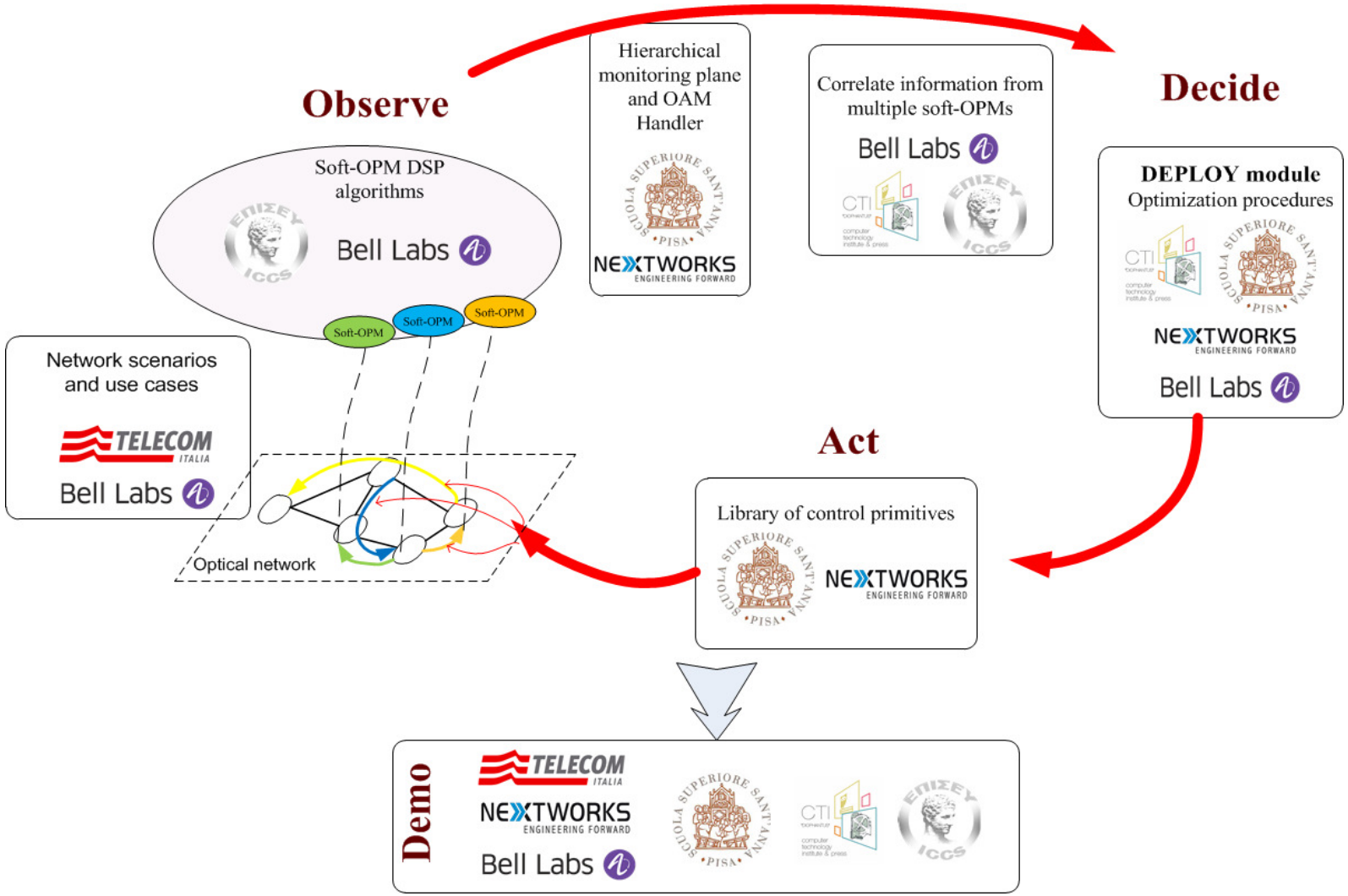
Outline

- Any system, including an optical network, has to be observable before it can become controllable and be subject to optimization.
- Coherent optical interfaces can be extended, almost for free, to operate as software defined optical performance monitors.
- A novel monitoring plane can collect and correlate information; optimization procedures and algorithms can enable network dynamic reorganization (modifying existing lightpaths or circuit parameters or triggering reconfiguration process).
- Network efficiency increases and optical resource utilization is improved.
- Investments are postponed and network cost decreases

Partner roles



Analog performance monitoring

- Optical aggregate power
- Optical per channel power
- Channel number
- Channel wavelength

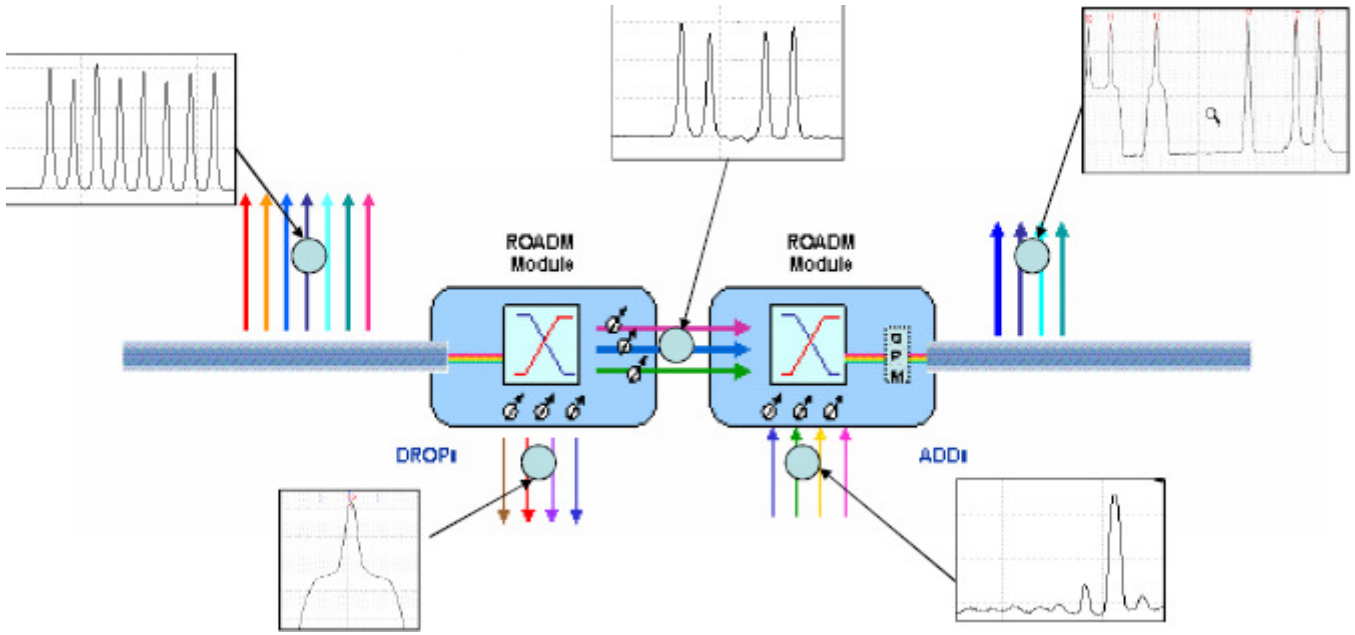
Span attenuation

OSNR degrade

ROADM routing

Photonic routing

OBSERVE



Digital performance monitoring

- PRE FEC BER, ES, SES, UAS
- OTN round trip delay
- TTI (Trail identifier)
- TCM (Tandem Connection)

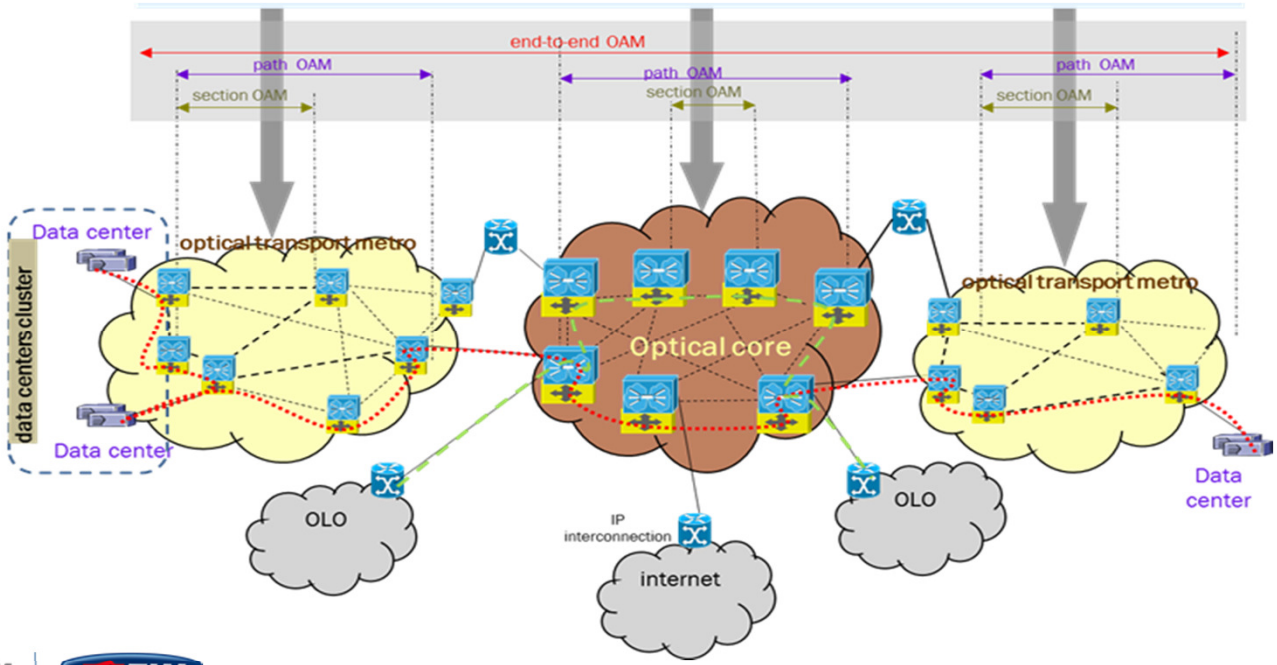
Service degrade

Latency

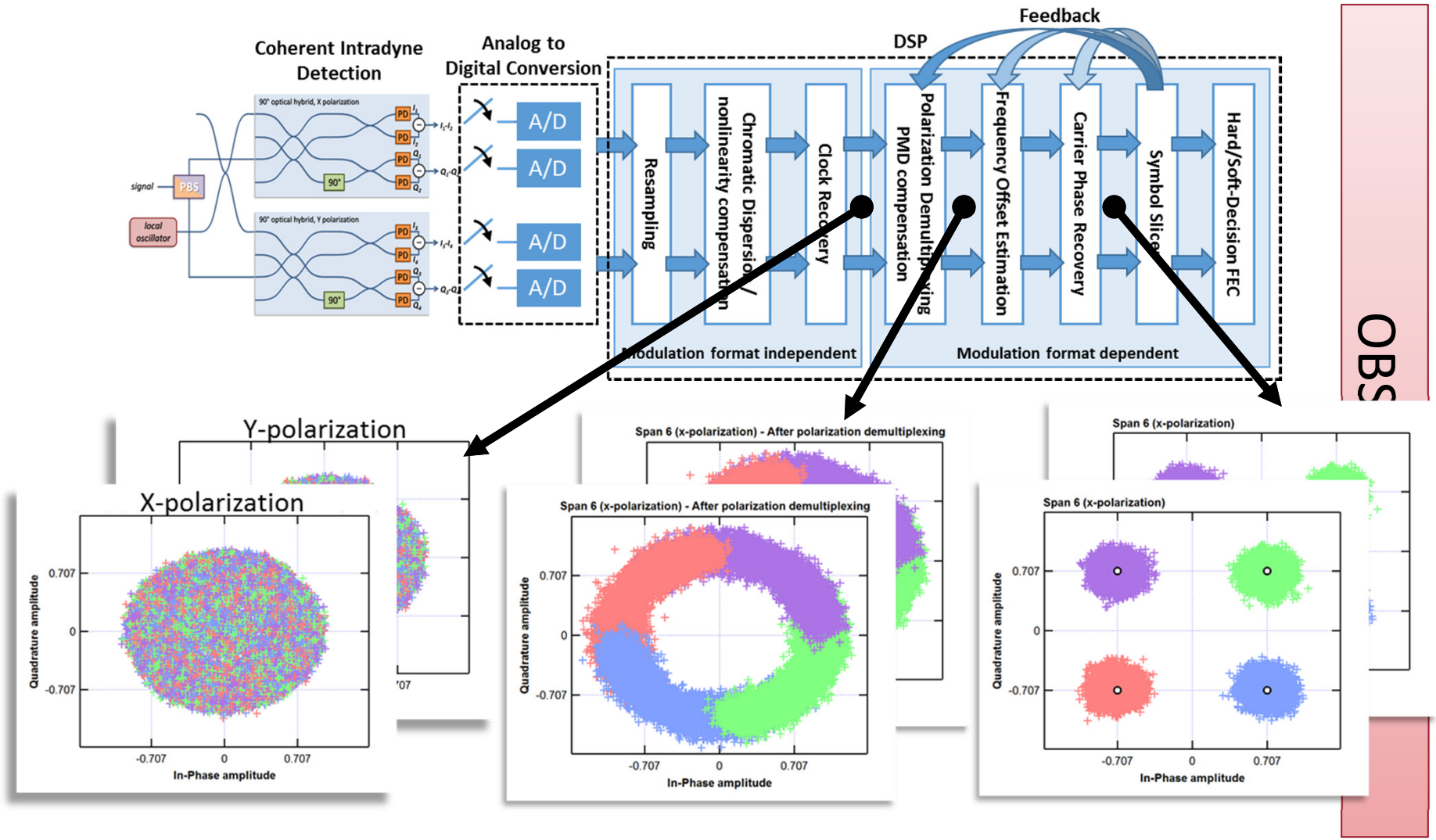
Wrong Xconn

Interoperability

OBSERVE



DSP for coherent receivers



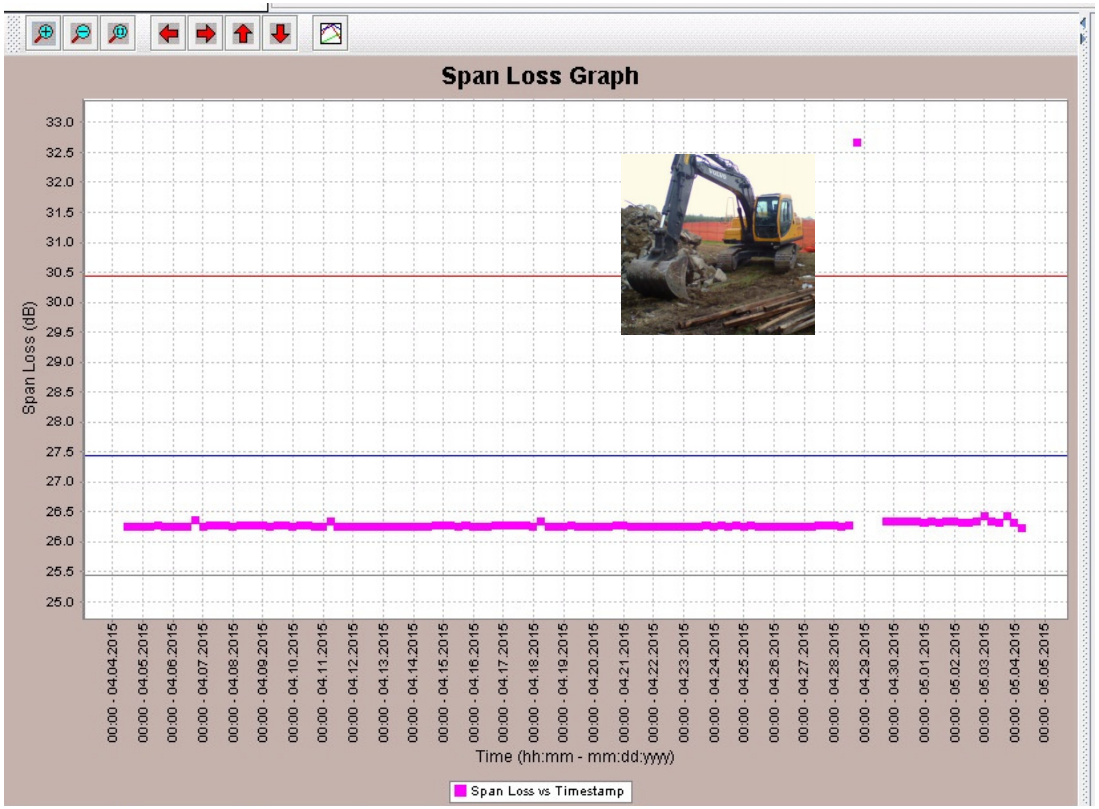
Soft performance monitoring

- DSP in Coherent Optical Receivers performs:
  - Carrier phase estimation
  - Dispersion compensation
  - Polarization demultiplexing and PMD compensation
  - Nonlinearity compensation
  - Wavelength demultiplexing
- Each parameter has to be detected in order to be compensated
- Each compensator is a monitoring probe, whose level of accuracy is correlated to the degree of compensation of other parameters

OBSERVE

Aging and failures

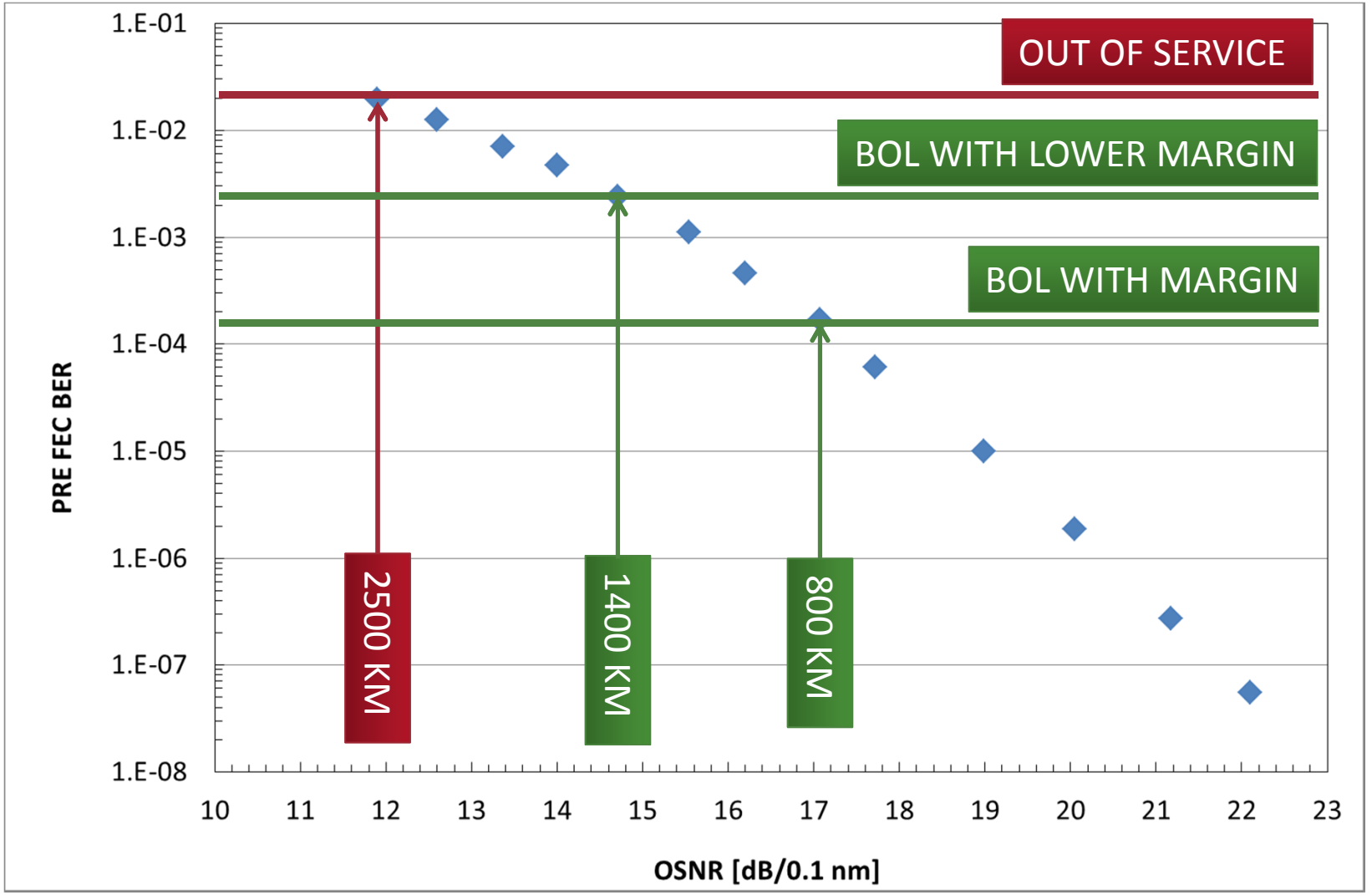
- Cable aging
- OLA aging
- Interface performance degrade



DECIDE

- Shall we take the risk of rerouting a circuit because of a bad forecast or shall we prefer to react only to out of service alarm?

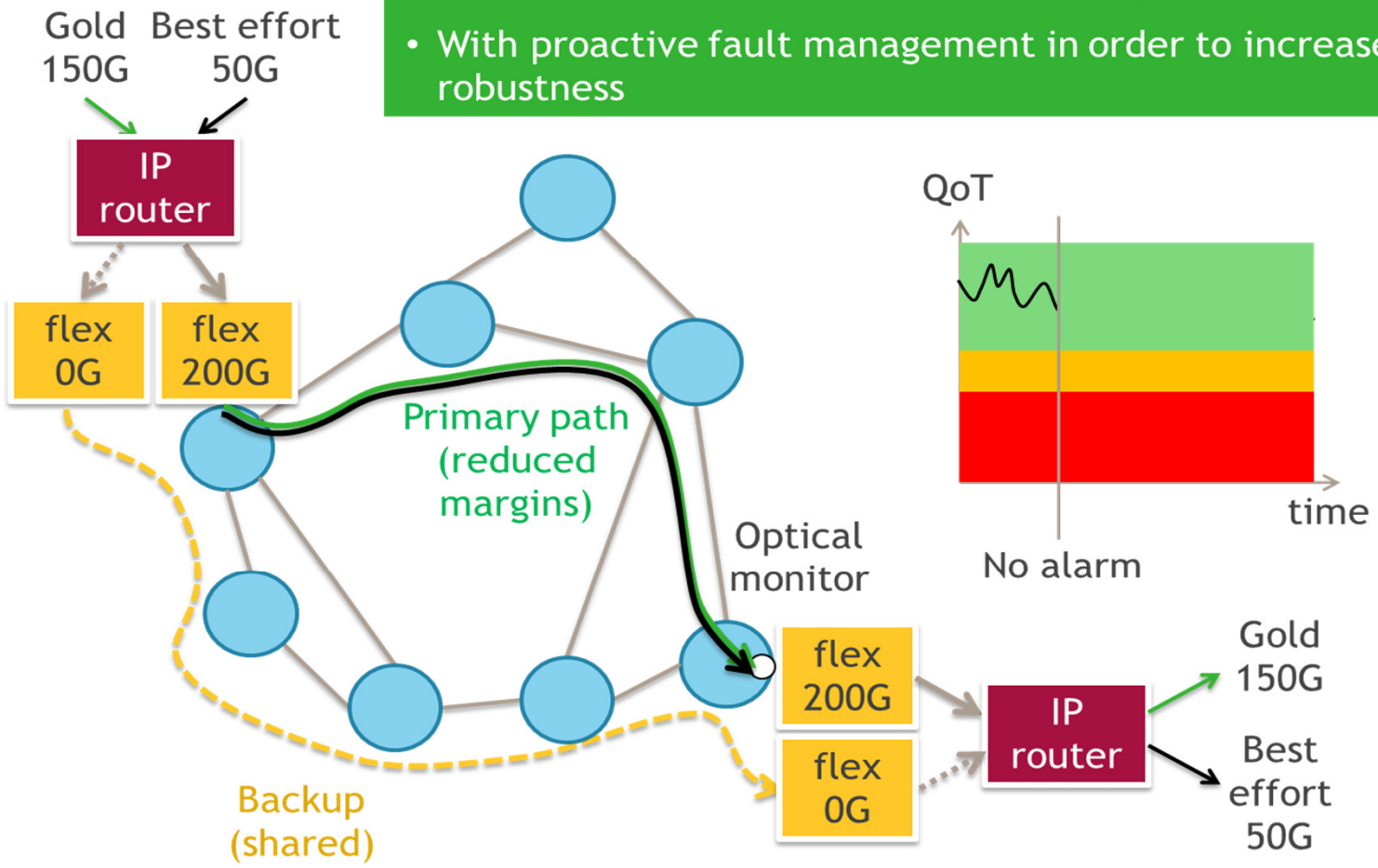
Go towards the limit



DECIDE

Postpone investment

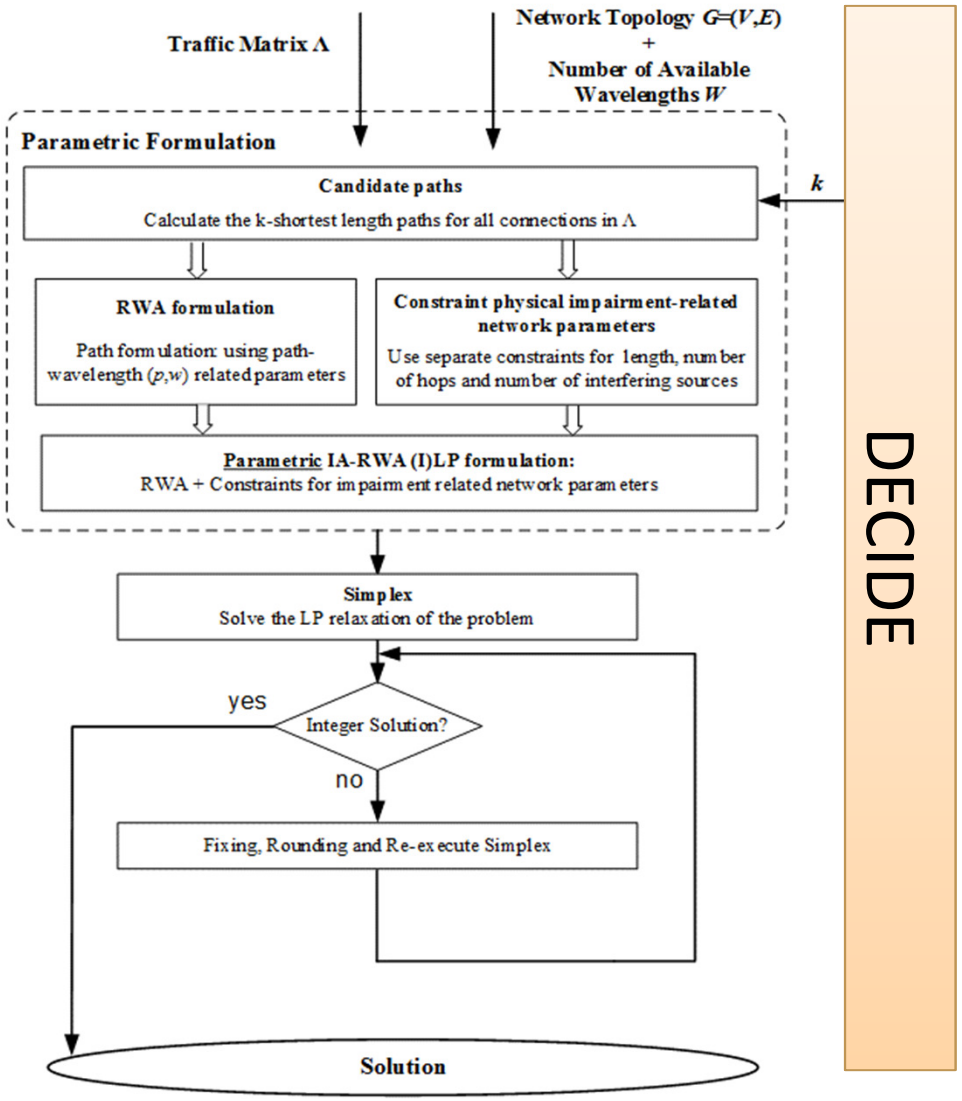
- Just-enough-margin design to limit overprovisioning
- With proactive fault management in order to increase robustness



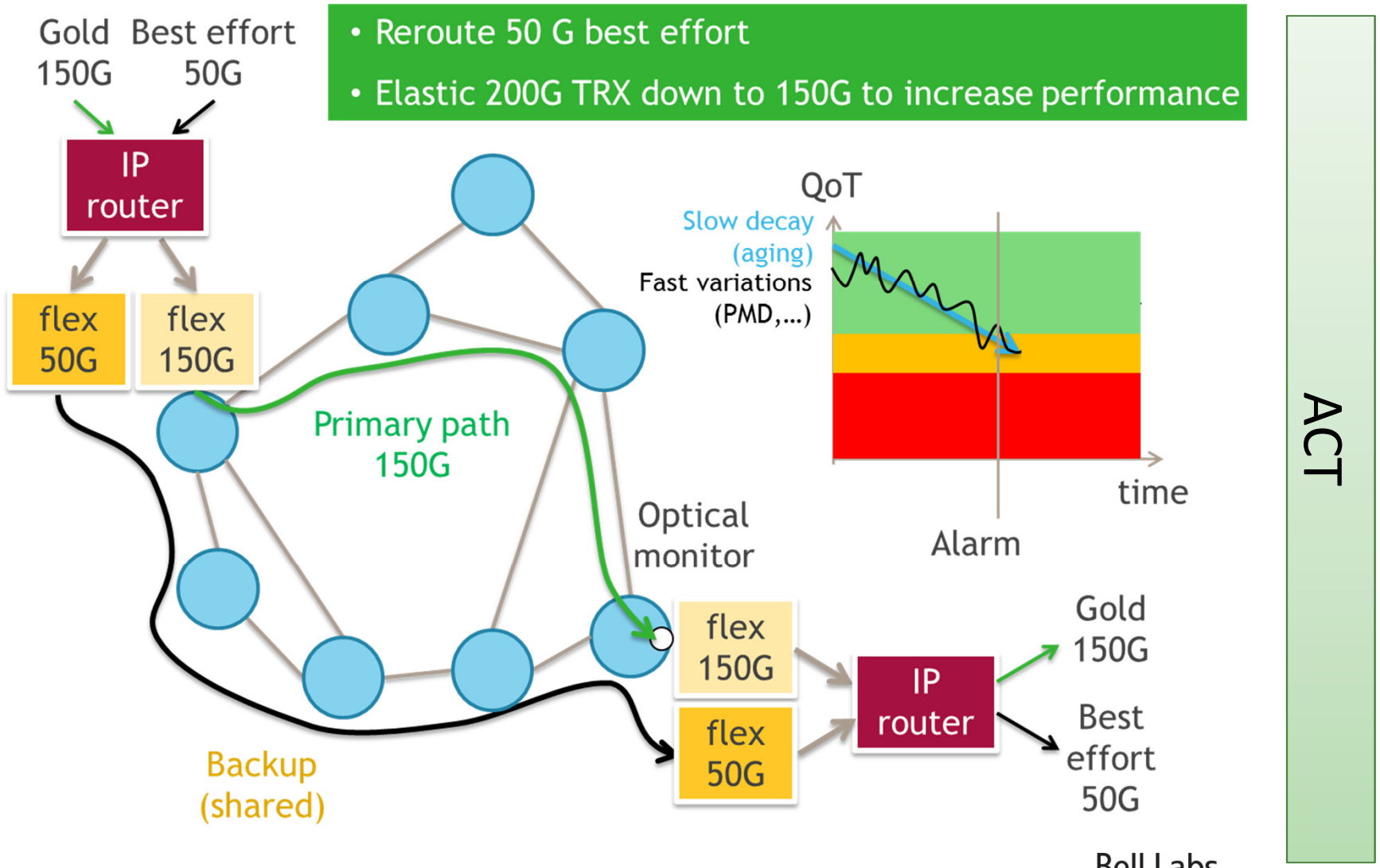
DECIDE

DEPLOY

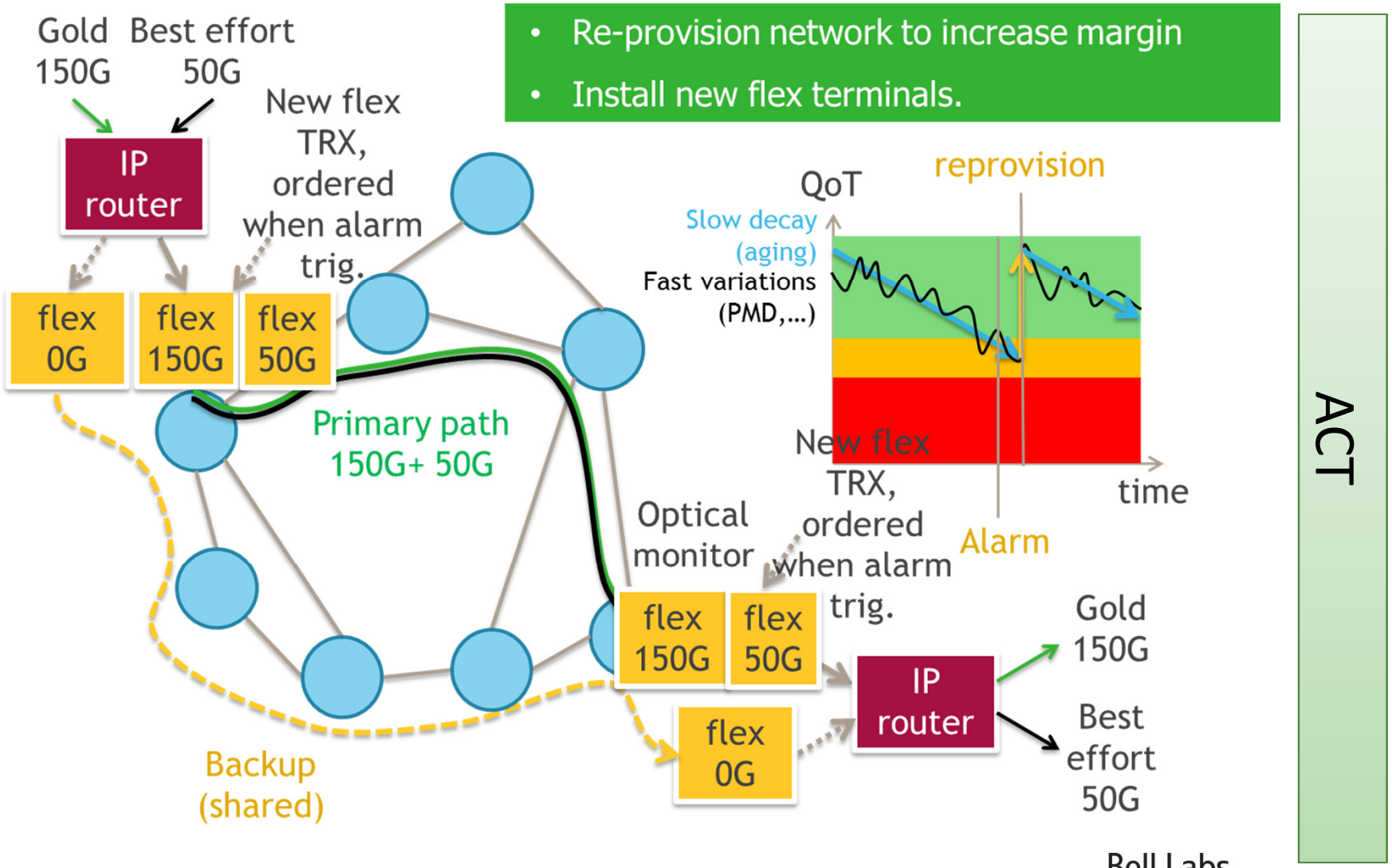
- DEPLOY is the Decision support module for PLanning, Operating and dYnamic network reoptimization (DEPLOY)
- Apply cross-layer optimization algorithm and translate solution to available control primitives
- They will be automatically self-adjusting, self-organizing and self-healing (instead of requiring the intervention of personnel)
- The time scale at which changes will happen will be in the order of minutes or less (as opposed to days or months)



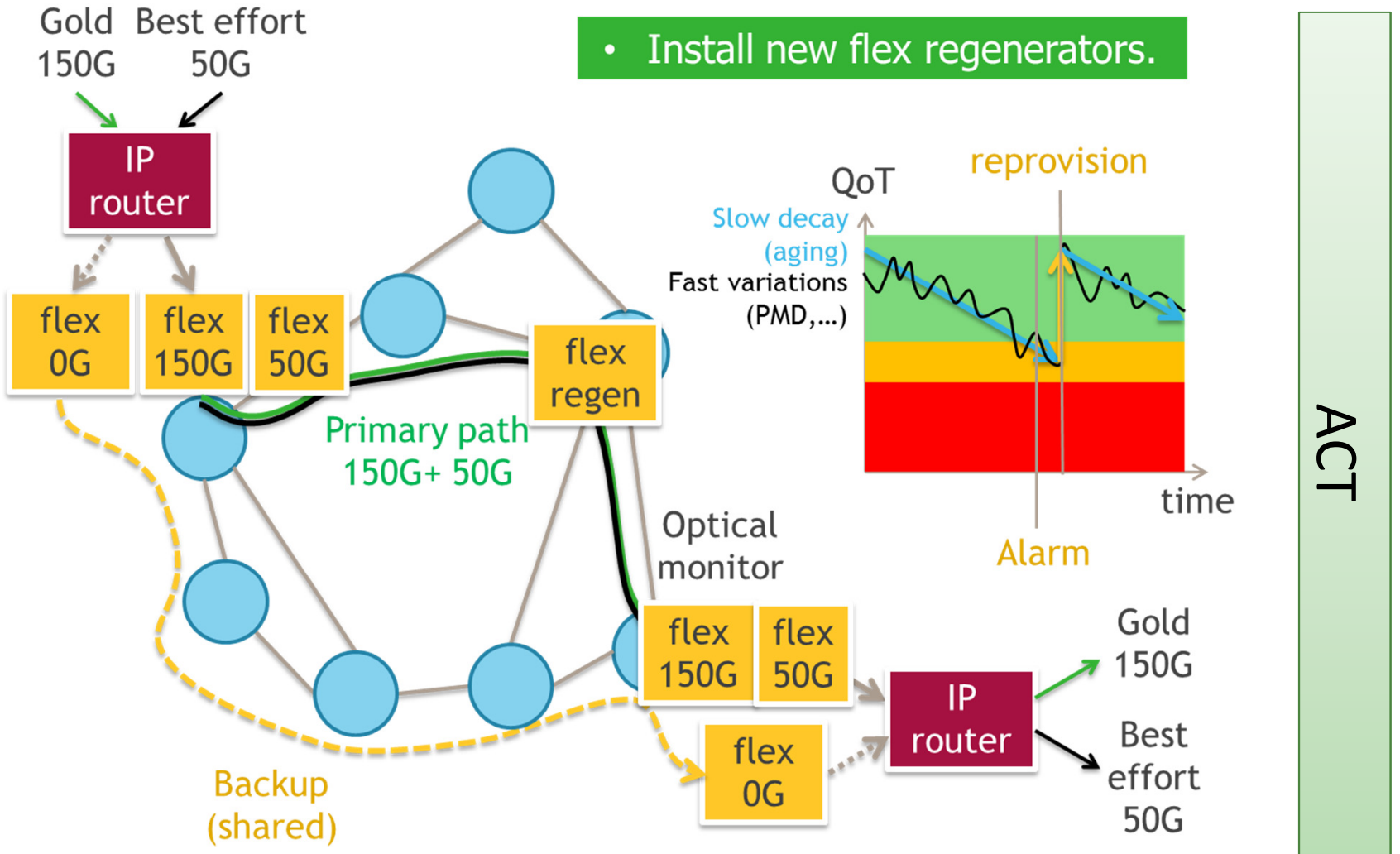
Routing and use of port flexibility



Proactive Network operation



Postpone regenerator provisioning



Conclusion

Coherent optical interfaces can operate as software defined optical performance monitors	A hierarchical monitoring plane can collect information	Optimization algorithms can correlate information
The interaction between degrades and failures and physical parameters can be understood	Failures can be predicted from the analysis of physical parameters.	Network availability could increase
Reducing margins traditionally considered in connection provisioning	Reducing CapEx or postponing investments	Network cost decreases

Thank you!

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