Path diversity for network resiliency

Make your IP services resilient to optical infrastructure damage

An IP/optical coordination use case

Path diversity is often needed for IP services or for router-to-router links; however, paths that are believed to be diverse at the IP layer may not be fully diverse in the physical optical domain. The Nokia Network Services Platform (NSP) can perform real-time diversity analysis to expose and mitigate these issues. You can expect this insight and control to reduce the probability of network and service outages.

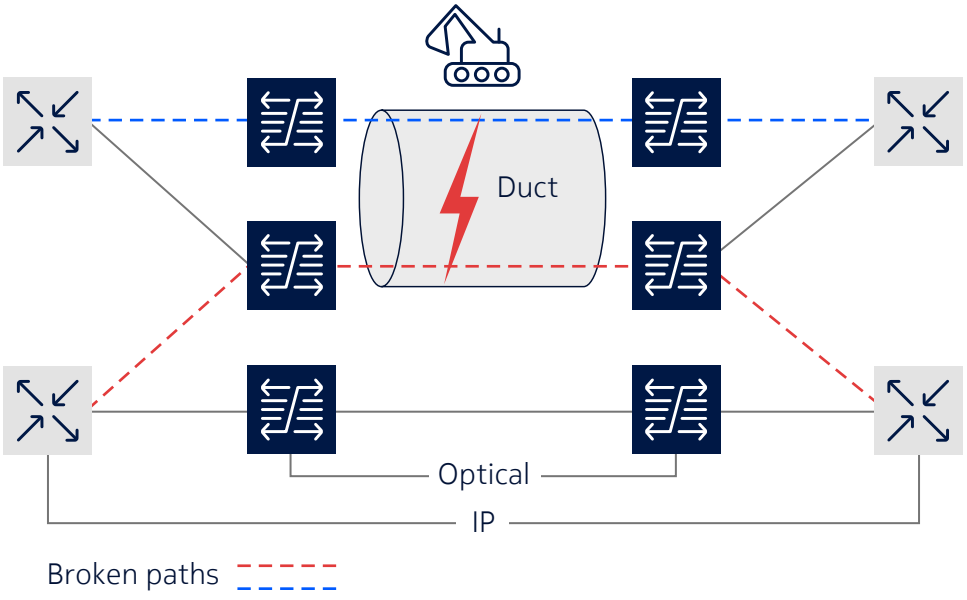
Is the infrastructure resilient?

In IP/optical networks, software-defined network (SDN) controllers provide great advantages in overall network supervision and control. The end-to-end visibility they bring makes traffic engineering, load balancing and protection activities highly efficient. However, the visibility of conventional IP/MPLS controllers is generally limited to the IP domain, with only a simple, abstract view of the organizational complexity of the optical layer. The optical layer is, in a sense, the foundation of the network because it supports the higher layers of the communication protocol stack. Ensuring that the network is as stable and resilient as possible to inadvertent or malicious damage to the optical layer is crucial to ensuring network availability.

When establishing connections at the IP layer, diversity can be requested in Link Layer Interconnects (LLIs), which are connections between routers over optical networks or in IP services. The intent is that diverse paths are taken through the network to allow overall resiliency to optical fiber failures or other failures. However, when using an optical domain for router interconnect, conventional controllers are unaware of the internal topology and physical arrangement of the optical network. The controller has no insight into the physical routes that the IP services or LLIs are actually taking.

The resulting paths may not be truly diverse in the optical domain, and paths that seem diverse in the IP domain may take the same optical fiber or they may take separate fibers that are within the same cable or duct, as shown in Figure 1. As a result, they share risk because a cut in a shared fiber, cable or duct will impact both IP services or both LLIs.

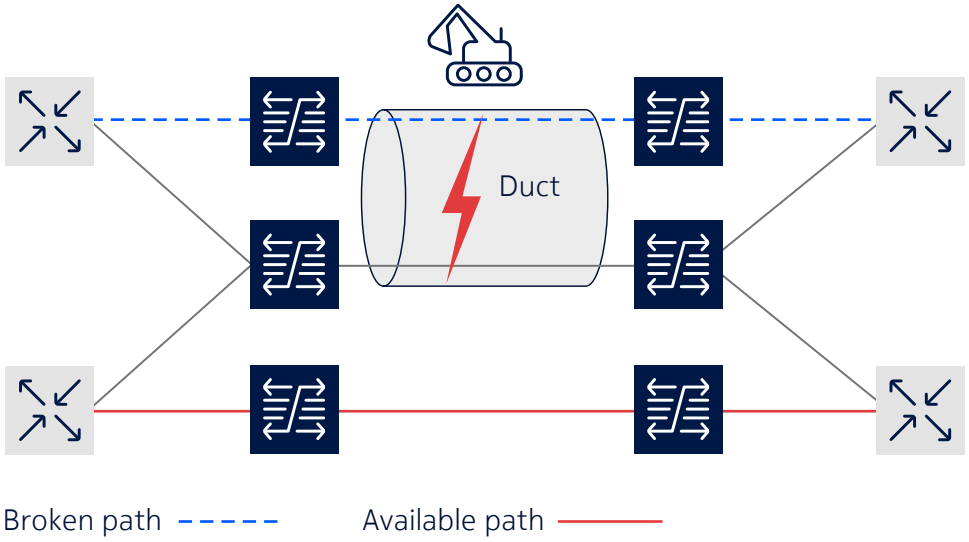
Figure 1. Lack of diversity in the optical domain



Diversity is strength

A capability is needed to look deeply into the optical infrastructure and expose any lack of true path diversity. The Nokia NSP Cross-Domain Coordinator application can perform real-time diversity analysis for IP services or LLIs traversing an optical network. The application checks the end-to-end path diversity and highlights the shared risk that prevents the desired diversity constraints from being met. This process allows true, end-to-end diversity to be established as required, as shown in Figure 2. End-to-end diversity increases resiliency, avoiding unnecessary outages, and also maintains high quality of service and quality of experience.

Figure 2. Diversity in the optical domain



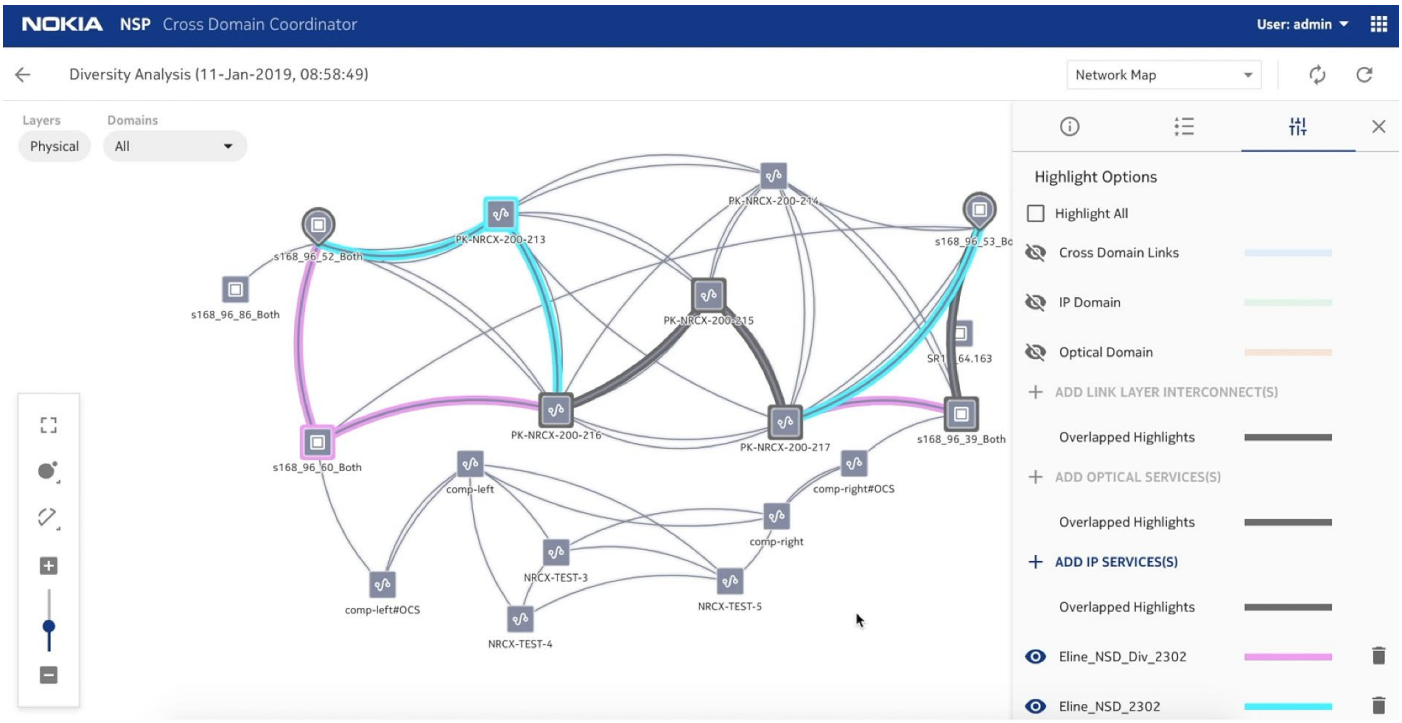
In preparing to perform a diversity analysis, the network operator defines groups of IP services or LLIs within which the analysis is to be performed. After these groups are defined, a diversity analysis can be performed using the Cross-Domain Coordinator application. The progress status of the diversity analysis is shown and a report is displayed during the analysis that shows details such as: groups scanned, groups meeting diversity constraints, groups failing diversity constraints, start time and end time.

After the analysis is completed, a list of groups failing the diversity constraints is displayed on the screen. If there are violations for certain groups, they are marked as ”fail” with the appropriate reason given.

The reason for failure can be “Link constraints failure“, to indicate a shared optical fiber, or “Shared risk link group (SRLG) constraints failure”, to indicate a shared cable or duct. The user can select a particular group and overlay the respective IP services or LLIs on the IP-optical map to see the physical path taken by each IP service or LLI.

Each of the paths is displayed in a different color. Links that are common to both paths are shown in dark gray/black. These links represent a root cause for diversity analysis failure. Figure 3 shows a sample display from a diversity analysis.

Figure 3. Cross-Domain Coordinator IP-optical map display



The network operator can also add a particular group to a list of known exceptions to prevent the group from appearing as a failure in subsequent diversity analysis runs.

A detailed report is generated after the successful execution of the diversity analysis. The report contains the summary of the run and lists all the groups that are successful or failed as well as the groups that were added to the exception list. This information allows the network operator to redirect paths as necessary to resolve the diversity check failures.

Build on a solid foundation

In IP/optical networks, using the NSP Cross-Domain Coordinator application allows you to understand the full set of non-diversity risk scenarios in the optical transport layers. With this knowledge you can:

- Reduce your network's exposure to accidental or malicious infrastructure damage
- Lessen the probability of network and service outages
- Simplify scenario planning.

For more information about this and other topics in IP/optical networking optimization and automation, visit the Nokia IP/optical coordination page.

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