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## Core Technologies 1

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# [CPS-SNAP3-01(Invited)] Investigation of Disaster-Resilient Network-Cloud Ecosystem with Open Disaggregation and Cooperation Technologies (Invited)

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We investigate the problem of future disaster-resilient optical network-cloud ecosystems. We introduce our solutions considering openness/disaggregation and cooperation for single- and multi-entity network-cloud ecosystems, respectively.

# Investigation of Disaster-Resilient Network-Cloud Ecosystem with Open Disaggregation and Cooperation Technologies (Invited)

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Abstract

We investigate the problem of future disaster-resilient optical network-cloud ecosystems. We introduce our solutions considering openness/disaggregation and cooperation for single- and multi-entity network-cloud ecosystems, respectively.

## 1. Introduction

To accommodate the growing demand for cloud services, the underlying networks and datacenters (DCs) form network-cloud ecosystems (ecosystem for short) hosting these services and are continuously evolving. These large-scale ecosystems must be resilient for supporting critical services. In this report, we introduce our research for enhancing the resilience of two types of ecosystems. Namely, (i) a single-entity ecosystem: the ecosystem is owned by a single entity, e.g., Telecom carrier (carrier for short) or emerging Telecom/DC partnership company, etc.; (ii) a multi-entity ecosystem: the networks and DCs are owned by different entities, e.g., carriers, DC providers (DCP), and Internet Service Providers (ISPs).

## 2. Resilient Single-entity Network-cloud Ecosystems with Openness and Disaggregation

In the first part of this report, we introduce and preliminarily evaluate a new approach with open and disaggregation technologies for enhancing the disaster resilience considering a single-entity scenario where a single owner (e.g., carrier) owns the whole ecosystem. Even in a single-entity scenario, the environment is heterogeneous, multi-vendor, multi-domain, multi-sector (i.e., Telecom and DC) features must be supported. Open and disaggregated optical-networking technologies [1] [2] promise to enhance multi-vendor interoperability thanks to their open interfaces in both data-plane and control/management-plane. Fig. 1 illustrates an ecosystem integration/control model showing our approach for handling the diversity in both underlying hardware systems and upper layer network models, which is aided by a functional block-based disaggregation (FBD) model [3] and ONF transport API (TAPI) [4]. The readers are referred to [5] for details of this approach.

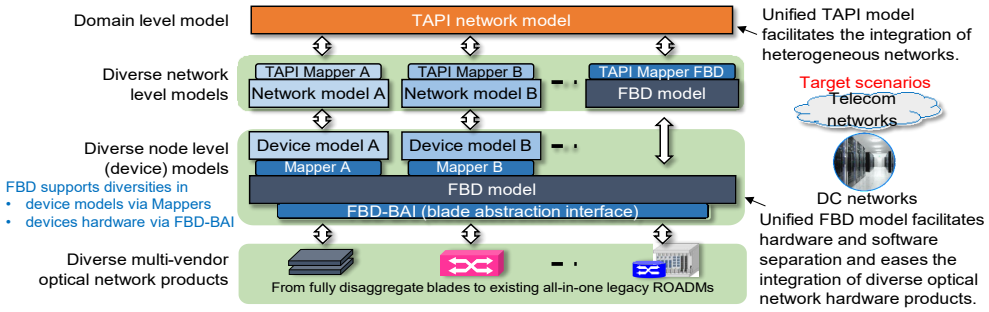


Fig. 1. Integration/control of heterogeneous Telecom/DC optical networks aided by FBD & TAPI.

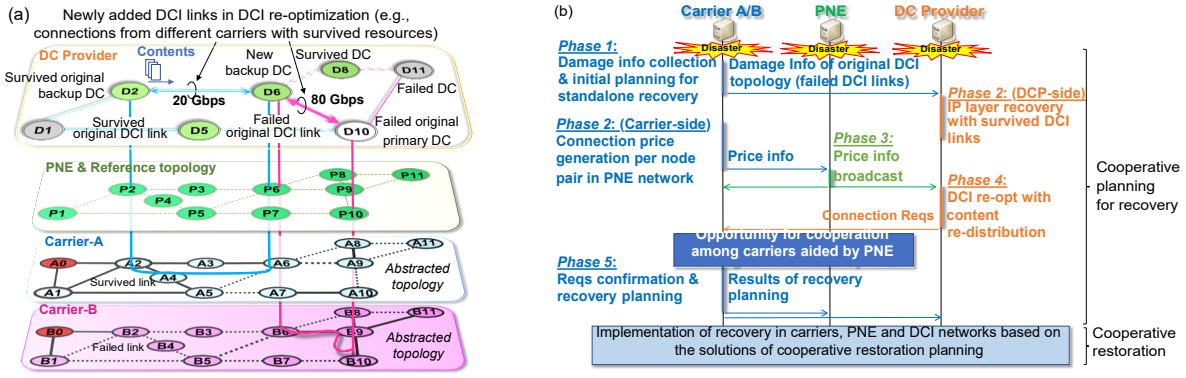


Fig. 2. DCP-carrier cooperative disaster recovery. (a) shared network view in cooperation and concept of cooperative recovery, (b) distributed cooperative planning.

## 3. Resilient Multi-entity Network-cloud Ecosystems through Cooperation between Network and Cloud

In the second part of this report, for multi-entity ecosystems, we introduce and preliminarily evaluate another new approach for enhancing the disaster resilience of future optical network-cloud ecosystems with cooperation between network carriers and DCPs. For large scale ecosystems which involve multiple entities, we observe that cooperation among DCPs and carriers is not only necessary to provide today's cloud services, but it can also be extremely helpful especially for disaster resilience. However, such cooperation is challenging as the DCPs and carriers are diffident entities and may not accept to disclose confidential information, e.g., detailed resource availability. Fig. 2 (a) illustrates the concept of DCP-carrier cooperative recovery, e.g., in case of disaster. Fig. 2 (b) shows a detailed breakdown of the decomposed optimization tasks for planning of cooperative recovery among DCPs and carriers, which is coordinated by a third-party provider neutral exchange (PNE) [6].

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