Telecom Infra Project—Its Structure and Activities

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Abstract

Telecom Infra Project (TIP) was launched in February 2016 through the initiative of Facebook. It is aimed at bringing about innovations in telecom hardware, software, and operations by introducing such technical trends as openness and disaggregation, which have become increasingly important in recent years. TIP is similar to open source projects in that communities play an essential role.

Keywords: TIP, openness, disaggregation

1. Background

In the technological fields involving datacenters and datacenter interconnections, de facto standards are widely used. They come from products and specifications developed by organizations such as the Open Networking Foundation as well as open source projects. What is characteristic is that these standards are developed through making the designs and interfaces open. In many cases, the resulting products are also open source. The trend of *openness* is now seen in not only the development of software but also of hardware. For example, the Open Compute Project (OCP) pushed through openness in the specifications of servers and racks used in datacenters, leading to a reduction in the purchasing cost as well as in the power consumption. In this approach, functions and components were unbundled. It is this *disaggregation* that made it possible for users to choose only the parts necessary to them, eliminating others.

The trend of openness and disaggregation is now beginning to expand to telecom networks. Telecom Infra Project (TIP) was established with the leadership of Facebook, one of the leading companies of OCP, and with the idea that the same approach as OCP's could be applied in telecom networks.

2. Overview of TIP

Since TIP started its activities in February 2016, the number of member companies has increased from several dozen to over 500. NTT joined TIP in 2017. The Board of Directors includes people from telecom operators such as Deutsche Telekom (DT) and SK Telecom, which have held the position since the foundation of the organization, and from Telefónica, Vodafone, and British Telecom (BT). This demonstrates that European operators are actively involved in the activities. Many operators from other regions such as India, South Africa, and Brazil are also participating. For these operators whose service areas include places where communications infrastructure has not been well established, the open-sourced products and the know-how arising from TIP would serve as a solution to address the issue adequately and cost-effectively.

Manufacturers of white box equipment, which use merchant chips and non-proprietary operating systems, and chip vendors are among those who have expanded their presence in concert with the markets of these products. There are also other kinds of participants such as Internet service providers and system integrators, including startup companies. There is a great deal of interest in the latest technical trends and expectations for their implementation among the wide variety of participants.

The organizational structure of TIP is shown in **Fig. 1**. Project Groups (PGs), responsible for creating specifications or developing products, are established after their charters are accepted by the Board of Directors and the Technical Committee. Although some PGs have been dissolved, the number of PGs has increased since TIP was founded, showing flexibility similar to that of other organizations in the field of datacenter technologies.

PGs are classified by their scopes into three technical fields: Access Projects, Backhaul Projects, and Core and Management Projects. The scopes of individual PGs are written in their charters along with goals and deliverables. Products developed by a PG are usually tested in a Community Lab. There are currently six Community Labs, two in the USA and one each in Germany, South Korea, Brazil, and India. Each Community Lab is hosted and operated by a specific company with a policy of allowing the participation of member companies. As is evident in many successful open source projects, creating open communities is recognized as a key to advancing development.

TIP Ecosystem Acceleration Centers (TEACs) provide startup companies with an environment for product development and tests. Currently, BT, DT, Orange, and SK Telecom each host a TEAC.

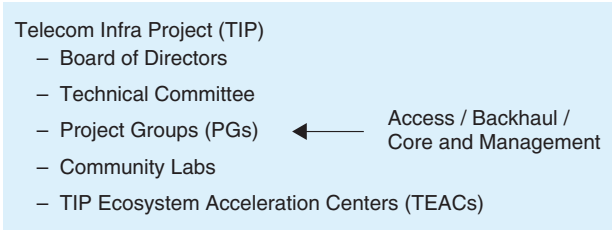

Fig. 1. Organizational structure of TIP.

3. Access Projects

The activities of the PGs whose scope is related to the Access field are listed in **Table 1** [1]. These PGs aim to make Internet access easier by innovating access network technologies. Reducing infrastructure costs and creating new technologies that are applicable where existing ones cannot be easily used are among the examples of the PGs' goals.

The OpenCellular PG is working to produce base stations of Long-Term Evolution (LTE) cellular networks. While open source software is employed for the management of the base stations, chips and other hardware are developed by the participant companies, and their design has been made public as open source hardware. This PG is focusing on the existing mobile technology, rather than the emerging fifth-generation (5G) mobile technology, and it has brought openness into its products, representing the TIP's concept. The products have been used in field trials in India, Pakistan, and other African and South American countries.

The activities of many of the other Access PGs are also related to mobile communications infrastructure. The vRAN Fronthaul PG is tackling issues on the mobile fronthaul, which is responsible for the connection between antennas and baseband signal processing units of base stations. In developing countries, optical fibers cannot always be used as transmission media due to costs or environmental problems. The PG is addressing this issue by studying how to implement fronthaul transmission using twisted pair cables, coaxial cables, or other non-ideal media.

A power supply can also be an impediment in deploying infrastructure that costs or environmental problems impose. The Power and Connectivity PG aims to establish technologies and business models to deploy power supply infrastructure in rural areas with lower costs, inviting power companies and battery makers as members.

The OpenRAN PG's scope is similar to that of the OpenCellular PG's in that both are aimed at developing LTE base stations. Their focus, however, is on software implementation and its programmability. Because the functionalities are programmed to work with general purpose processors, flexible and timely functional updates are possible.

4. Backhaul Projects

A rapid increase in the amount of communications traffic is being seen in many countries and is a common issue for telecom operators worldwide. Against this background, PGs related to the Backhaul field are trying to innovate technologies in trunk and backbone networks. The activities of the PGs focusing on this field are summarized in **Table 2** [1].

The Open Optical Packet Transport PG is targeting innovative optical fiber transmission techniques. They have released two equipment prototypes named Voyager and Cassini. As well as being optical transponders with integrated packet switching functions, they are characterized by the use of nonproprietary

Table 1. Access Projects.

Project Group	Scope and Targets*	Chair
Edge Computing	The Edge Computing Project Group will focus on lab and field implementations for services/ applications at the network edge, leveraging open architecture, libraries, software stacks, and mobile edge computing (MEC), into a platform.	Intel Telefónica
Power and Connectivity	The Power and Connectivity Project Group will initially focus on enabling network operators to deploy connectivity in areas that do not have electricity. It will also provide an ecosystem in which connectivity and electricity providers can collaborate to pilot and scale innovative technology and business models.	Telefónica Facebook
System Integration and Site Optimization	The System Integration and Site Optimization Project Group will address system integration via innovative, cost-effective and efficient end-to-end solutions in order to serve both rural and urban regions in optimal and profitable ways.	Deloitte Facebook
OpenCellular	The OpenCellular Project Group will focus on wireless access platforms (including cellular) and related technologies. It will develop solutions running on the OpenCellular platform, and support an ecosystem of contributors, OEMs, distributors and system integrators.	Facebook
Solutions Integration	The Solutions Integration Project Group will develop an open radio access network (RAN) architecture by defining open interfaces between internal components and focusing on the lab activity with various companies for multi-vendor interoperability.	SK Telecom
OpenRAN	The OpenRAN Project Group's main objective is the development of fully programmable RAN solutions based on general purpose processing platforms (GPPPs) and disaggregated software so they can benefit from the flexibility and faster pace of innovation capable with software-driven development.	Vodafone Intel
CrowdCell	The CrowdCell Project Group will focus on creating a CrowdCell by leveraging GPPPs, software-defined radio and open source designs for both hardware and software to minimize costs with a "one design" flexible platform.	Vodafone
vRAN Fronthaul	The vRAN Fronthaul Project Group will focus on virtualization of the RAN for non-ideal backhaul, in particular, maximizing the performance through optimization of the physical layer, compression, and other methods.	BT Vodafone

* Excerpts from the TIP website

OEM: original equipment manufacturer

Table 2. Backhaul Projects.

Project Group	Scope and Targets*	Chair
Millimeter Wave Network	The Millimeter Wave Network Project Group will define and advance 60-GHz wireless networking solutions to address the growing demand for bandwidth in dense, highly populated cities by delivering gigabits of capacity more quickly, easily, and cost-effectively compared to deploying fiber.	Facebook DT
Open Optical Packet Transport	The Open Optical Packet Transport Project Group will define dense wavelength division multiplexing (DWDM) open packet transport architecture that triggers new innovation and avoids implementation lock-ins. Open DWDM systems include open line system & control, transponder and network management, and packet-switch and router technologies.	Facebook

* Excerpts from the TIP website

components. In Cassini, for example, a merchant digital signal processor is employed to implement coherent optical transmission, which NTT's laboratory has developed with its partners and is now sold by NTT Electronics. The operating system employed in it is also a commercial, nonproprietary one.

This type of equipment, referred to as white box, enables multi-vendor implementation in such a way as to enable specific parts to be replaced with those of another vendor. Although the usage of Voyager or Cassini seems to be limited to a point-to-point interconnection between datacenters, the trend of disaggregation that they embody is likely to penetrate into more complicated optical transmission equipment.

In the field of wireless transmission, the Millimeter Wave Network PG is working to establish an infrastructure technology using 60-GHz radio waves. The frequency falls in an unlicensed band in many countries, including Japan and other Asian countries, Europe, and North and South American countries, reducing hurdles for its use. The wireless infrastructure can also be installed more easily than optical

Table 3. Core and Management Projects.

Project Group	Scope and Targets*	Chair
Artificial Intelligence and Applied Machine Learning	The Artificial Intelligence and Applied Machine Learning Project Group will define and share reusable, proven practices, recipes, models, and technical requirements for applying artificial intelligence and machine learning to reduce the cost to plan and operate telecommunications networks.	DT Telefónica
End-to-End Network Slicing	The End-to-End Network Slicing Project Group will identify end-to-end use cases that can be researched, developed, and demonstrated to help operators overcome many of the key challenges of employing network slicing to support their 5G services.	BT HPE
People and Process	The goal of the People and Process Project Group is to share cultural and process transformation practices that can materially improve operators' key metrics.	Facebook Bell Canada

* Excerpts from the TIP website

fiber. With these advantages, the PG is planning a field trial to obtain practical expertise to apply the technology in city areas where capacity demands tend to increase in a short period.

5. Core and Management Projects

The goal of PGs focusing on the Core and Management field is to innovate network operations. Their activities are summarized in **Table 3** [1].

The End-to-End Network Slicing PG deals with virtualized networks, or network slices, that are built on physical infrastructure. Their goal is to achieve operation that involves configuration and management of network slices spanning multiple operators' domains. To that end, they study interface specifications that enable cooperation of multiple orchestrators, each of which manages network slices and their constituent physical resources in a specific domain. Their scope is aligned with emerging 5G mobile technologies.

The Artificial Intelligence and Applied Machine Learning PG is working to introduce artificial intelligence (AI) in network operations. They study how to streamline operation processes or how to optimize networks by utilizing AI where human judgment currently intervenes. Although their work is in an early phase, it could attract attention as a new approach for introducing innovation.

6. Outlook

The advancement of processor chips' capabilities and software engineering techniques and the trend of openness have brought various innovations, disaggregation being an example. Disaggregation, or unbundling functions or parts that used to be integrated, sometimes as a black box, was first introduced in datacenters.

Because telecom networks contain a wide variety of equipment in terms of both functionality and size, it is not likely that the same techniques will be directly introduced into telecom networks immediately. However, it is almost certain that the approach will have a significant influence on the research and development of telecom networks.

NTT has been participating in several PGs of TIP not just to observe their activities but also to make contributions. For example, in the Open Optical Packet Transport PG, we have proposed a packet switching and forwarding architecture called Multi-Service Fabric (MSF) [2, 3] that enables highly reliable, multi-vendor implementations. Through the activities at TIP, we hope to keep engaging ourselves in the newest technical trends and use them in our research and development.

References

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He received a B.E. and M.E. in nuclear engineering from Kyoto University in 1994 and 1996. After joining NTT Optical Network Systems Laboratories in 1996, he studied optical fiber communications systems in access networks and their management. He then moved to the R&D center of NTT WEST, where he was responsible for developing and introducing commercial services, including broadband Internet access, Internet protocol (IP) v4/v6 virtual private networks, and wide area Ethernet. He also worked on reducing energy consumption of datacenter components such as servers, communications equipment, and air-conditioning systems. His current research involves network softwarization technologies including software-defined networking (SDN) and network virtualization.

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He received a B.E. in communication engineering in 1999 and an M.E. in electrical, electronic, and information engineering from Osaka University in 2001. After joining NTT Network Innovation Laboratories in 2001, he studied multicast networking and SIP (session initiation protocol)-based home networking. In 2005, He moved to the Visual Communication Division of NTT Bizlink, where he was responsible for developing and introducing visual communication services, including an IP-based high-quality large scale video conferencing system and a real-time content delivery system on IPv6 multicast. He also worked on developing their service order management system and network management system for video conference services. He has recently been developing high performance network function software for telecom carrier networks based on network functions virtualization at NTT Network Innovation Laboratories.

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He received a B.S. in physics from Waseda University, Tokyo, in 1991 and an M.S. in physics from the University of Tokyo in 1993. Since joining NTT in 1993, he has studied optical networks and network management and related areas such as optical network management systems, GMPLS (generalized multiprotocol label switching), and traffic engineering. He also spent time at the headquarters working on NGN (Next Generation Network) network architecture from the first phase of construction. He has recently been leading the research on SDN and network virtualization at NTT Network Innovation Laboratories.