Cyber Photonic Platform Consortium

Program Manual

Topology Description Generator
Quick Start Guide

V.1.0 2020/1/30

Please download the latest version at https://unit.aist.go.jp/esprit/cppc/

Contact: cppc-secretariat-ml@aist.go.jp

※Please note that we do not accept questions or inquiries regarding how to use the TDG.

Disclaimer of Warranties:
Topology Description Generator is provided AS IS, with all faults, without any warranty of any kind.

License:
Topology Description Generator is licensed under the Apache License Version 2.0 (http://www.apache.org/licenses/LICENSE-2.0).

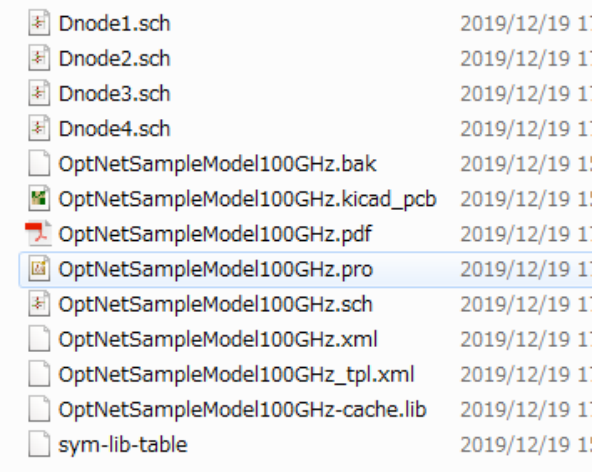
1. PREPARING YOUR SOFTWARE ENVIRONMENT

- Install the KiCAD software: https://kicad-pcb.org/
- Install Python 3.6: https://www.python.org/
- Download and uncompress TDG, as shown below.

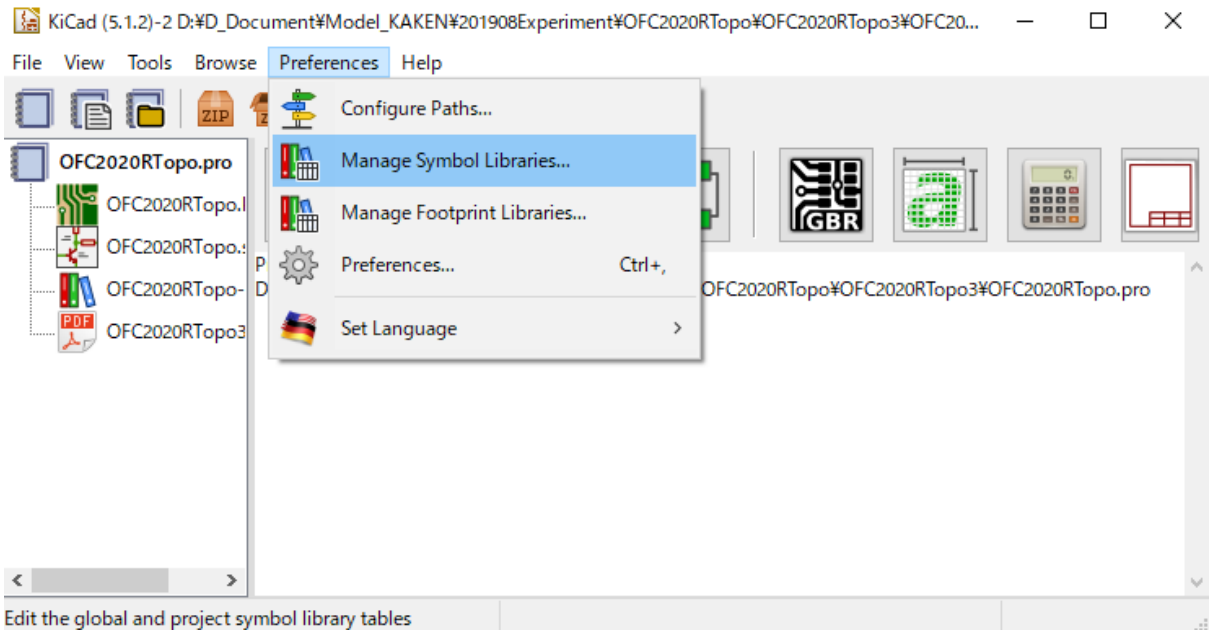
```
¥---TDG
   +---doc
   |       CPP-TPDG_manual.v.1.pdf
   |       LICENSE-2.0.txt
   |
   +---KiCADLibrary
   |       OptNetModel100GHz.v1.lib
   |       OptNetModel12.5GHz.v1.lib
   |       OptNetModel50GHz.v1.lib
   |
   +---SampleTopology
   |   +---OptNetSampleModel100GHz
   |   |       Dnode1.sch          OptNetSampleModel100GHz.kicad_pcb
   |   |       Dnode2.sch          OptNetSampleModel100GHz.pro
   |   |       Dnode3.sch          OptNetSampleModel100GHz.sch
   |   |       Dnode4.sch          sym-lib-table
   |   |       OptNetSampleModel100GHz.pdf
   |   |       OptNetSampleModel100GHz.xml
   |   |       OptNetSampleModel100GHz_tpl.xml
   |   |
   |   +---OptNetSampleModel12.5GHz
   |   |       Dnode1.sch          OptNetSampleModel12.5GHz.kicad_pcb
   |   |       Dnode2.sch          OptNetSampleModel12.5GHz.pro
   |   |       Dnode3.sch          OptNetSampleModel12.5GHz.sch
   |   |       Dnode4.sch          sym-lib-table
   |   |       OptNetSampleModel12.5GHz.pdf
   |   |       OptNetSampleModel12.xml
   |   |       OptNetSampleModel12_tpl.xml
   |   |
   |   ¥---OptNetSampleModel50GHz
   |           Dnode1.sch          OptNetSampleModel50GHz.kicad_pcb
   |           Dnode2.sch          OptNetSampleModel50GHz.pro
   |           Dnode3.sch          OptNetSampleModel50GHz.sch
   |           Dnode4.sch          sym-lib-table
   |           OptNetSampleModel50GHz.pdf
   |           OptNetSampleModel50GHz.xml
   |           OptNetSampleModel50GHz_tpl.xml|
   ¥---src
         AdditionalInfoFLEX386.xml
         AdditionalInfoWDM32.xml
         AdditionalInfoWDM96.xml
         xml2topology2.py
```

2. STARTING UP A SAMPLE PROJECT

- Open "\TDG\SampleTopology\OptNetSampleModel100GHz\OptNetSampleModel100GHz.pro"

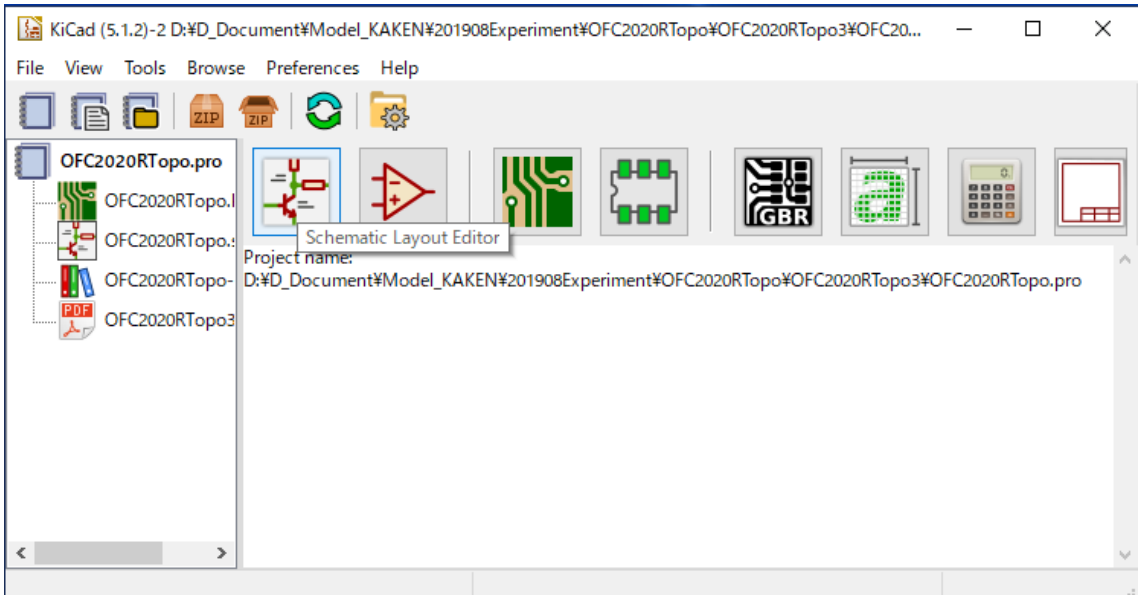


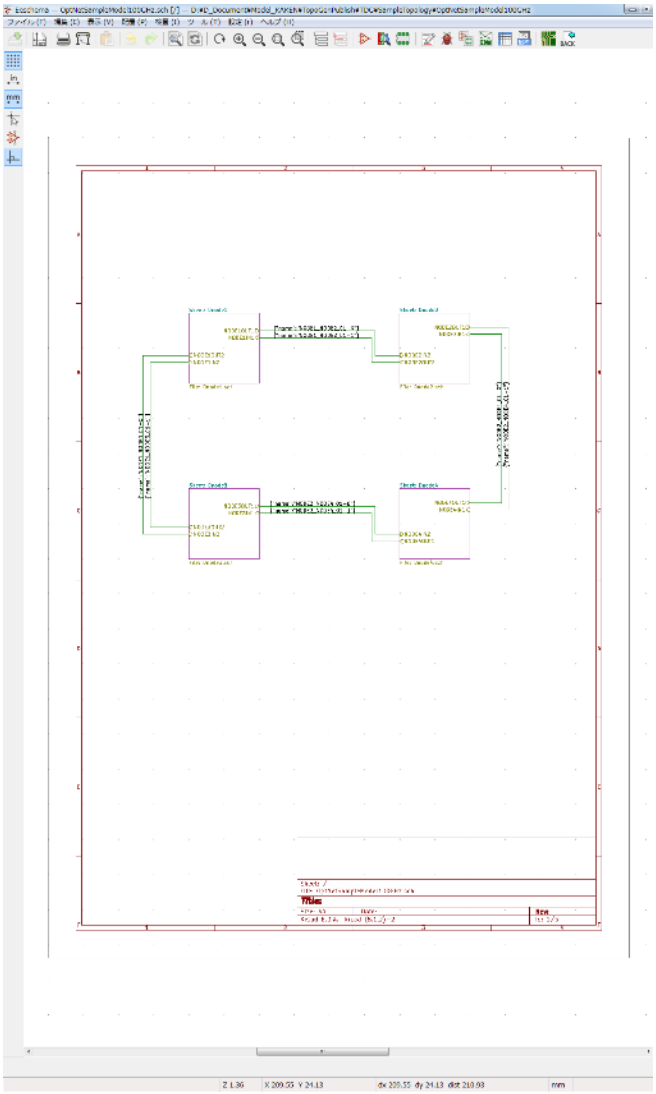
- The KiCAD software is opened.
- Click on "Preferences" and then on "Manage Symbol Libraries."



- Add "\TDG\KiCADLibrary\OptNetModel100GHz.v1.lib" to the "Project Specific Libraries."

- Open “Schematic Layout Editor.”



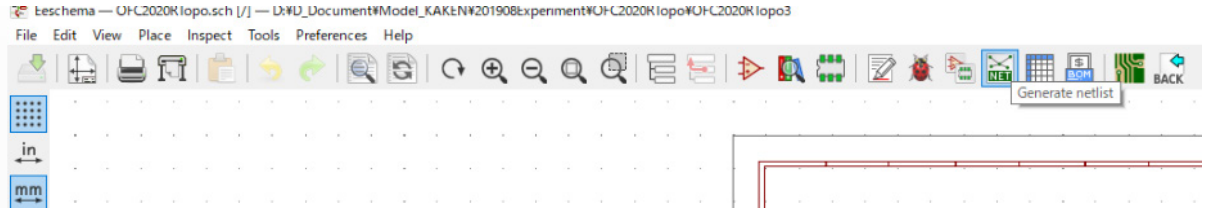


Now, you can edit and modify the topology according to your requirements.

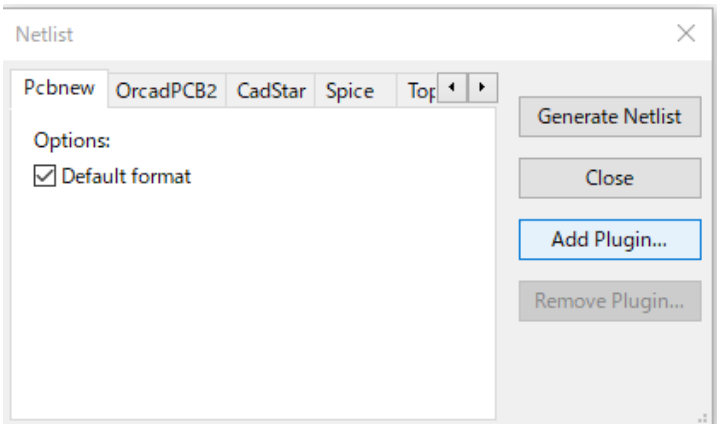
3. EXPORTING THE TOPOLOGY DESCRIPTION

After editing the topology, you can export the complete information describing the topology.

- Click on “Generate netlist.”



- Click on “Add Plugin…”



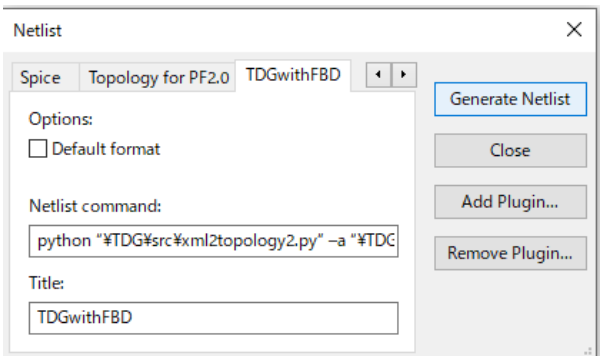
- Enter the below command in the field “Netlist command:.”
  python “\TDG\src\xml2topology2.py” –a “\TDG\src\AdditionalInfoWDM32.xml” –l “%I” “%O”

  *The folder path should be modified according to your system environment

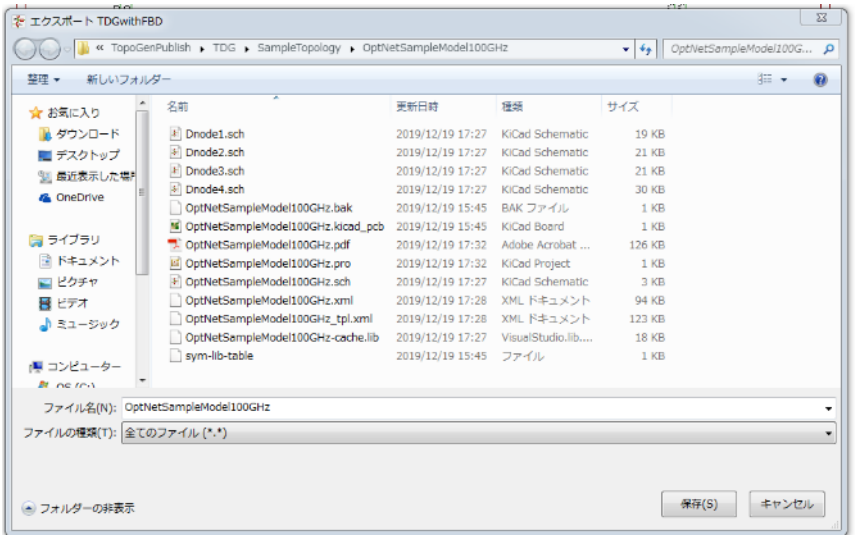
- Enter some name in the field “Name:” for recognizing the added plugin, e.g., “TDGwithFBD”

- Click on “OK.”

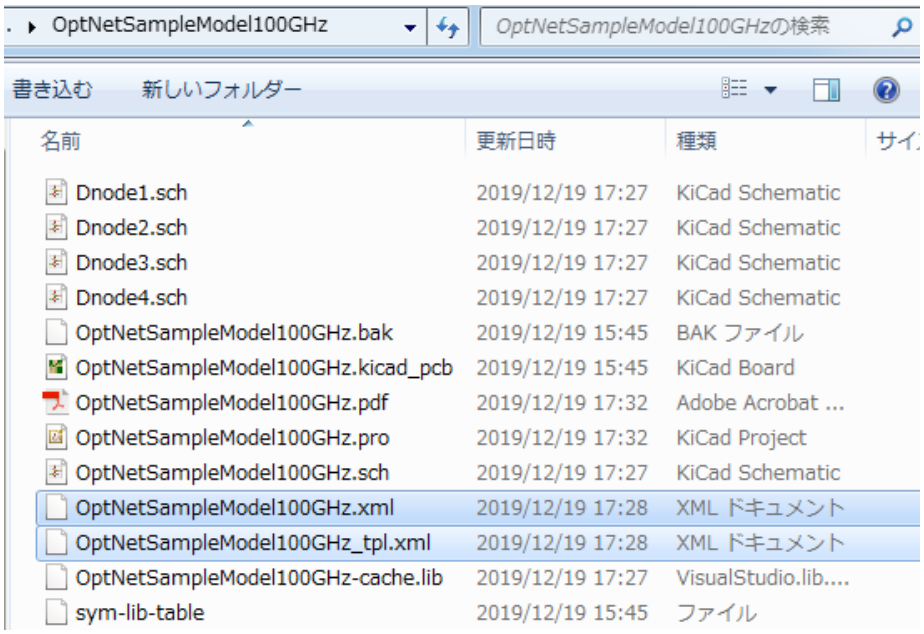
- Click the newly generated tub “TDGwithFBD” and then click the “Generate Netlist.”



- Save it with a file name, e.g., OptNetSampleModel100GHz.



- Two new files are generated. One is the OptNetSampleModel100GHz.xml, which describes the schematic circuit diagram content. The other is OptNetSampleModel100GHz_tpl.xml, which describes the optical network topology description, including the channel table information.



- The “OptNetSampleModel100GHz_tpl.xml” is the topology description file that includes complete information for the topology. The data structure is shown below.

```
<?xml version="1.0" ?>
<topology>
  <design>
(1)  <source>D:¥D_Document¥Model_KAKEN¥TopoGenPublish¥TDG¥SampleTopology
         ¥OptNetSampleModel100GHz¥OptNetSampleModel100GHz
         ¥OptNetSampleModel100GHz.sch</source>
     <date>2019/12/19 17:28:54</date>
     <tool>Eeschema (5.1.2)-2</tool>
     <sheet name="/" number="1" tstamps="/">
                                                    <Snip>
(2)  <channelInfo>
       <channelTable id="WDM32" type="optical">
         <channel no="1">
           <doubleParam name="frequency" unit="THz">195.5</doubleParam>
           <doubleParam name="bandWidth" unit="GHz">100</doubleParam>
         </channel>
                                                    <Snip>
  </design>
  <components>
    <comp ref="N202">
      <field name="idname">/TEST_WSS1X9_100GHz_N202</field>
      <field name="residence">/Dnode1/</field>
      <field name="Controller">192.168.60.1</field>   ←(3)-a
      <field GLPKchannelTableId="WDM32" GLPKtype="switching" name="GLPK">
(3)       set AvailableConnection := {i in InputPort, j in Channels, k in OutputPort,
           l in Channels: j = l}; s.t. input{j in Channels, i in InputPort}:
           sum{k in OutputPort} c[i, j,k, j] &lt;= 1;</field>          (3)-b
      <field name="LocalConfig">TBD</field>
      <field name="Model">WSS1X9_100GHz</field>                      (3)-c
      <field name="Socket">55100</field>
      <field name="Type">WSS</field>
      <ports>                                                        (3)-d
        <port io="input" name="/TEST_WSS1X9_100GHz_N202_IN" number="1"
                                        supportChannel="WDM32" supportSignal="ANY"/>
        <port io="output" name="/TEST_WSS1X9_100GHz_N202_OUT1" number="2"
                                        supportChannel="WDM32" supportSignal="ANY"/>
                                                    <Snip>
  </components>
  <nets>
    <net code="1" name="/NODE1_NODE2_01-1" pair="/NODE1_NODE2_01-0">
      <node pin="1" ref="N201"/>
(4)   <node pin="8" ref="N301"/>
      <cost>0.0</cost>
    </net>
                                                    <Snip>
  </nets>
</topology>
```

(1) The *design* element describes the header information, such as the software version and the date of update.

(2) The *channelInfo* element describes the wavelength channels supported by the network. Here, the 100 GHz-grid and 32 WDM channels are described.

(3) The *components* element describes all instances of the optical components. The *comp* element describes each component instance.

(3)-a: The intermediate controller address to which the instance belongs

(3)-b: The switching functionalities of the component instance is described in GNU MathProg modeling language

(3)-c: Information for the intermediate controllers such as the corresponding operation program type invoked by the intermediate controller

(3)-d: The detailed port attributes of the component instance

(4) The *nets* element describes all the fiber cablings (connections) among the optical ports of the component instances. The n*et* element describes each cabling defined by a pair of optical ports.

By reading and analyzing the _tpl.xml topology description file, we can perform optical path computation or optical node switching functionality analysis. Some studies using TDG have been published, as shown in Sec.4. TDG does not include tools for analyzing the topology description files currently; we plan to publish them in the future.

4. RELATED PUBLICATIONS

Journal:

・ Kiyo Ishii, Atsuko Takefusa, Shu Namiki, Tomohiro Kudoh, “Optical Network Resource Management Supporting Physical Layer Reconfiguration,” IEEE/OSA Journal of Lightwave Technology, Vol. 37, No. 21, pp. 5442-5454, Aug. 2019.

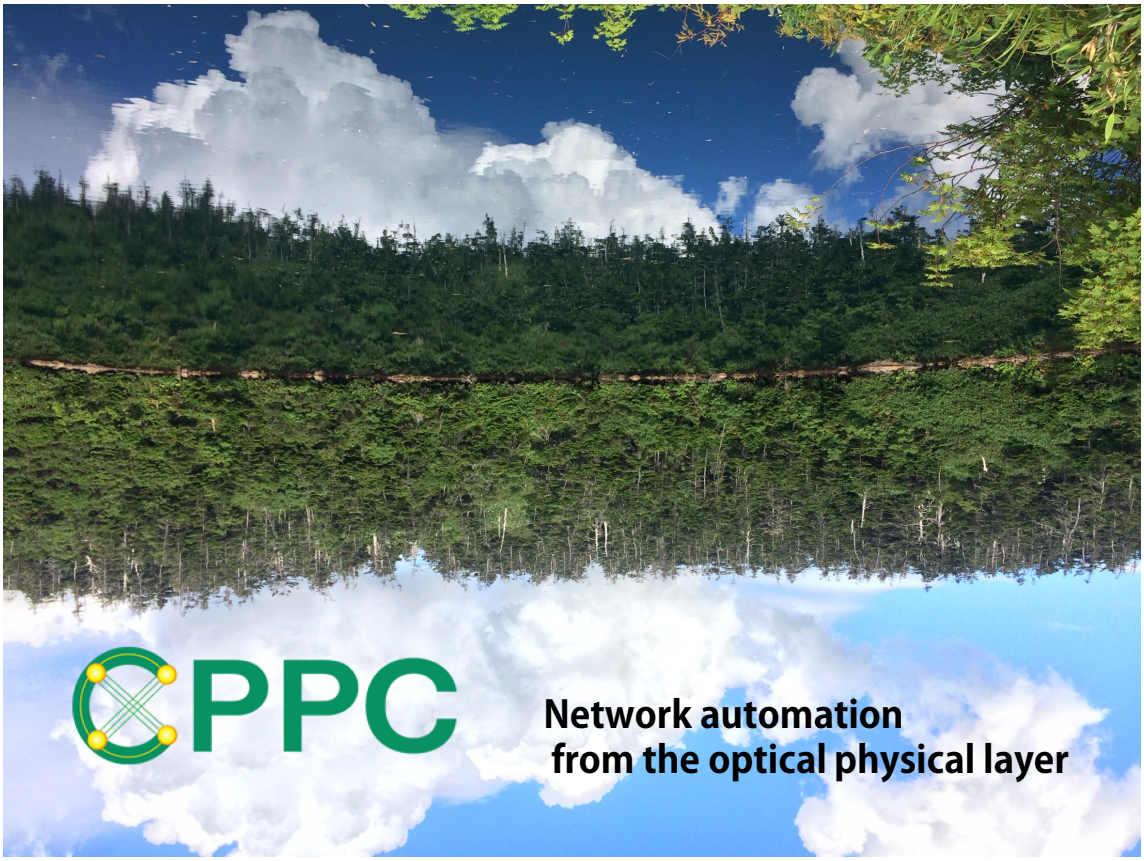
Proceedings:

・ Kiyo Ishii, Sugang Xu, Noboru Yoshikane, Atsuko Takefusa, Shigeyuki Yanagimachi, Takeshi Hoshida, Kohei Shiomoto, Tomohiro Kudoh, Takehiro Tsuritani, Yoshinari Awaji, Shu Namiki, “Automatic Resource Mapping Using Functional Block-Based Disaggregation Model for ROADM Networks,” in Proc. OFC2020, SDN/NFV Demo-zone

・ Kiyo Ishii, Shu Namiki, “Toward Automatized Handling of Future Agile Networks Employing Various Optical Switching Functionalities,” in Proc. OECC/PSC2019

・ Kiyo Ishii, Atsuko Takefusa, Shu Namiki, Tomohiro Kudoh, “Path Computation and Topology Description Scheme for Consistently Supporting Heterogeneous Optical Node Structures,” in Proc. Advanced Photonics Congress, OSA, 2019

・ Kiyo Ishii, Atsuko Takefusa, Shu Namiki, Tomohiro Kudoh, “Efficient Path Calculation Scheme for Advance Reservation of Hierarchical Optical Path Network Using Continuous Variables to Represent Switch States,” in Proc. PSC2018



ABOUT CPPC

Cyber Photonic Platform Consortium (CPPC) has been established on 2018/4/1 as one of the AIST consortia. The purpose of CPPC is driving the automation of the optical network layer leading to the creation of new markets, and pursuing sustainable development of the future information communication industry. For more information about CPPC, please visit https://unit.aist.go.jp/esprit/cppc/.

AIST developed this manual and TDG.