Technical Committee on Transmission, Access, and Optical Systems (TAOS)

Authors: Steve Hranilovic, Walter Cerroni and Mauro Biagi
Date/Time: Wednesday, July 7th, 2021 (10:30am-12:00pm EST)

Meeting Location: After ICC 2021 – Online meeting due to COVID-19 emergency

Officers: Steve Hranilovic, Chair, hranilovic@mcmaster.ca
Walter Cerroni, Vice-Chair, walter.cerroni@unibo.it
Mauro Biagi, Secretary. Mauro.biagi@uniroma1.it

Meeting agenda:

1. Introduction
2. Approval of the GC 2020 TAOS Meeting Minutes
3. Update from Chair
4. Conferences and Activities update
5. Election of TAOS TC Awards sub-committee
6. Business arising from Members
7. Guest speakers
8. Adjourn

The meeting was called to order at 10:35am

Participants (12)

- Nicola Andriolli, National Research Council of Italy, Italy
- Chedila Ben Naila, Nagoya University, Japan
- Mauro Biagi, University of Rome "La Sapienza", Italy
- Walter Cerroni, University of Bologna, Italy
- Taisir Elgorashi, University of Leeds,
- Melike Erol-Kantarci, University of Ottawa, Canada
- Steve Hranilovic, McMaster University, Canada
1. Introduction

The meeting was held online due to the COVID-19 emergency that caused all IEEE events, including ICC 2021, to run on a teleconferencing platform. The Chair, Steve Hranilovic, welcomed all connected participants and presented the meeting agenda. A motion was made to approve the meeting agenda. Then the attendees briefly introduced themselves (see participant list above). The attached slides were presented by the Chair and discussed item-by-item.

2. Approval of the GC 2020 TAOS Meeting Minutes

A motion was made by W. Cerroni to approve the minutes of the previous meeting held online after Globecom 2020. The draft of the minutes was previously made available on the TAOS website (http://taos.committees.comsoc.org/meetings) and distributed to the TAOS members through the mailing list. The motion was seconded by P. Monti and the minutes were approved unanimously without further remarks.

3. Update from Chair

The Chair informed that a process for reorganizing the COMSOC technical committees and industrial has started just after Globecom 2020 with an ad-hoc committee created by the Board of Governors. A discussion among attendants highlighted the broad competencies of TAOS-TC moving from optical wireless, to multiple access as well as historical aspects involving the birth of green communications and aerial communications.

4. Conference and activities update

The Chair comments the recent results in terms of submission and acceptance of ONS and GCSN by noticing the reduction of the interest. The reasons are manifold. Probably the pandemic moment and other concurrent conferences are subtracting appealing. M. Biagi (chair of ONS at Globecom 2021) commented the rebound of submissions at Globecom 2021. After a discussion it emerged that some possible countermeasure may be share the CFP proposal among the community and also trying to involve some colleagues to more active in the TC.

The Chair reported TAOS Co-Chair nominations for the following upcoming events:
For what concerns IEEE ICC 2023 – Rome, Italy TAOS indicates some nominees:
ONS: Nicola Andrioli (National Research Council of Italy), Murat Yuksel (University of Central Florida, USA)
GCNS: Taisis Elgorashi (University of Leeds, UK), Emad Alsusa (University of Manchester, UK), Daniel K.C.So (University of Manchester, UK)

Soon there will be openings for volunteers to be nominated for Globecom 2023, Kuala Lumpur, Malaysia

P. Monti reports about the conference ONDM 2021.

The Chair reminded that TAOS supports sponsorship of conferences that are related the activities of TAOS-TC and indicated the conditions to obtain the sponsorship. Moreover, the Chair reminded also other kind of sponsorship that TAOS-TC can support ranging from IEEE grade elevation to distinguished lecturer programs.

5. Election of TAOS TC Awards sub-committee

According to the P&P of the TC the awards sub-committee must be composed by 5-7 members where 1 is an officer. The nominations received have been Walter Cerroni (University of Bologna, Italy) - TAOS Vice-Chair, Abdelmoula Bekkali (TOYO Electric Corporation, Japan), Melike Erol-Kantarci (University of Ottawa, Canada), Ahmed Kamal (Iowa State University, USA), Daniel K. C. So (University of Manchester, UK).

A motion was made by M. Biagi to approve the sub-committee composition. The motion was seconded by R. Rojas-Cessa and the sub-committee was approved unanimously without further remarks.

6. Business arising from Members
The Chair invited the audience to raise questions or suggestions also by email and offline to improve the appeal of the activities. Moreover, the Chair presented the new initiative of web talks and asked for volunteers.

7. Guest-speakers

The two invited speakers that are Nicola Andriolli, from National Research Council of Italy and Taisir Elgorashi from University of Leeds, presented their contributions describing the current research. The first talk is entitled “Integrated photonic devices for optical networks and systems” while the second one is “Greening Communication Networks”.

8. Adjourn

The meeting was adjourned at 12:10pm.

Attachments: 1. Meeting Slides, 2. Talk slid
Transmission, Access and Optical Systems TC
Virtual Meeting at ICC 2021 – July 7, 2021
Steve Hranilovic (Chair)
Attendance

- Please register your attendance at this meeting!
  - Link posted in chat

https://docs.google.com/forms/d/1uaBPA_BlaPvIf8qG-n9aw2A08feX7Utp155c/mcnH4
Agenda

- Welcome and Introductions
- Approval of the ICC 2020 TAOS Meeting Minutes (available online),
- Update from Chair
- Conferences and Activities update
- Election of TAOS TC Awards sub-committee
- Business Arising from Members
- Guest Speakers
- Adjourn
TAOS Officers for 2021-2022

As of January 2021

- Steve Hranilovic (Chair)
- Walter Cerroni (Vice-Chair)
- Mauro Biagi (Secretary)
Minutes approval

Meeting at IEEE Globecom 2020 – January 11, 2021

Available on the website:
http://taos.committees.comsoc.org/meetings/
Update

ComSoc TC Board Meeting – April 2021

- Ad Hoc Committee on TC/IC restructuring
  - Created by ComSoc BoG at the Globecom 2020 meeting
  - Objectives:
    - To re-organize the technical committees (TCs) and Industrial Committees (ICs) for a more harmonious and efficient management and operation with flexibility
    - To better facilitate joint activities between academic and industrial members, to help produce industry-friendly content, and to attract industry participation
    - To better synergize with local chapters, and support for multi-disciplinary fields, while ensuring technical excellence and higher visibility within and outside ComSoc
    - To limit the number of TCs and minimize technical area overlapping among the committees
Update

Sponsored Symposia

- TAOS TC has consistently sponsored three symposia:
  - SAC Track on *Access Networks and Systems* (discontinued after GC 2020)
  - Symposium on *Optical Networks and Systems* (ONS)
  - Symposium on *Green Communications Systems and Networks* (GCSN)

- Moreover, TAOS TC technically endorses several other technical events
  - Co-located w/ ICC and GC, or stand-alone

- **Action:** Our TC needs to coordinate with Symposium TPC Co-Chairs and update the topics to keep tracking hot-topics. *e.g.,*
  - Writing of CfP
  - TPC nominations
  - New ideas!
Highlights and Trends

Symposia Statistics - Optical Networks and Systems Symposium

ONS

<table>
<thead>
<tr>
<th>Year</th>
<th>ICC</th>
<th>GC</th>
<th>Total</th>
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<tr>
<td>2021</td>
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<td>61</td>
<td>81</td>
</tr>
</tbody>
</table>

TAOS-nominated TPC Co-Chair for GC’21 – Mauro Biagi
Conferences and Activities Update

Current & Upcoming Events

- IEEE ICC 2021 (Montreal)
  - SAC-ANS: discontinued
  - ONS: *** no TAOS representative ***
  - GCSN: Jaafar Elmirghani (University of Leeds, U.K.)

- IEEE Globecom 2021 (Madrid)
  - GCSN: *** no TAOS representative ***
  - ONS: Mauro Biagi (University of Rome Sapienza, Italy)

- IEEE ICC 2022 (Seoul)
  - ONS: Steve Hranilovic (McMaster University, Canada)
  - GCSN: Fabrizio Granelli (University of Trento, Italy)
Conferences and Activities Update

*Upcoming Events*

- **IEEE Globecom 2022 (Rio de Janeiro)**
  - GCSN: Eirini Eleni Tsiropoulou (U. New Mexico, USA)
  - ONS: Anas Chaaban (U. British Columbia, Canada)

- **IEEE ICC 2023 (Rome)** – *TAOS nominees (June 2021)*
  - GCSN
    - Taisir Elgorashi (U. Leeds)
    - Emad Alsusa (U. Manchester)
    - Daniel K.C. So (U. Manchester)
  - ONS
    - Nicola Andriolli (National Research Council of Italy (CNR))
    - Murat Yuksel (U. Central Florida)
Conferences and Activities Update

Future ComSoc Symposia

- Chairing the TPC of a major ComSoc Symposia is a huge honour and great service to our community
  - TAOS submits nominations for GCSN and ONS for each ICC and GLOBECOM

- Next nominations will open soon for IEEE Globecom 2023
  - Looking for volunteers!

- In order to assess nominations, candidates are required to provide
  - Brief CV including past conference organizing experiences
  - A statement demonstrating their links to TAOS TC in the past as well as planned future interactions.
Conferences and Activities Update

Upcoming Events

- Our mandate is to support and sponsor technical activities within our scope!
  - If you are aware of a conferences covering areas within the technical scope of TAOS
  - Needs participation of at least three (3) TAOS members on Organizing Commitee of TPC
  - [https://taos.committees.comsoc.org/activities/endorsement/](https://taos.committees.comsoc.org/activities/endorsement/)

- Technical co-sponsorship
  - 17th International Conference on Network and Service Management (CNSM’21)
    Izmir, Turkey // 25-29 October 2021
Highlights and Trends

Ongoing Initiative

- TAOS Webinar Series: a series of webinars on recent developments in areas within TAOS-scope

- Aim: To better highlight who we are inside of ComSoc and IEEE

- Plan to start in Fall 2021. Need suggestions and volunteers
  - Topics that are widely of interest given by experts
  - New areas in our technical scope
  - Introductory, visionary or in-depts detailed technical talks ...
Other TC Activities

Membership and Publication Support

- TAOS TC supports members for elevation to IEEE Senior and Fellow positions
- Distinguished Lecturers endorsement
- Support to special issues and conferences
- etc.
- We are here to support you!

- Next officer elections will happen at GC’22
  - Many other volunteer positions available! Please ask.
TAOS Awards Sub-committee

Purpose: To administer process for TAOS Awards (BPA for conferences & journals, service awards, etc.)
- Online meeting roughly twice a year (but before the official TC meetings)
- Vote to the Technical Committees Director for approval.
- At most 1 TAOS TC officer + 4/6 members
- Members shall not serve simultaneously on the Awards sub-committee of more than two TCs.
- Term limit is two years concurrent with the nominal term of the TC Chair, with reappointment to at most one additional two-year term.

TAOS Awards Sub-committee

Nominations received

- Walter Cerroni (University of Bologna, Italy) - TAOS Vice-Chair
- Abdelmoula Bekkali (TOYO Electric Corporation, Japan)
- Melike Erol-Kantarci (University of Ottawa, Canada)
- Ahmed Kamal (Iowa State University, USA)
- Daniel K. C. So (University of Manchester, UK)
Business Arising

Input from TAOS TC Members

- Please feel free to raise and questions on discussion points from this meeting.
  - Updates on membership grade promotion, conference activities, standards activities, awards, etc.
  - New ideas of initiatives
  - Directions of interest within TAOS technical scope to promote

- Feel free to follow up with any questions/comments at any time via email to officers
Guest Speaker

ONS co-Chair Nominee

- Nicola Andriolli
  - National Research Council of Italy (CNR)
  - Institute of Electronics, Information Engineering and Telecommunications (IEIIT)

- Title: Integrated photonic devices for optical networks and systems
Guest Speaker

\textit{GCSN co-Chair Nominee}

- Taisir Elgorashi
  - School of Electronic and Electrical Engineering
  - University of Leeds

- Title: \textit{Greening Communication Networks}
Transmission, Access and Optical Systems TC

Thank you and see you at GLOBECOM 2021!

- Please register your attendance at this meeting! (Link posted in chat)
Integrated photonic devices for optical networks and systems

Nicola Andriolli

Institute of Electronics, Information Engineering and Telecommunications - National Research Council of Italy (CNR-IEIIT)
nicola.andriolli@ieiit.cnr.it
Outline

1. Research activities
   - Optical interconnection networks
   - Multi-wavelength transmitters
   - Frequency comb generators
   - Photonic neural networks
   - Integrated quantum photonics

2. Research directions
Research activities
Optical interconnection networks

1. Photonic integrated interconnection networks
   - Compact footprint & high bandwidth density
   - Distance-independent high-speed communications

2. FPGA-based network control & scheduling
   - High throughput
   - Low queuing latency

P. Pintus et al., JLT 33(23) 2015
I. Cerutti et al., JOCN 10(4) 2018
Optical interconnection networks

- Multiplane OAM-wavelength interconnection network
- Control via two-step scheduler implemented in FPGA

M.N. Malik et al., JLT 37(16) 2019
Multi-wavelength transmitter

8 directly-modulated tunable DFB lasers
- Operating at >30 Gb/s per channel
- NSA 5G NR multiband FiWi system

N. Andriolli et al., IEEE JSTQE 26(5) 2020, invited

M.S. Borsato Cunha et al., IEEE WCL 10(5) 2021
Integrated frequency comb generator

- Electro-optic modulation of a CW laser
- Central frequency and repetition frequency can be independently set

N. Andriolli et al., JLT 36(23) 2018

Custom PIC RF-PCB

F. Bontempi et al., IEEE JSTQE 25(6) 2019
Reconfigurable linear processors

- Silicon-on-insulator  

- Silicon nitride  
  L. De Marinis et al., OFC 2021, Tu1C.6
Integrated photonic electronic neuron

**Concept:** Perform reduced-precision multiplications in photonics, accumulation in analog electronics, and non-linear activation function in the ADC

The capacitance accumulates the results of several multiplications, thus relaxing the operation frequency of the differential amplifier and the ADC.
Integrated quantum photonics

Quantum random number generators:

- Fully trusted (generated states and used measurement devices) → All commercial devices
- Semi-device-independent (e.g., source-device-independent)
- Device-independent

Required assumptions

Level of security
Implementation complexity

Required assumptions
Integrated quantum photonics

- Heterodyne-based CV-QRNG
- Source-device-independent $\rightarrow$ No assumption on source, very effective to account for an imperfect state preparation

Research directions
Research directions

1. Photonic systems for neural network acceleration / offloading (reduced-precision analog computing)
   - Integrated photonics
   - Free-space optics

2. Convergence of quantum networks with classical optical networks
   - Needed to push forward QKD technologies for communication services
   - SDN flexibility critical to achieve this goal
Software-defined QKD

- QKD solutions are already available
  - Assuming P2P communication
- SDN controller:
  - configures P2P channels
  - provides NBI to applications

- Quantum / classical channel interplay
- SDN enabler and consumer of QKD
- Survivability
- Increase transmission speed & propagation distance, make QKD systems low cost, compact and robust

Thank you for your attention!

Nicola Andriolli
Greening Communication Networks

Core Networks, Cloud-fog Computing, Data Centers

Taisir Elgorashi, Jaafar Elmirghani

Institute of Communication and Power Networks
School of Electronics and Electrical Engineering
University of Leeds
ICT Carbon Footprint

- 2007 Worldwide ICT carbon footprint: 2% = 830 m tons CO₂
- Comparable to the global aviation industry
- Expected to grow to 4% by 2020

Smart Grids
Smart Transportation
Smart Communities
Enabling a Low Carbon Economy
Smart Buildings
E-Health

Source: U.S. Dept of Energy/Clean Energy Information Analysis Center (CEIA)
S. Roy, IEEE Intelec 2008
INTelligent Energy awaRe NETworks (INTERNET)

- INTERNET, £5.9m EPSRC Program Grant established a new generation of ICT infrastructure architectures, protocols and algorithms to enable communications systems to adapt their speed and power consumption according to both the user demand and energy availability.

Collaborators
End-to-End Network
Routing in the optical layer coupled with renewable energy nodes can reduce the CO emission of the IP over WDM core network considered by up to 52\%.
Core Network Physical Topology Optimisation

- Not taking embodied energy into account when optimising the physical topology significantly increases the total power consumption.

- 47% total energy saving by optimising considering operational and embodied energy.
Distributed Energy Efficient Clouds Over Core Networks

Cloud services distribution

Network power consumption

Cloud power consumption

76% network power consumption saving
GreenTouch Greenmeter

Energy efficiency of 2010 and 2020 AT&T

- Total energy efficiency improvement in the core network by 316x was achieved compared to the 2010 equipment power consumption and networking practices.
Energy Efficient Cloud-Fog Architectures

Edge Vehicular Cloud

Fog-Based Healthcare Monitoring Infrastructure
Disaggregated Data Center

- Implementing logical disaggregation at rack-scale enables up to 20% power savings.
- Adopting of disaggregated servers reduces total fog computing power consumption by up to 18%.
PONs in Future Data Centers

Connectivity created by a typical PON deployment

- A PON data centre design with no tunable lasers can reduce the power consumption of provisioning connectivity for 5120 servers by up to 69% compared to 3-tier data centre architecture.
Publications

Publications


Energy Efficiency in 6G Networks

- **ML optimisation**
  - Lightweight ML algorithms

- **Blockchain**
  - Fully distributed fog computing networks, IoT networks, vehicular networks.
  - Reward systems encouraging sharing of opportunistic resources

- **Optical wireless Tb/s multiuser systems**
Thank you