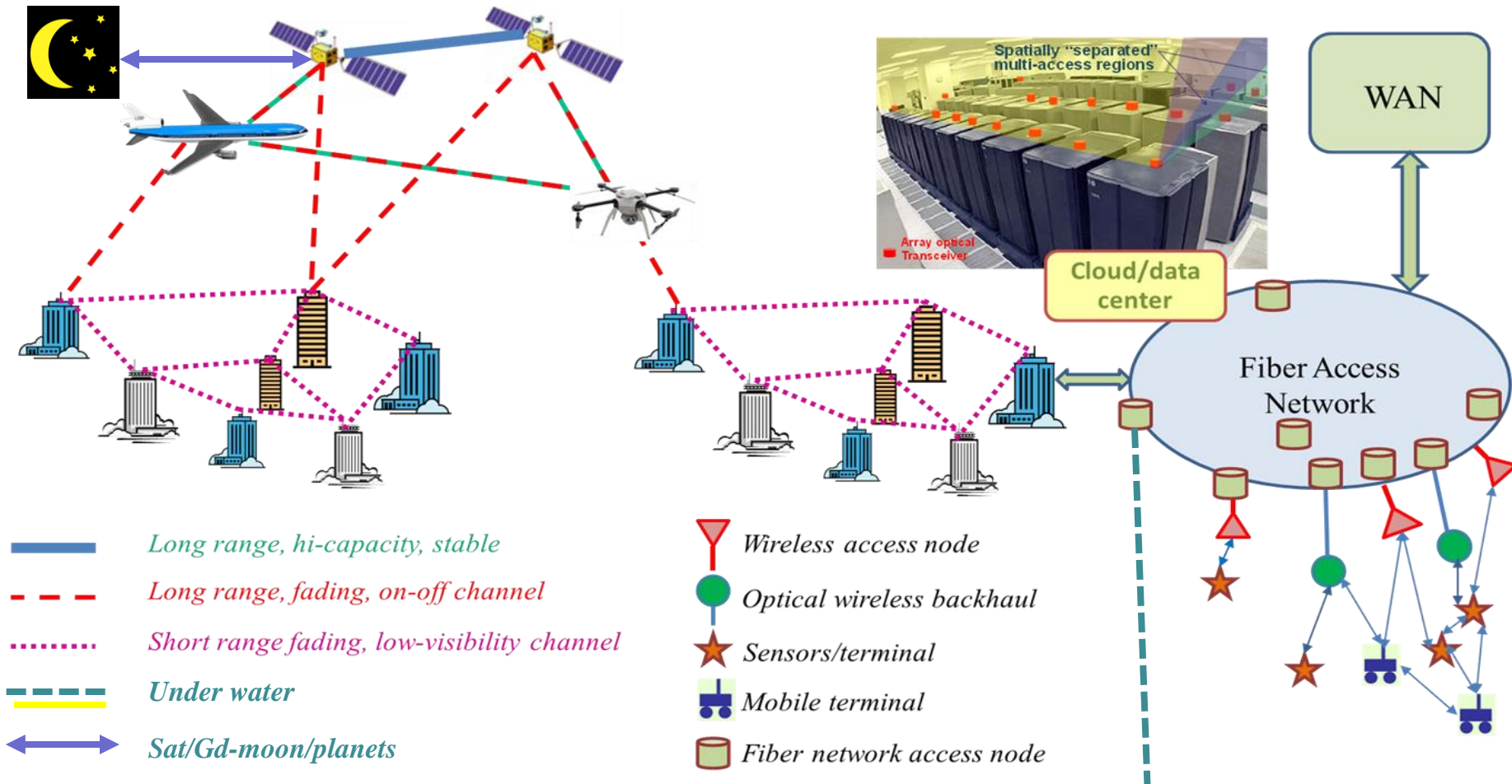


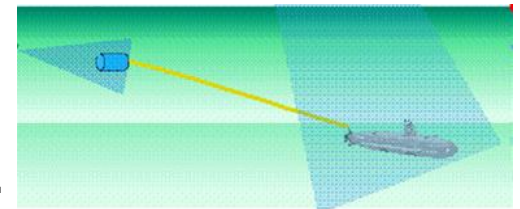
WORKSHOP ON FREE SPACE OPTICAL NETWORKS



Supported by CISE NSF: POC Ann Von Lehmen

Co-Chair: Donald Cornwell, NASA, Vincent Chan, EECS, MIT.

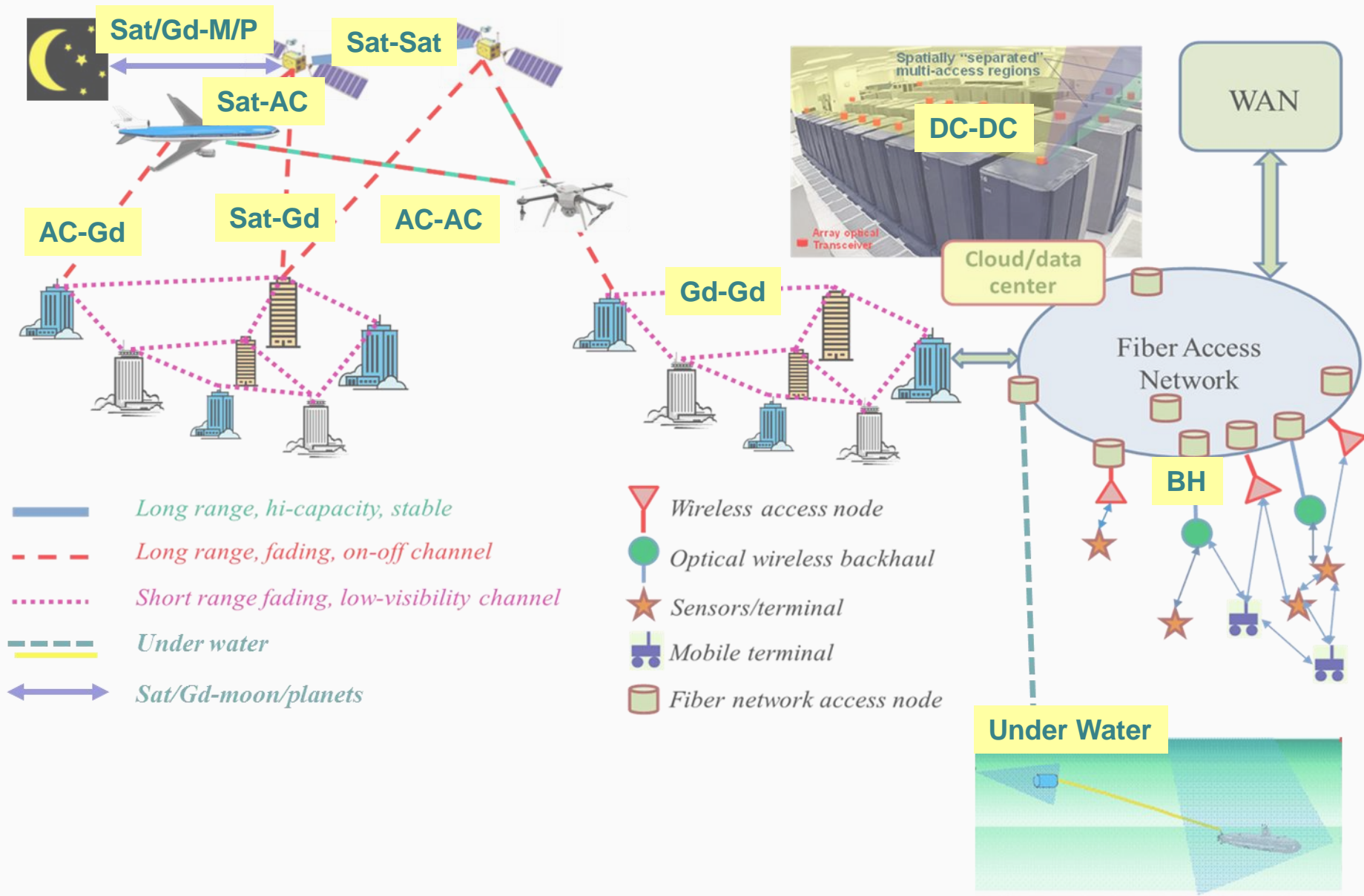
Student staff: Manishika Agaskar, EECS, Raichelle Aniceto, AA.



Objectives of Workshop

1. Lay out state-of-the-art and challenges in free space optical communication/networks
2. Researchers and practitioners from academia, industry and gov. labs and agencies
3. Channel and network modeling, hardware implementation, devices, system designs and network architectures.
4. Sat Xlinks and Dlinks to earth and airborne platforms, communication among aircraft, metro short haul applications including back haul, and data center networks
5. Challenges in creating communication and network designs that deal with
 - a. Widely varying channel properties,
 - b. Lower cost systems, including nano-photonics and adaptive techniques
 - c. Networking and systems need more attention and new ideas that can accommodate a highly variable channel.
6. Goal of workshop and report is to stimulate the research community into tackling the emerging hard problems in this space.

Types of links



Important attributes affecting system/network designs

Attributes

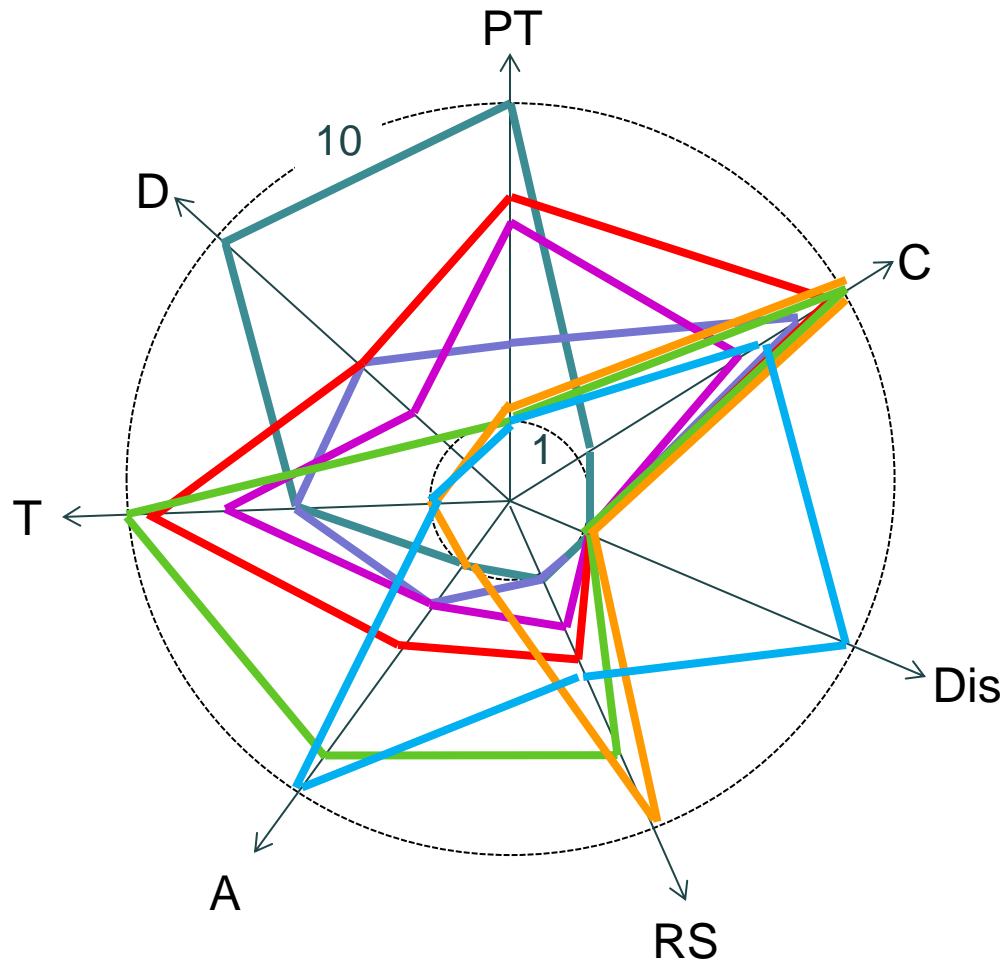
1. Pointing and tracking (PT)
2. Link delay (D)
3. Turbulence (T)
4. Weather attenuation (A)
5. Reconfiguration speed (RS)
6. Cost/HW-integration (C)
7. Spatial dispersion (Dis)

Attributes are not all orthogonal
and independent

Areas needing possible changes

1. New technologies to reduce SWAP
2. Turbulence mitigation
3. MAC
4. Routing
5. Transport layer protocol
6. Fast dynamic reconfiguration –
capacity, routing, transport layer,...

Types of channels and degrees of challenges



Sat/Gd-M/P

Sat-Sat

Sat-AC

AC-AC

Sat-Gd

AC-Gd

Gd-Gd

BH

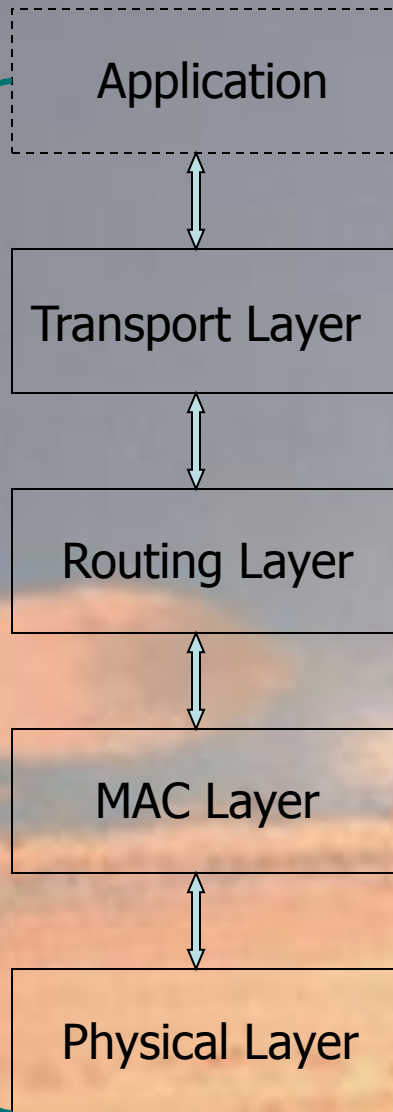
DC-DC

Under Water

Degree of challenges: 1-little, 10-huge

New architecture for free space optical networks

Single control plane covers multiple layers



New designs for all layers of network

Integrated architecture from physical layer to the transport layer

Single control plane covers multiple layers

Dynamic adaptation

Substantial performance gains:

1. Throughput
2. Delay
3. Reliability/availability
4. cost

Agenda DAY ONE – 9:00 a.m. to 5:30 pm

- 9:00 AM **INTRODUCTION**
- 9:15 AM **Keynote:** Progress in Free Space Optical Networking – Linda Thomas, NRL
- 9:45 AM **Keynote:** Overview on Lasercom – Scott Hamilton, MITLL
- 10:15 AM **BREAK**
- 10:45 AM **Keynote:** Backhaul Communications at Tens of Gbps – Hamid Hemmati, Facebook
- 11:15 AM **Keynote:** Silicon Photonics for FSO – Chris Doerr, Acacia
- 11:45 AM **LUNCH**
- 12:45 PM Free Space Optical Communications with Nanosatellites – Kerri Cahoy
- 1:00 PM Implementation Challenges in Low-SWaP Free-Space Optical Networks – Jim McNally
- 1:15 PM Stable Lasercom Platforms – Dave Pechner
- 1:30 PM Lasercom in Space and in the Air – Tom Wood
- 1:45 PM DARPA FOENEX and Beyond – Larry Stotts
- 2:00 PM High-rate Free Space Optical Communications for Terrestrial Platforms – Juan Juarez
- 2:15 PM Status of Free Space Optical Communications Technology at the Jet Propulsion Laboratory – Sabino Piazzolla
- 2:30 PM FSO Network Challenges – Ned Plasson
- 2:45 PM Measurements and Modeling to Overcome Shortcomings in the Atmospheric Channel Model – Rainer Martini
- 3:00 PM Understanding and Approaching Fundamental Limits to Free Space Optical Communication Through the Turbulent Atmosphere – Joe Kahn
- 3:15 PM **BREAK**
- 3:45 PM MEMs for FSO – Pierre-Alexandre Blanche
- 4:00 PM The Challenge of Multiple Access for Free Space Optics – Matthew Sherman
- 4:15 PM Designing Reliable FSO Networks – Suresh Subramaniam
- 4:30 PM Challenges and Opportunities for Free Space Elastic Optical Networking – S.J. Ben Yoo
- 4:45 PM Towards Interference-free Wireless Networks: The Role of Optical Wireless Networks – Harsha Chenji
- 5:00 PM Optical Free Space in Time Sensitive Networks – Andrea Fumagalli
- 5:15 PM Digital Optical Processing and Latency Challenges for Free Space Optical Networks – Joe Touch

Agenda: DAY TWO – 8:30 a.m. to 3:00 p.m.

- 8:30 AM Undersea Narrow-Beam Optical Communication – Nicholas Hardy
- 8:45 AM Integrated FSO and Sensor System Networks – Tim Kane
- 9:00 AM Multi-element Free-Space Optical Modules for Mobile Opportunistic Networking – Murat Yuksel
- 9:15 AM FSO-based Reconfigurable Networks in Data Centers and Picocell Backhaul – Himanshu Gupta
- 9:30 AM Visible Light Communications for Gb/s Indoor Connectivity – Maite Brandt-Pearce
- 9:45 AM VLC-backscatter Design for Self-charging Indoor IoT Devices – Abdallah Khreishah
- 10:00 AM **BREAK**
- 10:30 AM Breakout Sessions Long-medium Distances Short distances to Data Centers
- 12:30 PM **LUNCH**
- 1:30 PM Outbrief
- 2:30 PM Discussion: Next Steps

Path forward: half page summary recommendations from every speaker by July 24th. Report by mid Aug.

Reimbursements: send all receipts to Leslie Rice (lrice@mit.edu) within one week, copy me and Manishika

1. Companies: please no commercials
2. Academics and private company speakers will be reimbursed for travel up to \$1200/person, hotel paid only if you stay at the Hilton.
3. Reimbursements: send all receipts to Leslie Rice (lrice@mit.edu) within one week, copy me and Manishika
4. Non-profit speakers talk to me
5. Gov. (receipt will be provided)
 - a. \$20 for each breakfast
 - b. \$10 for each break
 - c. \$40 for each lunch
6. Half page summary recommendations from every speaker by July 24th.