



Research Activities on Optical Wireless Communication Systems

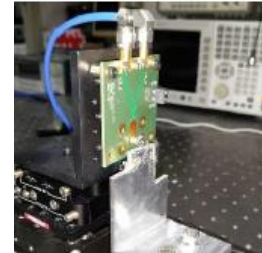
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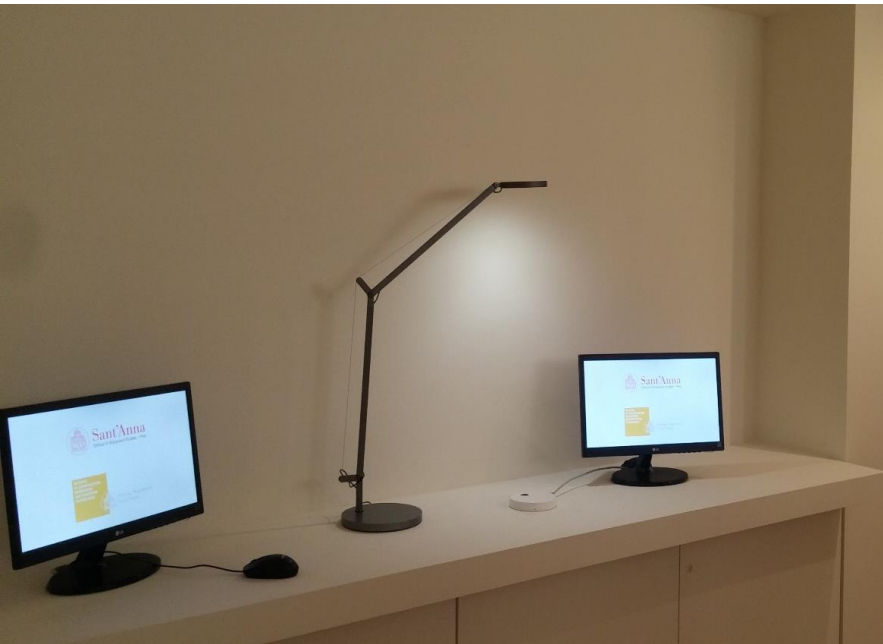


Our Approach

- We present recent realizations on OWC systems for different applications, all based on COTS components (= we do not ask for new devices)
- We cover a wide range of application scenarios:
 - indoor links and localization
 - underwater OWC
 - space applications

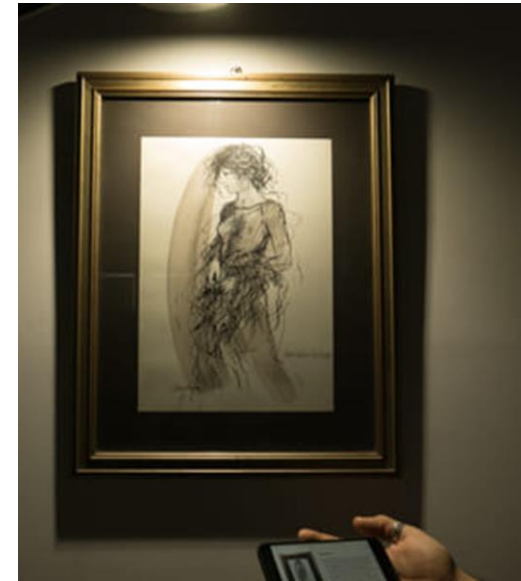


Indoor Optical Wireless Communications

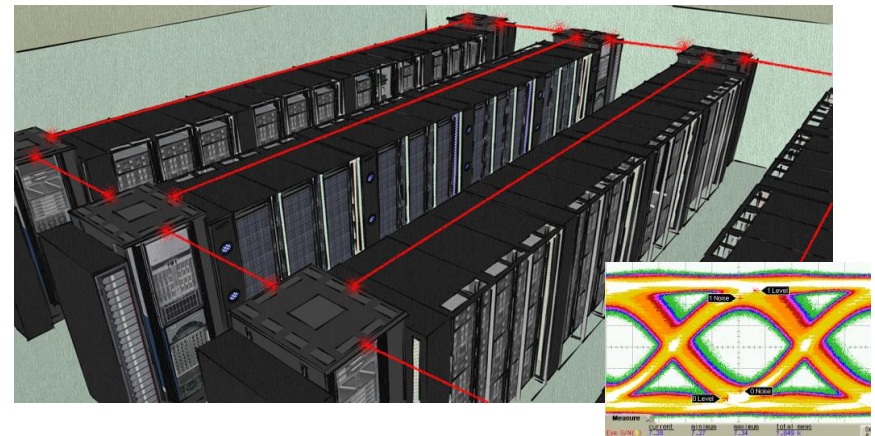


VLC demo with Artemide lamps
(Ethernet protocol)

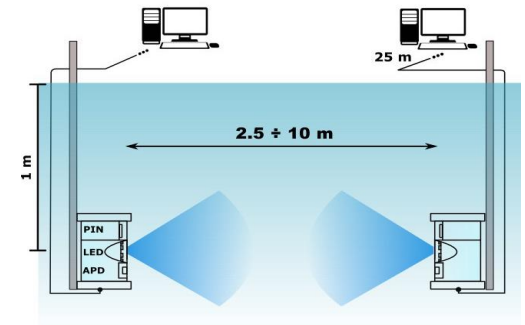
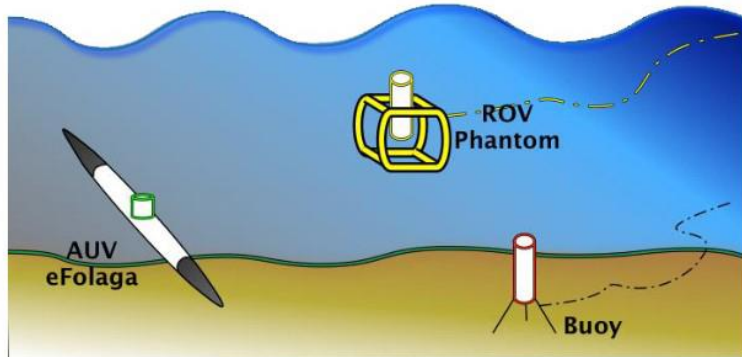
Localization using LED lights and a common smartphone
(industry-driven project)



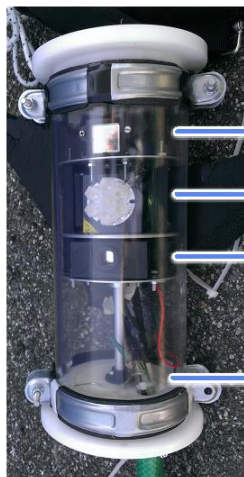
OWC systems up to 40 Gbit/s for datacenters
(FIPILI3 Project)



Underwater Optical Wireless Communications



Sea-trial of UOWC experiments at CMRE-NATO, La Spezia (SUNRISE Project, with ISME)



- PhotoDiode (PD)
- Blue LEDs
- AvalanchePhotoDiode (APD)
- Humidity Sensor

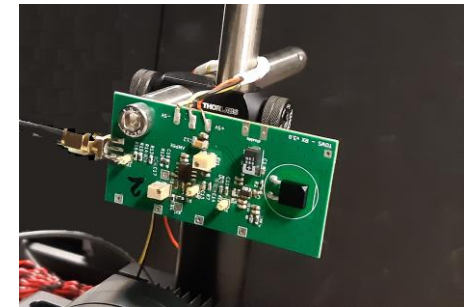
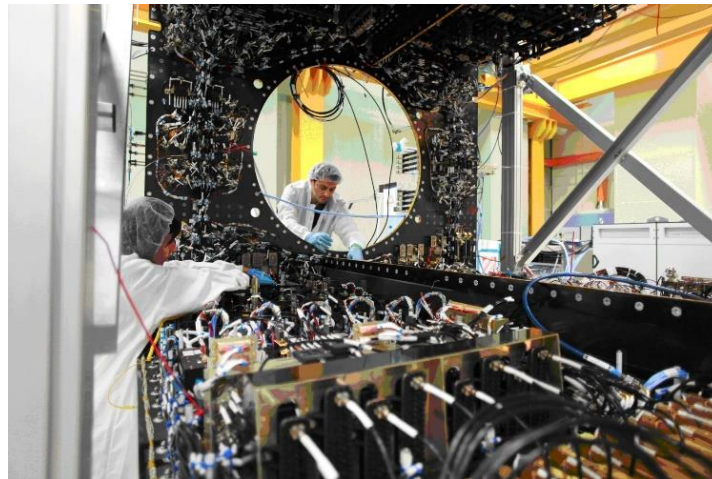
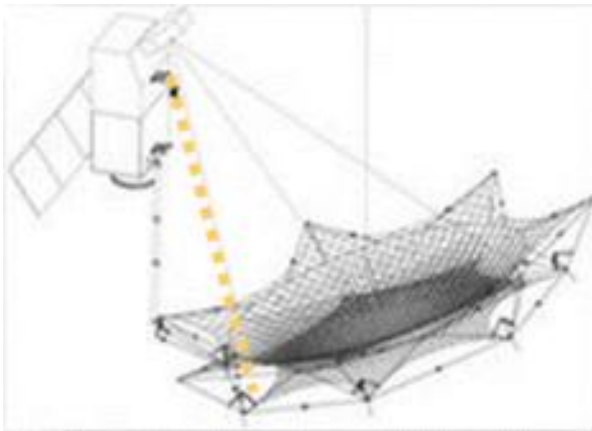
10 Mb/s UOWC modem (blue LEDs) for 10Base-T Ethernet



Optical Wireless for Spacecrafts

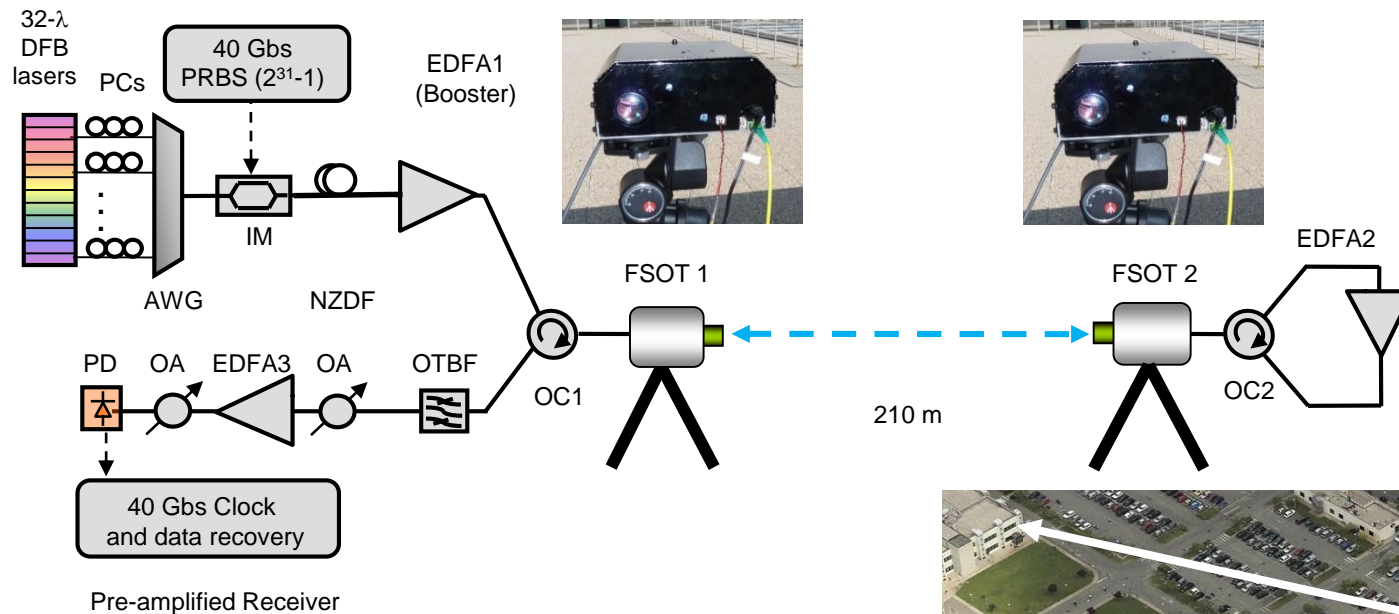


- ESA project with TAS-I
- Replace massive cables by OWC, in 3 application scenarios: intra S/C, extraS/C and AIT
- Proper interface with existing communication protocols for space equipment



1.28 Terabit/s (32x40 Gb/s) OWC experiment

- First-ever WDM FSO link enabled by transparent terminals (*)
- Fiber-free space-fiber between two buildings in CNR campus area (2x210 m)

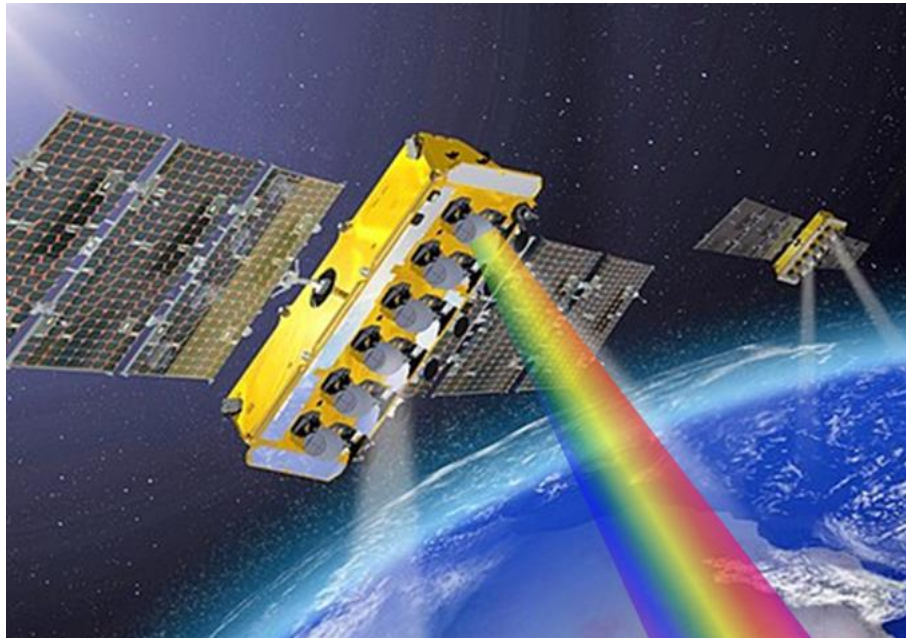


*: joint activity with Osaka University and NICT



OWC in the sky

- Hydron Concept proposed by ESA, to realize a network of OWC links
- Needs transparent terminals & WDM
- Feasibility and architecture study is ongoing



Selected OWC papers

- E. Ciaramella, Y. Arimoto, G. Contestabile, M. Presi, A. D'Errico, V. Guarino, and M. Matsumoto, "1.28 Terabit/s (32x40 Gbit/s) WDM Transmission System for Free Space Optical Communications", IEEE J. Selected Area in Communications, 27 , 9, 2009 , p. 1639 – 1645
- A. M. Khalid, G. Cossu, R. Corsini, P. Choudhury, E. Ciaramella, "1-Gb/s Transmission Over a Phosphorescent White LED by Using Rate-Adaptive Discrete Multitone Modulation" Photonics Journal, IEEE, Volume: 4 , Issue: 5Page(s): 1465 - , 1473Oct. 2012
- G. Cossu, A. M. Khalid, P. Choudhury, R. Corsini, and E. Ciaramella, "3.4 Gbit/s visible optical wireless transmission based on RGB LED", Optics Express, Vol. 20 Issue 26, pp.B501-B506 (2012)
- G. Cossu, R. Corsini, E. Ciaramella, "High-Speed Bi-directional Optical Wireless System in Non-Directed Line-of-Sight Configuration," J. Lightwave Technology, 32, no.10, pp.2035,2040, 2014
- G. Cossu, W. Ali, R. Corsini, and E. Ciaramella, "Gigabit-class optical wireless communication system at indoor distances (1.5 - 4 m)," Opt. Express 23, 15700-15705 (2015).
- W. Ali, G. Cossu, A. Sturniolo, R. Dell'Orso, A. Messineo, F. Palla, E. Ciaramella "Design and Assessment of a 2.5-Gb/s Optical Wireless Transmission System for High Energy Physics," IEEE Photonics Journal, vol. 9, no. 5, pp. 1-8, Oct. 2017
- G Cossu, A Sturniolo, A Messa, D Scaradozzi, E Ciaramella "Full-Fledged 10Base-T Ethernet Underwater Optical Wireless Communication System", IEEE J. Selected Areas in Communications, vol. 36, 1, pp. 194-202, Jan. 2018.
- G. Cossu, W. Ali, M. Rannello, E. Ertunc, L. Gilli , A. Sturniolo A. Messa, E. Ciaramella, "VCSEL-Based 24 Gbit/s OWC Board-to-Board System," IEEE Comm. Letters, 23, 9, pp. 1564-1567, 2019
- E. Ciaramella et al., "TOWS: Introducing Optical Wireless for Satellites," 2019 21st International Conference on Transparent Optical Networks (ICTON), Angers, France, 2019, pp. 1-4, doi: 10.1109/ICTON.2019.8840565.
- G Cossu, A Sturniolo, E Ciaramella, "Modelization and Characterization of a CMOS Camera as an Optical Real-time Oscilloscope" IEEE Photonics Journal (in press)



Thanks for your kind attention

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