

Editor's Note

Welcome to the first newsletter of the COST Action IC1101 "**Optical Wireless Communications - An Emerging Technology (OPTICWISE)**". This semi-annual newsletter shall serve as a communication tool for the COST Action's participants and colleagues that are interested and want to stay up to date with optical wireless communication trends. This first issue mainly describes the scope and organizational structure of the Action. Subsequent issues will cover news from the Management Committee, the Working Groups and the Special Interest Groups. We will have reports on the Action's activities including workshops, short term scientific missions, project collaborations, and also interviews with the Action members, book reviews, and many more.

Best regards,
Florian Mall
Editor of the Newsletter

Scope of OPTICWISE

Wireless transmission via optical carriers opens doors of opportunity in areas that are largely unexplored. Offering significant technical and operational advantages, optical wireless communication (OWC) can be a powerful alternative or complementary to existing wireless radio frequency (RF) systems. Variations of OWC can be employed in a diverse range of communication applications ranging from very short-range optical interconnects (on the order of millimeters) within integrated circuits to satellite links (larger than 10,000 kilometers). In many respects, OWC research is still in its infancy and calls for extensive research to begin to harness the enormous potential of the optical spectrum. The COST Action OPTICWISE serves as a high-profile consolidated



Terrestrial OWC link
(Source: Ozyegin University)



Inter-satellite OWC link
(Source: ESA)

This Issue

Editor's Note	1
Scope of OPTICWISE	1
Organizational Structure	2
Working Groups	2
Meetings	3
Member Profiles	4
Upcoming Events	4
Contact Information	4

European scientific platform for interdisciplinary OWC research activities, spanning from characterization of diverse propagation media to modeling, design and development of devices, components, algorithms, protocols, and systems. OPTICWISE contributes to the scientific understanding, technical knowledge, engineering design and applications and furthermore promotes community awareness of this emerging field.



Scenarios for mobile OWC in airborne applications (Source: DLR)

The design of pervasive and trustworthy next generation communication networks is recognized as a major technical challenge that European researchers face in the next ten years. Development of novel and efficient wireless technologies for a range of transmission links is essential for building future heterogeneous communication networks to support a wide range of service types with various traffic patterns and to meet the ever-increasing demands for higher data rates. As the need for bandwidth rises exponentially, there is an urgent need for transformative and far-reaching solutions. *OWC has such promise!*... It is in fact not a new technology, but it has in the past been overshadowed by wireless RF and optical fiber communications. With recent advances in visible light

and ultraviolet communications, the potential of OWC is promising more than ever. There are however many unknowns in the largely unexplored territory of the optical spectrum. OPTICWISE is the very first COST Action dedicated solely to OWC. Development of novel communication technologies resulting from integrated research activities made possible with OPTICWISE will be a main enabler for future generation heterogeneous communication networks supporting a wide range of services and applications.

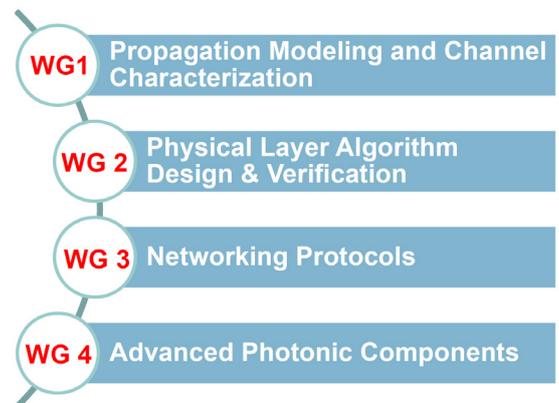


Visible light communication system: An example for short distance indoor OWC link (Source: Ozyegin University)

aspects of the planned scientific activities, four topical Working Groups that complement one another have been identified. These Working Groups (WGs) are: WG1 Propagation Modelling and Channel Characterization; WG2 - Physical Layer Algorithm Design and Verification; WG3 - Networking Protocols; and WG4 - Advanced Photonic Components. A Special Interest Group (SIG) entitled "Techno-Economics, Industrial Standards and Future Trends in OWC (SIG-TESEO)" has been formed. This SIG focuses on leading trends in emerging OWC applications and educating and influencing decision makers at all levels of the OWC market chain. Based on the needs and technical development trends, other SIGs will be further created.

Working Groups

The Action contains four Working Groups (WGs), each dedicated to a core topic of OWC. The groups are strongly linked and build on outputs from each other. This structure covers best the interdisciplinary challenges that are to be investigated and overcome.



Overview of the four WGs in OPTICWISE.

WG1 Propagation Modeling and Channel Characterization

The first step in OWC system design is to develop, evaluate and validate statistical and empirical channel models for indoor and outdoor applications that realistically capture the physical properties of the underlying OWC channel. This is treated by WG1. It covers characterization of microphysical phenomena like scattering and absorption by e.g. rain, fog and clouds as well as deterioration of signal quality due to clear air turbulence. Tools to predict and model these phenomena are to be developed. Furthermore, "effective" channel models are investigated taking into account the imperfections of transmitters, receivers etc. encountered in practical realization.

Organizational Structure

OPTICWISE is an Action of the COST Programme (European Cooperation in Science and Technology) funded by the European Science Foundation. The Action aims to serve as a high-profile consolidated European scientific platform for interdisciplinary optical wireless communication (OWC) research activities. OPTICWISE brings together more than 70 researchers from European academic and research institutions, government bodies and companies who are involved in different aspects of OWC research supported by national and EU research grants. Through its activities, OPTICWISE provides linkages among these research groups and allows the coordination of OWC research on a European level.

The Action is administered by a Management Committee (MC) chaired by Prof. Murat Uysal of Özyeğin University, Turkey. The MC consists of two representatives from each COST country and one representative for each non-COST institution admitted to participate in the Action. As of October 2012, there are 19 COST countries involved in OPTICWISE and pending participation requests from 5 non-COST institutions.

Implementation of the scientific tasks defined in the Action's Memorandum of Understanding (MoU) requires to synergize the interdisciplinary scientific expertise of European researchers in diverse fields. To cover all

WG2 Physical Layer Algorithm Design and Verification

Within the last decade or so, several exciting developments have been witnessed in the area of physical layer (PHY) research for wireless communications, most notably the introduction of multiple-input multiple-output (MIMO) communication and cooperative diversity along with the proliferation of multicarrier communication techniques. Some of these innovative approaches have already been incorporated in international wireless standards and turned into commercial wireless RF products. Such PHY layer methods and techniques have an enormous potential for optimum OWC system design enabling reliable links with higher throughputs, but yet largely unexplored for deployment in optical spectral bands. Therefore, the work of this WG covers, but not limited to, the analysis and design of MIMO systems, cooperative schemes, adaptive coding and modulation, OFDM-based multicarrier transmission, channel estimation and equalization in the context of OWC.

WG3 Networking Protocols

While WG2 focuses on physical layer for point-to-point transmission, WG3 deals with upper layer protocol stacks as well as investigation of co-existence and interoperability of OWC with other communication networks. Due to OWC's inherently different link nature, traditional networking protocols developed either for wired networks or wireless RF networks are mostly not applicable to degree-constrained and highly dynamic OWC networks. To fill out this research gap, this WG deals with topics such as multiple access techniques, interference management, advanced automatic repeat request (ARQ) algorithms, cross-layer designs, dynamic and autonomous topology control schemes, routing and wavelength assignment algorithms, fault detection, avoidance and recovery strategies, etc.

WG4 Advanced Photonic Components

The successful implementation of OWC systems and research activities highlighted in the previous WGs are premised on the availability of suitable and appropriate opto-electronic/optical front-end devices and components. This is the central theme of WG4. Specifically, the WG deals with the investigation of OWC wavelength selection for outdoor and indoor applications, contribution to a comprehensive modeling effort to understand how device trade-offs affect system performance, investigation and subsequent design of large area photo detectors with low capacitance, design and development of highly sensitive optical receivers with optical amplifiers, beam steering and tracking devices, and other related areas.

Meetings

1st MC Meeting

The Action's kick-off meeting was held on November 11, 2011, in Brussels. The proposer of the Action Prof. Murat Uysal was unanimously elected as the MC Chair. Prof. Fary Ghassemlooy was elected to serve as the MC Vice Chair. Chairs and Vice Chairs for WGs and SIG TESEO were also elected. The budget and work plan for 2011-2012 were discussed and approved.

2nd MC Meeting

The second MC meeting was in March 19-21, 2012 and held at Özyeğin University, the home institution of Action Chair Prof. Uysal. During the meeting, all participants presented an overview of their research activities and R&D capabilities. The scientific expertise of the Action participants were identified to cover all aspects of the planned scientific activities within the Action. WG meetings co-located with the MC meeting further provided a platform for the participants to exchange ideas on research topics of each WG in a more focused manner and discuss future directions of the field.



Participants of OPTICWISE at 2nd MC meeting held at Özyeğin University, Istanbul.

To avoid duplication, and to increase collaboration among the Action participants, as well as to effectively and fully utilise research resources within the community it was decided by the MC that a common database will be put together prior to the next MC meeting. The database will contain information on research activities and research resources for all partners, and will be put on the Action website. It was further agreed to establish two new SIGs; one on "Underwater OWC" and another on "Visible Light Communications". The SIGs will be focusing on the specific applications of OWC technology and will be drawing members from all four WGs.

The next MC meeting will be held on October 22-24, 2012 and be co-located with the 1st Annual Action Workshop hosted by Scuola Superiore Sant' Anna, Pisa, Italy.

Member Profiles



Prof. Murat Uysal
Action Chair

Murat Uysal received Ph.D. degree in electrical engineering from Texas A&M University, College Station, Texas, in 2001. Dr. Uysal is currently an Associate Professor at Özyeğin University, Istanbul, Turkey where he leads the Communication Theory and Technologies (CT&T) Research Group. Prior to joining Özyeğin University, he was a tenured Associate Professor at the University of Waterloo, Ontario, Canada, where he still holds an adjunct faculty position. Dr. Uysal's research interests are in the broad areas of communication theory and signal processing with a particular emphasis on the physical layer aspects of wireless communication systems in radio and optical frequency bands. His recent research focuses on terrestrial OWC systems and addresses the analysis and design of efficient fading mitigation techniques such as advanced channel coding, cooperative diversity, and MIMO transmission schemes in the presence of atmospheric turbulence. Dr. Uysal has authored more than 170 journal and conference papers and received more than 2000 citations.



Prof. Frank S. Marzano
Co-Chair of WG1

Frank S. Marzano received Ph.D. degree in applied electromagnetics from the Sapienza University of Rome, Rome, Italy, in 1993. Since 2005, he has been with the Department of Electronic Engineering, Sapienza University of Rome, where he currently teaches courses on antennas, propagation, and remote sensing. His current research concerns passive and active remote sensing of the atmosphere from ground-based airborne and space-borne platforms, with a particular focus on precipitation using microwave and infrared data, development of inversion methods, radiative transfer modeling of scattering media, and radar meteorology issues. He is deeply involved in free-space optics and radio propagation topics, including incoherent wave modeling, scintillation prediction, and rain fading analysis along satellite and terrestrial links.

Upcoming Events

- 2nd IEEE Workshop on Optical Wireless Communications (OWC) in conjunction with IEEE Global Communications Conference (GLOBECOM) 3-7 December, 2012, Anaheim, USA.
- High-Capacity Optical Networks & Emerging/Enabling Technologies (HONET-IT). December 12-14, 2012, Istanbul, Turkey.
- SPIE LASER Photonics West February 2-7, 2013, San Francisco, USA.
- The Optical Fiber Communication Conference and Exposition (OFC) and the National Fiber Optic Engineers Conference (NFOEC) 17-21 March, 2013, Anaheim, USA.
- European Conference on Lasers and Electro-Optics 12-16 May 2013, Munich, Germany.
- SPIE Defense, Security & Sensing, April 29-May 3, 2013, Baltimore, USA.
- Conference on Lasers and Electro-Optics (CLEO), 11-13 June 2013, San Jose, USA.
- SPIE Optics & Photonics, August 25-29, 2013, San Diego, USA.

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Website of the Action

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