

ESA SCYLIGHT INDUSTRY DAY

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EUTELSAT BACKGROUND ON OPTICAL COMMUNICATIONS (1/2)

✓ EDRS on Eutelsat9B

→ Before opting for hosting the EDRS Payload on Eutelsat 9B, Eutelsat was intending to operate the EDRS System and, as such, it gained a wide knowledge on the EDRS communication system in general and on the Tesat Laser Communication Terminal (LCT) in particular;

✓ Artes 1 1A.066 “Introduction of Quantum Communications in Satellite Communication Networks”

→ In 2012 Eutelsat did participate to this Artes 1 study aiming to develop a Space-based Quantum Communication network able to implement the “Quantum Key Distribution”; the mainstream approach was to develop a dual-use LCT able to provide EDRS service switchable with an entangled-photon source suitable for being pointed to visible Earth for cryptographic key transmission;

✓ OptiQSat proposal for “Horizon 2020”

→ In 2016 Eutelsat did participate to a bid for a LEO cubesat mission able to demonstrate Quantum Communications in Space, in the frame of the Horizon 2020 EU initiative. Main stakeholders of the consortium were Emyxis (Spain, LEO cubesat provider), IQQI(Austria, Quantum communication experts), Politecnico Milano (optical package).

✓ **ONUBLA (Optical Network Communication Availability Assessment)**

→ Eutelsat has been pleased to participate as member of Advisory Board to this ESA funded activity aiming to determine the availability of optical space-to-ground links for various S/C configuration (LEO to GEO), together with a first consolidation of optical communication link architecture (analog vs digital over optical);

✓ **Proposal for an Artes on Optical Feeder link related technologies**

→ Eutelsat, in concertation with DLR, has proposed an Artes 1 study aiming to evaluate the repeater architecture able to support a digital-over-optical feeder link for an HTS Mission;

→ The digital transparent DWDM-based Optical communication network would need an On-Board Processor able to process the received optical bits and regenerate the Ka-band DVB-S2 signal, which implies an important development to achieve very high capacity due to Optical oversampling and quantization;

✓ **Discussion with Primes for Photonic IOD/IOV/Atlas**

→ Eutelsat has been involved in advanced discussions with ESA and selected manufacturers for potential demonstration missions on Photonic Technology;

EUTELSAT UNDERSTANDING OF SCYLIGHT (1/4)

✓ **Line 1 Common System and Technologies Activities, ESA-initiated**

- ESA attempt to define and consolidate roadmaps taking into account existing technology, market needs and work plan for achieving those, is appreciated;
- The role of a major Operator as Eutelsat would be key in this phase to assist and recommend major assets development, along with a clear identification of main market needs for each ScyLighth topic;
- Regular participation to initial discussions intending to coordinate among different stakeholders could be a mean to share and build an initial vision on “what is available in Europe” in terms of technology building blocks, permitting then to develop a market vision able to address each of the three development lines addressed hereinafter;

✓ **Eutelsat would be pleased to participate to further activities with ESA and to support the consolidation of the roadmap**

EUTELSAT UNDERSTANDING OF SCYLIGHT (2/4)

Line 2 Optical Communication Terminals and components

- The development of Optical Communication Terminals aiming to provide connectivity in the Optical domain is seen as of great interest on Eutelsat side;
 - As one of the world's HTS market leader, Eutelsat foster the implementation of innovative techniques related to GEO HTS mission. As such, evolution from Ka to V-band and, then, to Optical communication, is seen as an opportunity to achieve wider capacity while optimizing the associated economics;
- Eutelsat is on the forefront of evaluating the possible different implementations of a Ground to Board Optical Feeder Link and is in contact with main European industrial suppliers such as TAS, Airbus D&S, Tesat, Contraves and DLR;
 - The participation to ESA study ONUBLA has permitted to gain in visibility and understanding on several technical issues associated with this exciting target;
 - Tesat published results on bi-directional links established with the Transportable OGS in Tenerife towards the Alphasat LCT have been seen with great interest;
- It is considered that main development areas consist in:
 - Optical Ground Station and on-board LCT;
 - Additional repeater hardware to support selected optical comms protocol (analog vs digital);
 - Ground network availability and number of Optical Ground Stations;

Line 3 Intra-Satellite Photonics / Optical Payloads

- Eutelsat has been and is in contact with main Industrial suppliers of Photonic technology, such as TAS, Airbus D&S, DAS Photonics, with the main target to minimize mass and power of Payload Input Section;
- As far as Eutelsat is aware, main areas of interest are related to the possibility to miniaturize components, to create optical switch matrixes, to develop multiple optical LOs to be used in HTS RTN missions and, which seems quite promising, to implement channel filtering in optical domain;
- The maturity in terms of TRL of the main building blocks is to be checked for each application areas; more, the trade-off towards the mainstream technology and the associated savings in terms of mass, power, volume and cost, are to be matured;
- The possibility of a demonstration Mission is of great interest to Eutelsat and could materialize as an Atlas or a Hosted Payload;

Line 4 Quantum Cryptography Technologies

- Eutelsat confirm its interest to stay abreast of developments and achievements on the related technologies and looks forward to supporting activities aiming to develop real applications in Space;
 - While confirming that market model would focus on GEO Spacecraft, Eutelsat would be supportive to demonstration missions in lower orbits, such as the OptiQSat concept;
 - Depending on market assessment, the trade-off outcome could help in selecting between a dedicated Quantum Laser Communication Terminal vs a dual-use one (for example shared with EDRS-like communications);
 - Accommodation-wise, additional constraint on S/C pointing should be evaluated, together with disturbances originated on-board and associated to Solar Array and other RF moving antennas;
- The possibility to perform an additional activity aiming to confirm technical feasibility would be beneficial to develop market models which could further support the need for demonstration missions;
- Thanks to its previous heritage, Eutelsat would be interested in supporting those activities up to identify credible IOD/IOV missions, including cubesat in low orbit;

CONCLUSION

✓ The three development lines proposed by ScyLight are of particular interest to Eutelsat

- For medium (photonic repeater) and long term (optical links and Quantum communications) needs
- For Eutelsat to stay abreast of and benefit from most recent developments

✓ Eutelsat welcomes this ESA initiative and is ready to put some effort into supporting the European Industry towards Satellite Optical Communications

✓ Quote from our CEO, Rodolphe Belmer:

“Innovation sits at the heart of Eutelsat’s DNA. It is an indispensable competitive imperative in constantly evolving video and connectivity markets [...]. Benefiting from in-depth market knowledge and unique expertise, we want to seize every relevant opportunity to innovate. In doing this, we seek to leverage our assets and collaborate with a wide array of players in our ecosystem.”