

Proposal No. 02
(Proposal details for the R&D scheme of USOF)

Subject: Collaborative development of Free space optical communication (FSOC) solution

1) Introduction

Free Space Optical communication (FSOC) also called optical wireless communication has always been a topic of attention as it utilizes the broad unlicensed spectrum in infrared band instead of already congested radio spectrum.

Today's FSO technology is able to transmit several gigabits of data per second over several kilometres. FSO proves to be only possible solution to the connectivity problems, wherever it's too expensive or difficult to install fibres.

DOT invites participation from the Indian start-ups/ organizations/ research and academic Institutions for this collaborative project, for development of a FSO solution, capable of delivering at least 10G bandwidth (full duplex) per wavelength for a distance of at least 5km. The aggregate bandwidth will depend upon the number of wavelengths used.

The potential participants should have demonstrable expertise in optical communication related technologies in the form of fully or partially prototyped optical technologies, including but not limited to, components/ modules / hardware / software / subsystems or end products thereof.

The final outcome of the collaborative development project shall be commercially deployable FSO solution. The project outcomes shall be licensed back to interested participants or third parties, capable of its mass production, marketing and deployments for end users, directly or in association with system integrators.

2) Project Description

Free-space optical communication (FSO) is an optical communication technology that uses light propagating in free space to wirelessly transmit data for telecommunications. "Free space" means air, outer space, vacuum, or something similar. This contrasts with using solids such as optical fiber cable.

The technology is useful where the physical connections are impractical due to high costs or in difficult terrains.

Keeping in mind the technologies available with the Indian industry, DOT shall prepare common product requirement specifications (PRS) in consultation with the partners, through its R&D wing C-DOT, and the project Partners will work collectively in physically realizing the PRS in form of Field deployable commercial product(s).

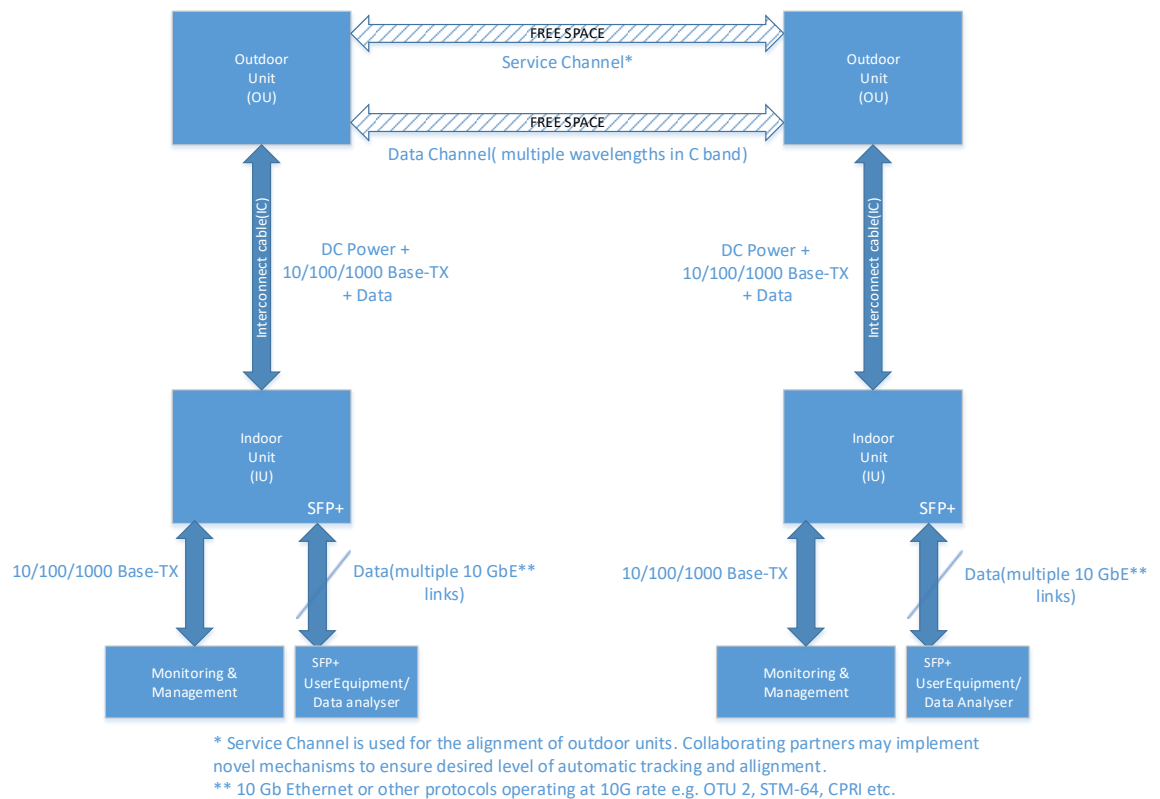


Figure 1 – Block Diagram of a FSO solution

Figure 1 broadly illustrates the scope and expected final outcome of the collaborative project. The DOT invites collaborative project participation in two areas for the Free Space Optics project which are detailed below:

(a) Develop outdoor unit with automatic tracking and alignment:

Collaborating partners in the project are required to develop the outdoor unit (OU) as shown in the Figure 1. During participation in the project, the Partners may use their respective pre-existing background technologies or undertake fresh development of new foreground technology or both. The outdoor unit should have the following main features–

- It should have one 10/100/1000 Base -Tx Ethernet link for controlling and debugging.
- It should have auto-tracking feature and should be able to align with the peer OU automatically and track it continuously to be aligned at all times.
- It will interface with the indoor unit through optical fiber to transmit/receive the data which would be sent in free space. The details of this interface will be worked out by the collaborating partners in consultation with C-DOT.
- It should support data speeds of 10 GbE per wavelength (10 Gb Ethernet or other protocols operating at 10G rate e.g. OTU 2, STM-64, CPRI etc.) in the C band and such multiple wavelengths should be supported by the outdoor unit.
- It can use any wavelength near infrared region in the visual range for auto-tracking and C-band for data channel. Alternatively, it may utilise the C-band wavelength for auto-tracking as well, ensuring that the data channel remains intact. Collaborating

partners may implement novel mechanisms to ensure desired level of automatic tracking and alignment.

- Powering mechanism for the outdoor unit needs to be decided in consultation with C-DOT.
- Collaborating partners may also suggest novel mechanisms which can be implemented in Indoor unit or Outdoor unit to improve the performance of the FSO solution in presence of atmospheric turbulences. The performance improvement may be in terms of
 - Distance supported
 - Supported data rates
 - Alignment of outdoor units & automatic tracking of the same.
 - Minimising the effect of atmospheric turbulences on QoS of the FSO.

(b) Develop scheme for forward error correction for Free Space Optics:

FSO system is vulnerable towards various atmospheric phenomenon like absorption, scattering, atmospheric turbulence and adverse weather conditions. In order to fully utilize the capacity of FSO system, it has to overcome various challenges offered by heterogeneous nature of atmospheric channel. Forward Error control coding is used to improve the performance of the FSO link by making use of different forward error control (FEC) schemes (like Reed-Solomon (RS) codes, Turbo codes, convolutional codes, trellis-coded modulation (TCM) and LDPC). These codes add redundant information to the transmitted message so that any kind of error due to channel fading can be detected and corrected at the receiver. The DOT invites proposals from collaborating partners to implement efficient FEC / HARQ schemes with minimal delay latencies.

- Collaborating partners may suggest ways to implement error correction algorithms which may be housed in the OU or IU.
- They should be able to demonstrate the performance of the same using a 10GbE link between two FSO nodes.
- Details of any background IPs for the same need to be shared.

Format of Response

Companies / organizations / institutions / individuals developing enabling technologies / modules / components / subsystems / products are required to respond in the format provided in Annexure-A, on the DOT website ([link address provided- refer "format of response"](#))

Annexure-A : Format of Response

S. No		Response	Remarks
Company Profile			
1	Name of the Organization		
2	Address and Contact Details		
3	Type of participant (MSME, Start-up, Govt. Institution, Academia, Domestic Company/ PSU/ Society/University/College / other registered organization etc.)		
4	Area of work / Domain expertise		
5	Size of company		
6	Location of Head office and branches if any		
7	Company turnover – last three years		
System / module Readiness			
8	Proposed Product area category- Product (Module/Sub module), Solution (Software Application)		
9	Product phase (development TRL level/ POC / Field trial / ready for deployment)		
10	Compliance to any standards		
11	Customers / Clients / Collaboration if any		
12	List of IPR / Awards / Paper Published if any		
13	Standard body membership / contributions if any		
14	Certification testing (TEC / security etc.)		
Manpower			
15	Size of skilled manpower in the proposed area		
16	Number of Architects		
17	Number of Developers in the proposed area		
18	Number of Test and Integration Engineers		
19	Number of Field Support Engineers		
Principal Investor (first point of contact)			
20	Name & Designation		
21	Institution/ Department/ Address		
22	Bio-data/ Professional credentials		
Co- Investor			
23	Name & Designation		
24	Institution/ Department/ Address		
25	Bio-data/ Professional credentials		
Infrastructure			
26	Software and development tools used		
27	Details of Test equipment available for Proposed Modules/ system		

28	Deployment, Network planning tools used		
Process			
29	Product development lifecycle and Quality practices followed		
30	Test Automation practices followed if any		
Funding			
31	Estimated development cost of the proposed modules/system. (Separately module wise, in case multiple modules are proposed)		
32	Fund expected from this program (Separately module wise, in case multiple modules are proposed)		
33	Details of funding received for the Same / Similar project from other schemes of DoT / GOI.		
34	Details of self-funding / other sources for the Proposed modules / system		
Product description			
35	Brief product/ solution/ idea description		
36	Primary Objective of the module/ sub-system/system/ product/ Solution proposed		
37	Key deliverables/ expected outcome		
38	Type of solution/ product- Stand-alone/ Sub-system/ Application/ Complete system / product		
39	Details of prior experience, expertise and components/ sub-systems/ product developed in selected area of interest.		
40	(If the proposed solution/product is not stand-alone and/or a module, please provide details of the larger solution it caters to/ required to integrate to arrive at full solution)		
41	Is the product/ technology related to present activities/ products being developed by DOT? If so, how does the product tie in with present activities/ products, being developed by DOT?		
42	Is it a new concept/ design/ solution/ product? If so, What are relevant standards being adopted?		
43	Are there any alternate competitive technology/ product? available/ under development locally / outside India? Please provide the information available with you. What is the comparison of performance/ specification/ features?		
44	Provide the specification document relevant to your product?		
Project Plan			

45	Provide development Plan indicating the major milestone and respective cost break up of each milestone Provide bar chart/ project plan		
Additional Resource Requirements			
46	Manpower support requirements		
47	Infrastructure support requirements		
48	Tools, Testers and platform requirements		
49	Any development tools and software requirements		
Risk and Risk mitigation proposed			
50	Risk areas and challenges, as envisaged		
51	Mitigation plan and/or contingency plan suggested, if any		
52	Potential foreground IPR (Intellectual Property) that can be developed by the participants individually and collectively		
53	Background IPR available for contribution to the project and Nature of ownership of the background IPR (exclusively owned, Jointly owned, Taken under license etc.)		
54	Status of background IPR (eg in planning stage, on roadmap, patented/ copyrighted, under development, under field trials, mass deployed etc.). And also specify expected duration of IPR availability to this project		
Regulatory approvals Requirements			
55	Any regulatory approvals required from Govt for the product/ solution being proposed		