Atmospheric Mitigation Techniques for Freespace Optical Communication

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Problem

- Growing bandwidth demands of DoD applications fuel the need for freespace optical communication (FSOC).
- Atmospheric variability presents limitations on freespace communications.
- Current FSOC terminals do not address variable link conditions and fail to maximize both system availability and throughput.
- Next-generation FSOC terminals must dynamically react to changing atmospheric conditions in order to optimize overall system performance.

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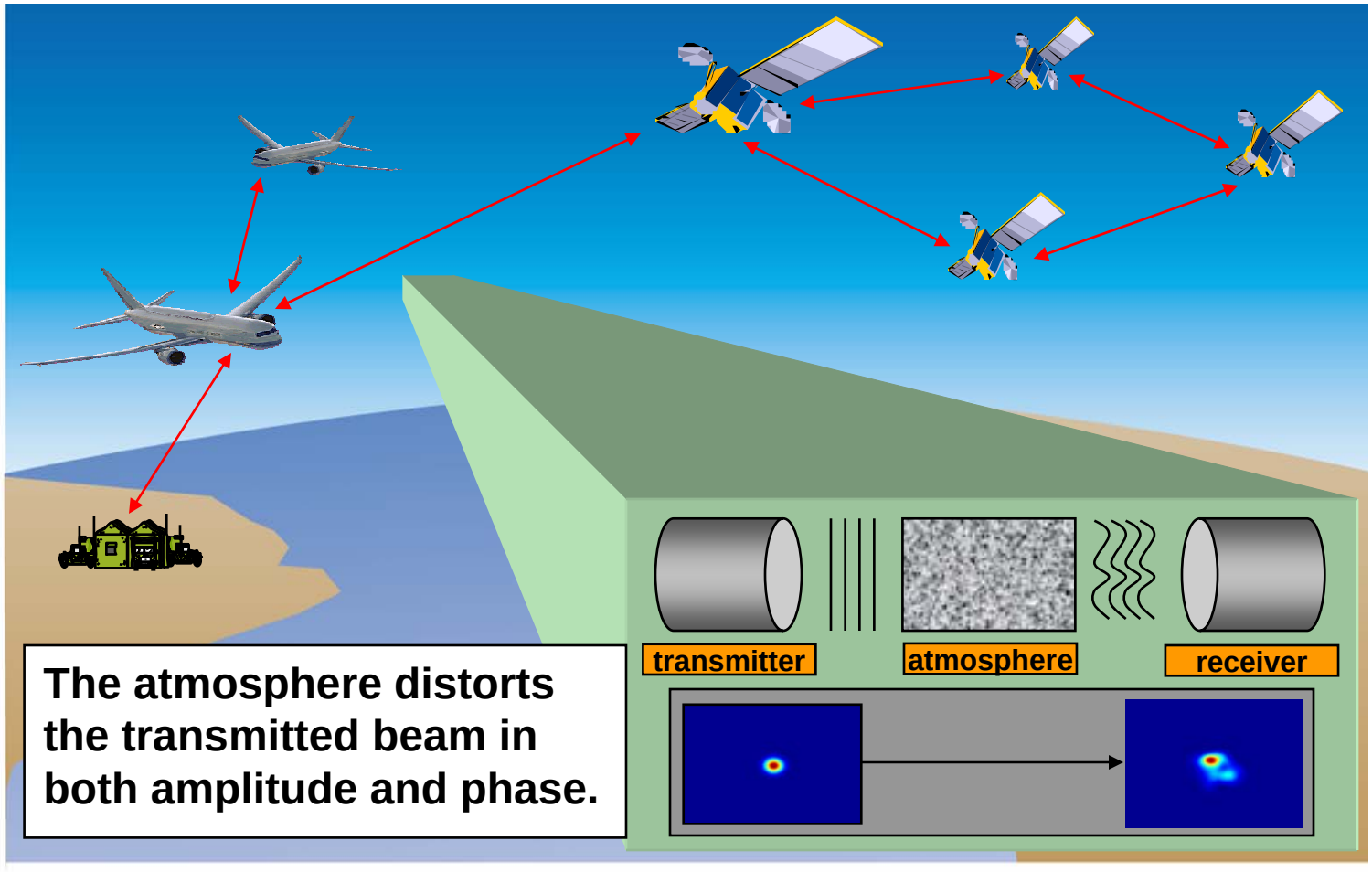
Background



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Objective

Build a freespace optical communication terminal that will dynamically optimize performance under varying link conditions

- **Understand atmospheric channel via modeling and simulation**
- **Emulate the channel in a laboratory environment**
- **Implement adaptive mitigation techniques that optimize link performance using electrical, optical, and network modalities**

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Activities

- ***Wave-Optic Computer Simulation***: Optical software toolkit to investigate regions of the atmosphere where analytical turbulence theory breaks down
- ***Laboratory Emulation***: Optical test facility to recreate, in a laboratory environment, the phase and intensity perturbations caused by the atmosphere
- ***Rate/Modulation Adjustable Transceiver***: Mechanism to trade margin for improved system performance
- ***Adaptive Data Link Layer***: Autonomous controller that modifies terminal characteristics to compensate for atmospheric channel variations and adjust according to user requirements

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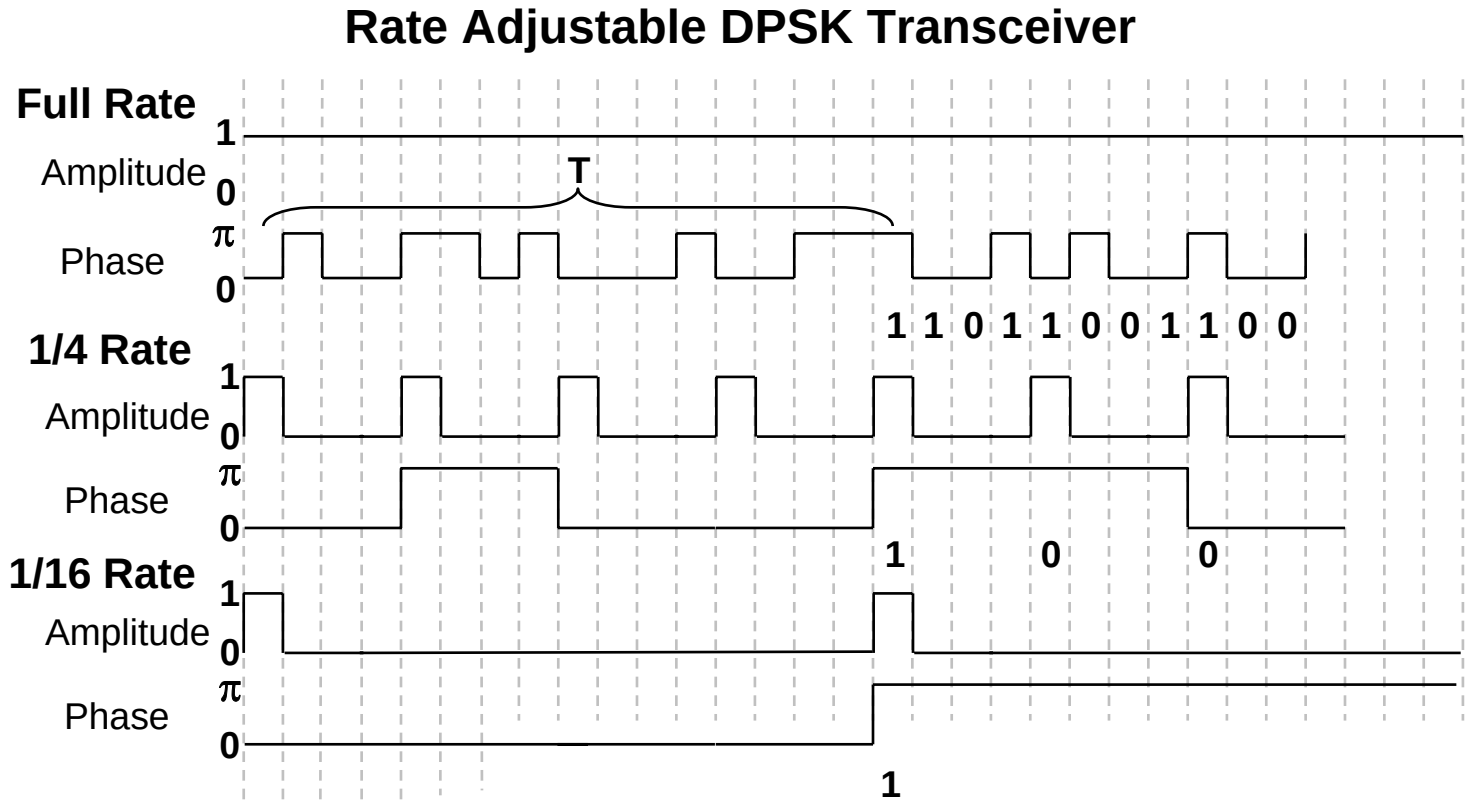
Highlight



- **Data is encoded by a phase difference with a fixed time delay.**
- **Amplitude carving selects phase encoded bits for comparison.**

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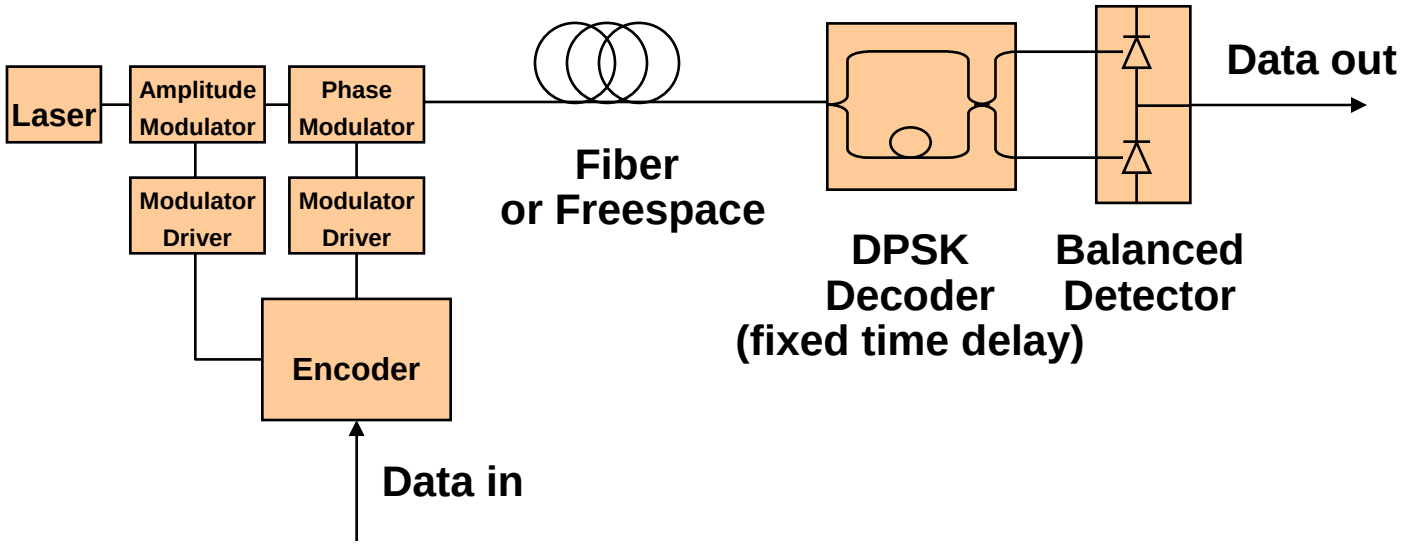
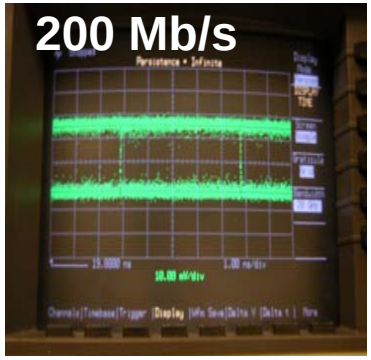
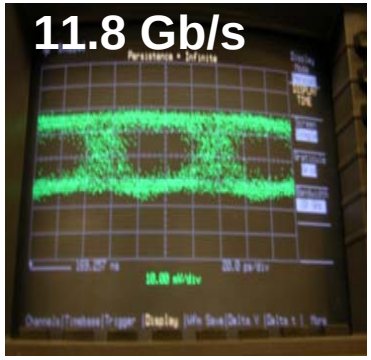
Demonstration







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Impacts

- Expand the practicality and usability of freespace optical communication (FSOC)
- Provide a solid baseline to identify key enabling technologies for future needs
- Contribute to risk reduction and technology maturation efforts for current and envisioned lasercom programs
- Develop an in-house optical testbed for future ventures and directly funded work programs in FSOC

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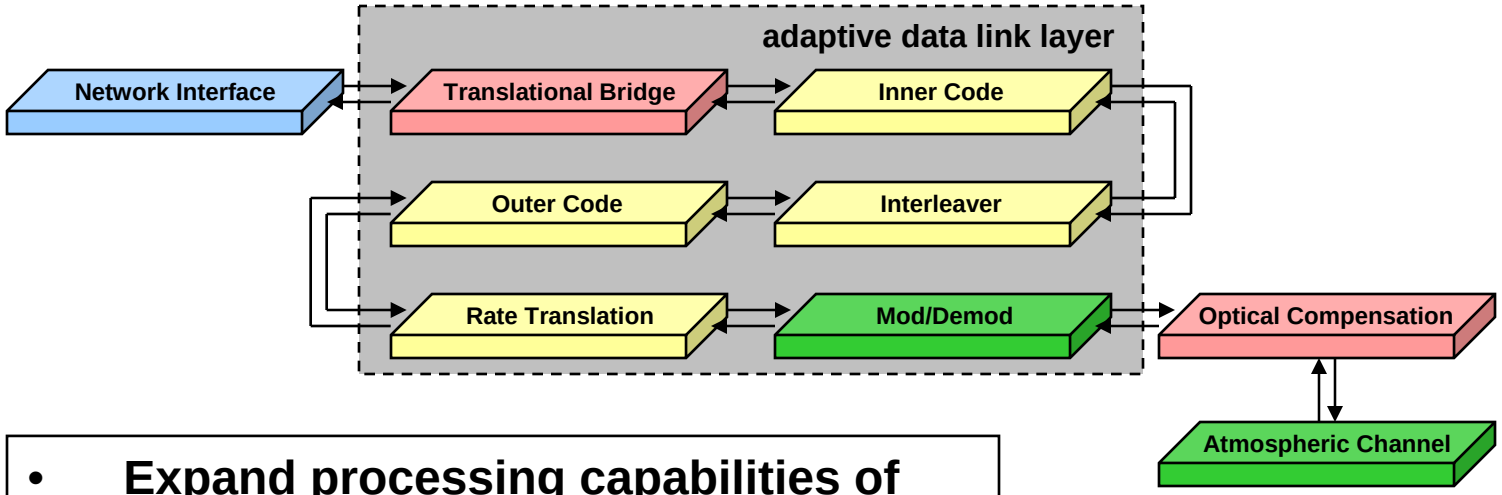
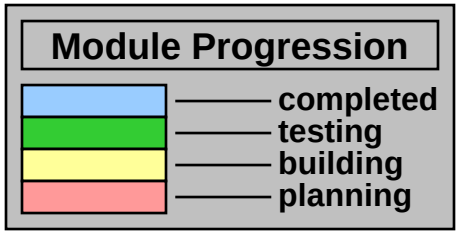
Future Plans



- Expand processing capabilities of wave-optic simulation code
- Improve phase space emulation capabilities
- Implement optical compensation techniques (phase conjugation, grid equalization, etc.)



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