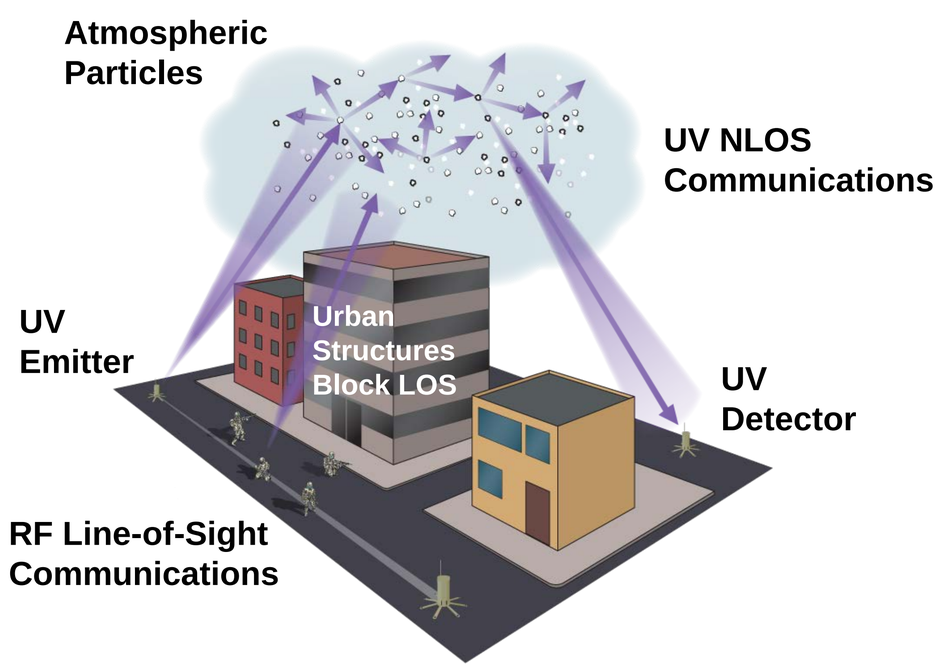
Tactical Optical Communications

S&T Campaign: Information Sciences
Networks and Communications

Robert Drost, (301) 394-0158
robert.j.drost6.civ@mail.mil

Research Objective

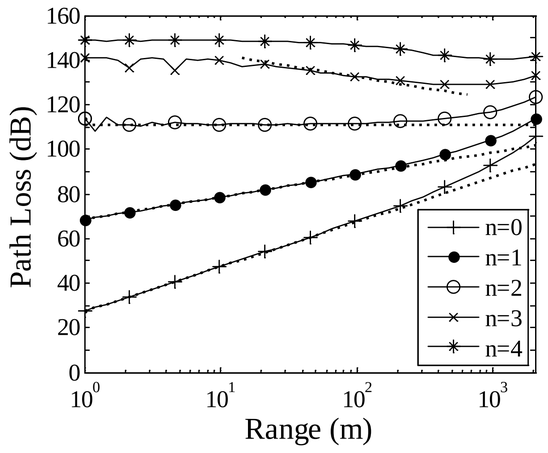
- **Fundamental study of ultraviolet (UV) and visible light communications (VLC) channel modeling and system design with experimental validation**
- **Modeling and analysis of hybrid networking**
- **Prototype development for experimentation and demonstration to promote transition**



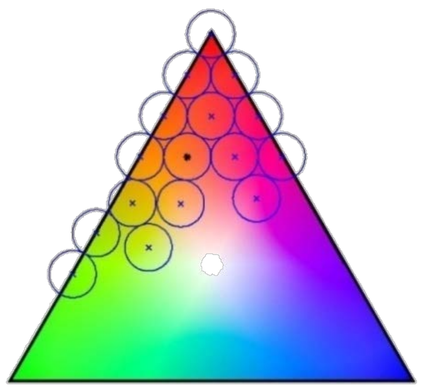
Two-hop hybrid UV/radio-frequency (RF) link employing non-line-of-sight (NLOS) optical communications

Challenges

- **High link loss inherent in long-range UV channel**
- **Complex atmospheric channel in NLOS UV links**
- **Unconventional design constraints** (e.g., UV safety and perceived visible-light emission)
- **Limited experimental data for modeling & design**
- **Lack of commercial off-the-shelf components for UV system development**



(a)



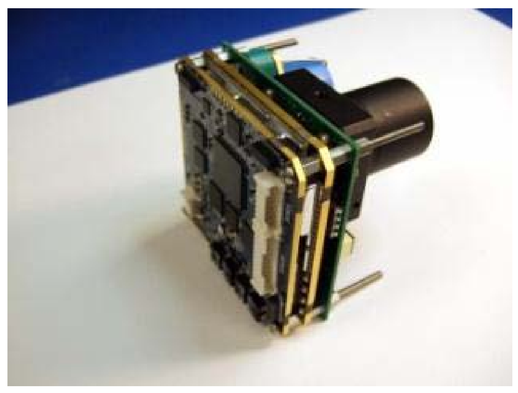
(b)

(a) Analytical UV channel modeling results and (b) VLC modulation with perceived-emission constraint

ARL Facilities and Capabilities Available to Support Collaborative Research

- **NLOS UV channel modeling framework**
  R. J. Drost, et al., "Ultraviolet communications channel modeling incorporating multiple scattering interactions," *JOSA A*, vol. 28, pp. 686–695, April 2011.
- **UV communication system analysis**
  - **End-to-end link modeling**
  - **System design tradeoffs (e.g., rate/range/pointing)**
- **Patent-pending RGB visible light communication modulation design approach**
  R. J. Drost, et al., "Constellation design for channel precompensation in multi-wavelength visible light communications," *IEEE Trans. Commun.*, vol. 62, pp. 1995–2005, June 2014.
- **UV channel-sounding measurement systems developed with academic collaborators**
  - Short-distance systems employing LED transmitters
  - Long-distance system employing pulsed UV laser
- **ARL hybrid UV/RF Common Sensor Radio (CSR)**
  - Leverages mature CSR RF radio system with efficient power management & networking protocols
  - UV MODEM enhancement provides UV communication capabilities
  - Experimental platform for UV/RF hybrid networking
  - Demonstrated three-hop RF/UV/RF link

(a)



(b)

(a) Long-distance laser-based UV channel sounding system and (b) prototype hybrid UV/RF Common Sensor radio

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- **Device development: UV LEDs, APDs, & solar-blind filters**
- **Measurement and communication system development for expanded experimentation**
- **Rigorous experimental design, execution, and analysis**
- **Atmospheric modeling**