

Tactical Optical Communications

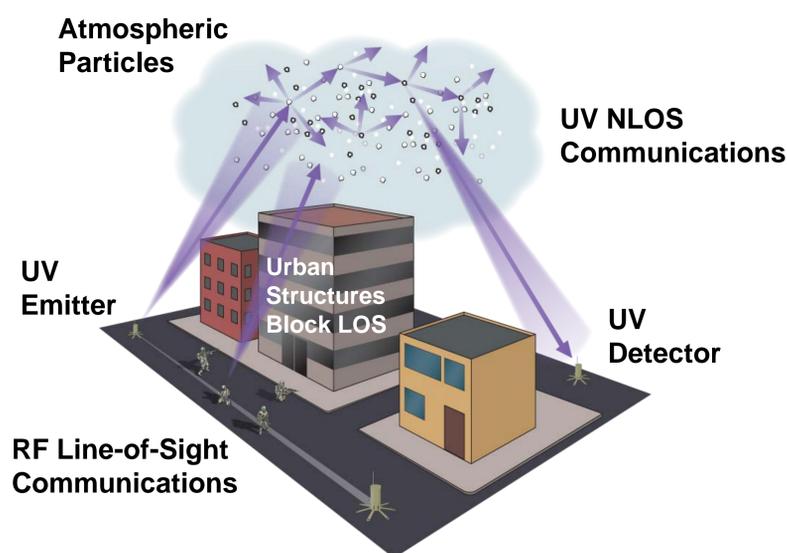


S&T Campaign: Information Sciences
Networks and Communications

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Research Objective

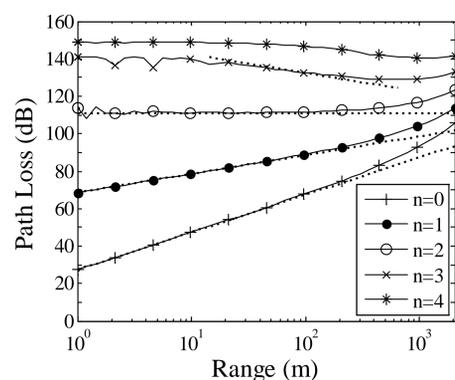
- Fundamental study of ultraviolet (UV) and visible light communications (VLC) channel modeling and system design with experimental validation
- Modeling and analysis of hybrid networking
- Prototype development for experimentation and demonstration to promote transition



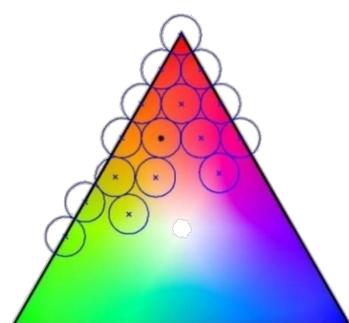
Two-hop hybrid UV/radio-frequency (RF) link employing non-line-of-sight (NLOS) optical communications

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)

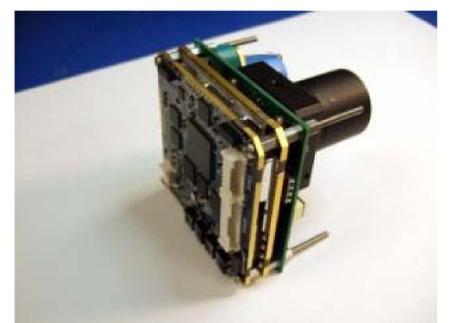
(a) Analytical UV channel modeling results and (b) VLC modulation with perceived-emission constraint

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