

Opportunity Title: Satellite Internet of Things Communications

Opportunity Reference Code: ICPD-2021-56

Organization Office of the Director of National Intelligence (ODNI)

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How to Apply **Create and release your Profile on Zintellect** – Postdoctoral applicants must create an account and complete a profile in the on-line application system. **Please note: your resume/CV may not exceed 2 pages.**

Complete your application – Enter the rest of the information required for the IC Postdoc Program Research Opportunity. The application itself contains detailed instructions for each one of these components: availability, citizenship, transcripts, dissertation abstract, publication and presentation plan, and information about your Research Advisor co-applicant.

Additional information about the IC Postdoctoral Research Fellowship Program is available on the program website located at: <https://orise.orau.gov/icpostdoc/index.html>.

If you have questions, send an email to ICPostdoc@orau.org. Please include the reference code for this opportunity in your email.

Application Deadline 2/26/2021 6:00:00 PM Eastern Time Zone

Description **Research Topic Description, including Problem Statement:**

The Internet of Things (IoT) has now reached outer space, and startup companies—such as Lacuna—are hoping to roll out a service using modified low-power, wide-area networks (LoRaWans) that will allow users to transmit data to a satellite from low-power, remote devices in locations that lack terrestrial infrastructure. Applications, among others, include asset tracking (including vehicles, aircraft and vessels), wildlife conservation, climate change monitoring, situational awareness for disaster relief, and policing and border control.

The concept of worldwide universal IoT connectivity from remote locations normally not serviced by terrestrial networks is a potential game changer for so many applications, however, this scheme will only offer one-way communication from the ground to the spacecraft and the initiative is predicated on a modified stack/silicon—so the IoT devices must be specific to space transmission. This research topic aims to explore the theory, practicality, and limits of operating native IoT communications waveforms for bidirectional IoT communications to and from a low-Earth orbit satellite. This focus on ground-based technologies for satellite IoT will investigate radio waveforms and protocol designs—maximizing exploitation of entropy sources for secure cryptographic communications and constraints from necessary power-saving/harvesting and 'wake-up' designs. Optimization is for power efficiency and endurance and effective exploitation of channels with very low link budgets. Low-gain antennas with limited efficiency can be assumed to be a real-world constraint of any practical system.

Example Approaches:

As an example of possible inclusion in the research, ultra-narrowband as typified by devices from the French global network provider SIGFOX use a very low-power transmitted waveform, which coupled with digital processing gain techniques, are achieving communications over many tens of kilometers in terrestrial applications. The questions the research would be addressing is: Could such a waveform be used in a space application? What are the limits to its use given the constraints of link budgets through the atmosphere and the effects of doppler?

Relevance to the Intelligence Community:



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The Intelligence Community is interested in remote sensing and actuation in a number of security applications requiring remote command and control.

Key Words: Internet of Things, IoT, LoRaWan, Data, Satellite, Terrestrial Infrastructure, Remote Sensing, Radio Wave Forms, Communication

Qualifications **Postdoc Eligibility**

- U.S. citizens only
- Ph.D. in a relevant field must be completed before beginning the appointment and within five years of the application deadline
- Proposal must be associated with an accredited U.S. university, college, or U.S. government laboratory
- Eligible candidates may only receive one award from the IC Postdoctoral Research Fellowship Program

Research Advisor Eligibility

- Must be an employee of an accredited U.S. university, college or U.S. government laboratory
- Are not required to be U.S. citizens

Eligibility Requirements

- **Citizenship:** U.S. Citizen Only
- **Degree:** Doctoral Degree.
- **Discipline(s):**
 - **Chemistry and Materials Sciences** ([12](#))
 - **Communications and Graphics Design** ([2](#))
 - **Computer, Information, and Data Sciences** ([16](#))
 - **Earth and Geosciences** ([21](#))
 - **Engineering** ([27](#))
 - **Environmental and Marine Sciences** ([14](#))
 - **Life Health and Medical Sciences** ([45](#))
 - **Mathematics and Statistics** ([10](#))
 - **Other Non-Science & Engineering** ([2](#))
 - **Physics** ([16](#))
 - **Science & Engineering-related** ([1](#))
 - **Social and Behavioral Sciences** ([27](#))