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TITLE OF PAPER:
The Small Satellite Integrated Communication Environment (I.C.E.)

ABSTRACT:

As the SMALLSAT and NANOSAT communities advance, a new satellite communications paradigm is also needed. Most people do not realize how expensive it is to operate an unmanned vehicle; in this case a satellite. The infrastructure required to effectively maintain, monitor, command, and communicate with a satellite takes significant resources. Historically, this communication link consisted of a dedicated dish antenna on a steerable pedestal, which offers only limited daily access, requires pointing and operation of the equipment, and is dedicated to a single satellite at a time. Although variations of this concept are being considered, to realistically offer inexpensive satellite applications we need to break this paradigm, and put it on **ICE**!

Our solution, known as the Integrated Communication Environment (ICE), is to modify existing cellular towers with the addition of fixed upward-pointing antennas. Distributing these antennas over appropriately spaced cell towers will create overlapping coverage spanning large areas of almost any size. The goal is to integrate satellite communications into the existing cellular networks and break free from the legacy ground station concept, thus offering a new communications paradigm for future satellite programs. The satellites themselves must also be modified. Smartphone technology is currently being considered for the operating system on many new small satellite applications. The benefit of using this technology is further enhanced by the inherent communications capability offered by these phones. Although the technology has greatly evolved over the past decade for terrestrial applications, modifications would be required for celestial applications; such as increased transmit power merged with a high-gain antenna. As for the data, a generic approach is proposed to send data to and from the satellite in logically-small transfer packages (ICE Pacs). Based on average cell tower access statistics (worst-case short duration access), packages would be designed to identify standardized data types: Command and Control uplink; Status of Health downlink; and Data Packages, etc.

The goal of ICE is to not only offer a novel means for communicating with your satellite, but also to stimulate growth of a whole new community that supports this communication concept solution. The inherent nature of this "Plug and Play" SMALLSAT community will contribute to the satellite communication solution through cell tower and satellite antenna design, smart phone apps, data information structure (ICE Pacs), communication management software, etc. Software must be designed to monitor SoH, manage requirements, perform tasking, create satellite commands, operate the ICE Network, and manage the ICE Pacs into logical ICE Trays.

The overall benefit of ICE is to provide large-area unrestricted satellite communications using relatively simple, inexpensive, redundant, and scalable technology. Utilizing existing cellular networks will leverage an established massive data communications network infrastructure to disseminate the information. As the number of small satellites and constellations increases, this approach will offer unlimited access. While the legacy dish pedestal approach can only handle a single satellite within its field of view, ICE will meet the demand to simultaneously handle hundreds of satellites within the view of each cell tower.