

Description of the Research Project

This private research project requires a fully functional licensed CDMA picocell having limited range capability with commercial handsets. The request for experimental license is limited to static lab conditions only and does not include aircraft use, however, a future request for experimental license modification may occur to include experimentation in an aircraft and/or other technologies including GSM and UMTS. This research requires authentic handset-to-RF base cellular connectivity using the CDMA waveform for the purpose of conducting research in a controlled fixed lab environment, more specifically in the following areas;

- 1) To provide realistic network test conditions including network protocols and data payload traffic between the base-station MSC (mobile soft-switch center) the interface to the PSTN (Public Switched Telephone Network) for the purpose of identifying and creating optional candidate network designs that can be supported by aircraft-to-ground communications services.

Authentic data payload and protocol traffic is required to identify potential network interface issues associated with air-to-ground connectivity services. More specifically efforts are required to develop an interface between the CDMA base-station picocell soft-switch (MSC) having a T1-interface, with various satellite or direct air-to-ground communications service options. Other significant issues that must be addressed include network latencies associated with air-to-ground communications connectivity.

- 2) The demonstration system must be capable of supporting live demonstrations for engineering proof-of-concept demonstrations and business development efforts.
- 3) The proof-of-concept system is also intended to enable area RF field strength measurements to be studied and quantified under controlled conditions and by using the embedded automatic power control of the picocell base transceiver subsystem. Information gained from this experimentation will assist with the model and prediction of aircraft cabin cellular RF propagation.
- 4) The system will allow study of the picocell's stepped RF power control feature to determine limitations, adequacy and applicability for possible need for system improvement prior to aircraft cabin application.

Showing that the communications facilities are necessary for the research project involved

The research project will investigate options for an end-to-end cellphone communications system using satellite or other communications options as the backhaul connection to the PSTN and having potential applicability to aircraft. The lab facilities at Rockwell Collins provide the necessary networking and satellite communications equipment to conduct this project research. A licensed wireless CDMA picocell is necessary on the Rockwell Collins premises because other options do not meet our investigation and development requirements.

Showing that existing communications facilities are inadequate.

Existing licensed CDMA communications alternatives in the area belong to private commercial cellular systems, and do not provide options for on-going access for conducting MSC protocol and BTS power control testing. It is also not practical to use existing commercial cellular facilities for other technical and business reasons.

Purposed Program:

The proposed program is designed to gain knowledge in relation to a class of low-power CDMA picocell base station technology, and to identify issues and discover methods that can lead to adaptation to aircraft and other aircraft communications technologies extending the utility of the picocell to include the cabin.

In addition, the proposed program is designed to identify FCC, FAA, and other regulatory issues that must be resolved prior to future product design.

Description of Equipment:

Element of the system requiring application of license:

Picocell Interwave Communications Inc. (<http://www.iwv.com/>)

- RF Picocell – Wave 2000 Pico BS PLUS 1900 MHz, FCC ID: OEW-AGBBP1, CDMA Cellular Base Station, 100 mW (28.1 dBm (EIRP), Dual omni direction antenna (one main transmit and one diversity receive), helical pattern type antenna, with 0dBi gain.
- Softswitch w/ T1 wired Interface, Sunfire V60/65x, provides scaled MSC functions
- Audio Codes LTd. Class B Digital Device for access to ISDN

Other system elements – (connected to picocell via wired T1 Interface)

- Rockwell Collins Inc. L-band Satellite Transceiver (Satcom SRT-900) w/ T1 wired Interface to the Interwave picocell.

Theory of Operation:

A complete theory of operation of the commercial picocell system may be found with the vendor (Interwave Communications Inc. Wave 2000 Pico BS PLUS 1900 MHz). A general theory of operation is presented here. System operation may begin with the CDMA base station where a link is established via a control channel between the base and a wireless handset (on one of the selected 1900 MHz channels). The handset listens for a SID (system identification code) from the BTS (base transceiver subsystem). Authorized handset power settings are then communicated and a data channel is established (this is done automatically as part of the CDMA Interwave commercial system product – no attempts will be made to modify this base unit or handset a part of the experimentation. The base station communicates with the Softswitch (MSC) where the information will be

routed to an ISDN interface. The ISDN interface in turn provides voice data and protocol to an available PSTN service. Examples of the PSTN interface may include a Rockwell Collins Satcom (satellite communications) radio product or other direct air-to-ground services which may ultimately be used to tie the picocell to the PSTN service.

Example Flow: (starting from Handset to PBX)

Cellphone Handset $\leftrightarrow$ 1900 MHz CDMA Picocell (Interwave) $\leftrightarrow$
 Switch MSC $\leftrightarrow$ CEPT-E1 Interface $\leftrightarrow$ RSC Satcom Radio $\leftrightarrow$ RF
 Link $\leftrightarrow$ Satellite or Direct Air-to-Ground system $\leftrightarrow$ RF Link $\leftrightarrow$
 Ground Service Providers $\leftrightarrow$ Telephony PBX System

Objectives sought to be accomplished:

- Verification of Interwave's picocell system capabilities including RF power control stepping to determine potential suitability and technical and regulatory (FAA, FCC) recommendations and actions prior to application on aircraft.
- Verifying base-station's T1/E1 interoperability with Rockwell Collins radio system options and interfaces.
- Verifying protocol compatibility with air-to-ground link and communications service provider PBX protocols.

Experiment's contribution to the development, extension, expansion of radio art:

Experimentation shall contribute to knowledge for developing possible avenues for safely enabling cell phones on aircraft compliant with all FAA safety and FCC spectrum regulations. Few if any industry players have solved all the technical and regulatory issues. Experimentation will help identify remaining areas requiring work.