COMMENTS OF SKYCROSS, INC.

Alan L. Haase	Chief Executive Officer
Kerry L. Greer	Vice President of Engineering
Frank M. Caimi, Ph.D., P.E.	Senior Scientist

SkyCross, Inc.
300A North Drive
Melbourne, FL 32934
321-308-6600

Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems	)	ET Docket No. 00-258
Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use By the Mobile-Satellite Service	)	ET Docket No. 95-18
The Establishment of Policies and Service Rules for the Mobile-Satellite Service in the 2 GHz Band	)	IB Docket No. 99-81
Petition for Rule Making of the Wireless Information Networks Forum Concerning the Unlicensed Personal Communications Service	)	RM-9498
Petition for Rule Making of UTStarcom, Inc., Concerning the Unlicensed Personal Communications Service	)	RM-10024

MEMORANDUM OPINION AND ORDER AND
FURTHER NOTICE OF PROPOSED RULEMAKING

Comments of SkyCross, Inc.

I. Introduction

SkyCross, Inc. ("SkyCross"), a leading developer of advanced wireless antenna solutions for fixed and mobile devices, appreciates this opportunity to comment on the Commission's *Memorandum Opinion and Order and Further Notice of Proposed Rulemaking* ("MO&O and FNPRM") to allocate spectrum below 3 GHz for mobile and fixed services.

SkyCross fully supports the allocation of frequency for third generation services in these higher frequency bands as compared to the UHF band, which has also been considered for these services. SkyCross is further pleased that the Commission is considering options at or near the frequencies specified by the ITU as part of IMT-2000.

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II. Frequency Band Allocation Implications to Antenna Design

Radio transceiver design in general, and antenna design in particular, are inexorably linked to the specific frequency band of use. The following is a list of factors that SkyCross recommends the Commission consider when allocating frequency bands for advanced wireless or 3G systems.

A. Antenna Size – The wavelength of an electromagnetic signal is inversely proportional to its frequency. Antennas are designed accordingly, with traditional designs being ¼- or ½-wavelength (lamda λ). For reference, a ¼-wave monopole "stubby" antenna commonly designed for use at the PCS frequency of 1900 MHz in free space is approximately 1.5 inches long. Likewise, a similar ¼-wave monopole designed for use at 700 MHz in free space would be approximately 4.2 inches long. SkyCross believes that as the world transitions to third generation devices, consumers will continue to demand physically smaller and lighter devices. Therefore, SkyCross encourages the Commission to allocate third generation services at the higher frequencies similar to those in the FNPRM, rather than the previously considered lower frequencies such as the 746-806 MHz band.

B. Separation of Paired Services – Existing PCS allocations for mobile services specify 1850 – 1910 MHz for uplink and 1930 – 1990 MHz for downlink. This bandwidth represents 120 MHz of spectrum for use by licensed PCS carriers. Antenna manufacturers must design for the entire range of frequencies in order to facilitate duplex transceiver operation within a single antenna. Therefore in the case of PCS, antennas are designed for the entire 140 MHz of bandwidth (1850 MHz—1990 MHz), ignoring the 20 MHz gap between bands. This represents about 7% bandwidth, which is easily achievable for a single antenna (7% = 140 MHz BW / 1920 MHz Center). SkyCross would the like Commission to consider when allocating future bands that the spacing between uplink and downlink bands has a significant impact on the antenna performance. For example, if the Commission were to allocate paired services at 2150 – 2160 MHz uplink and 2390 – 2400 MHz downlink, this would represent a total frequency separation of 250 MHz, even though only 20 MHz of bandwidth would actually be used in this case. In this example 250 MHz of bandwidth would be approximately 11% total bandwidth. This would be approaching the operating limit for a conventional single-band antenna of standard quarter or half wavelength size. In the general case, the bandwidth is limited by the Chu-Harrington relation for a given size (volume) antenna. The Chu-Harrington relation states that the ultimate limitation for a highly efficient antenna's volume is determined by the operating wavelength and fractional bandwidth. This limitation is evidenced in Fig. 1 where the inverse fractional bandwidth is plotted against the volume of the antenna normalized to wavelength. As shown, some antennas are smaller than others for a given fractional bandwidth but are ultimately limited in size by the curve at the bottom of the figure. As can be observed, larger fractional bandwidths require a larger antenna volume to achieve the same level of performance. Therefore larger fractional bandwidths may be impractical for designs that must maintain a small size relative to the wavelength. Although there is a limit to how small a device may be designed in order to allow the user to interact with buttons and keyboards, current cellular phone designs are being made smaller, creating significant demands on the antenna design and location. The use of polarization and space diversity methods to improve communications performance is an additional factor limiting the antenna design and creating engineering design conflicts for valuable design space within the mobile device, as more device "real estate" is required to accommodate the separate antennas. We therefore favor the adoption of standards that generally use higher frequencies and smaller fractional bandwidths.

C. Proportional Bandwidth – Another factor that comes into consideration is the amount of bandwidth needed for given services relative to the band of operation. This issue is related to frequency separation above, although it is relative to the center frequency of allocation. As detailed above, antennas designed for use in PCS devices require about 7% bandwidth centered at 1920 MHz. Hypothetically, if the same 120 MHz of spectrum were to be allocated in the 700 MHz band, this would result in approximately 16% bandwidth relative to the center of that band (750 MHz). This would be too great of a percentage bandwidth for convention antenna technology to cover in a single antenna, resulting in poor reception and wasted transmitter power by the mobile unit. SkyCross recommends the Commission to first determine how much operational bandwidth will be required to support 3G services, and then consider potential frequency band allocations based on proportional bandwidth.

III. New Alternatives

Many of the issues presented above already impact the transceiver and antenna designs today for existing bands. Furthermore, these challenges are compounded when multiple frequency (multiple mode) transceivers are considered. For example, current handheld models offer dual-mode capability (AMPS at 850 MHz and PCS at 1900 MHz). The antennas for these phones have typically been designed to resonate in both frequency bands, although they perform better in upper PCS band. External models are typically ¼-wave and ½-wave monopoles. Internal antennas are not much more than looped copper traces. But as the Commission begins to allocate 3G frequencies, another frequency band will have to be supported by OEM handsets. This will require a tri-band antenna design in order to maintain backward compatibility to 1G and 2G systems. Traditional antenna designs will not easily extend to a third frequency (within a single antenna).

In anticipation of this challenge, a few companies are actively testing alternative handset antenna designs based on new technologies, such as MLA technology. Initial tests show that SkyCross' MLA-based embedded antennas provide up to 2.3 dB better performance then existing OEM embedded PCS antennas, resulting in fewer dropouts in marginal cell coverage holes.

Furthermore, SkyCross is developing wideband versions of its MLA technology, which are designed to work in a handset from 800 MHz up to 2500 MHz. This will enable the development of future multiple-mode handheld devices, with various combinations of 1G, 2G, 3G, GPS, and IEEE 802.11b/Bluetooth in a single handheld device using a single antenna. In spite of these technological advancements, the ultimate limitation in required space for a highly efficient antenna is dictated by the fraction bandwidth required by the service as well as the center frequency.

II. SkyCross Profile

SkyCross' antenna solutions are based on patented Meanderline Antenna (MLA) technology that allows engineers to design high performance, multi-frequency antennas that can be hidden inside a mobile casing, have a very low radiation profile, and offer much better gain characteristics over existing solutions. The small, powerful antennas are designed for original equipment manufacturers serving the cellular/PCS, wireless data and telematics markets.

MLA technology was originally developed by BAE SYSTEMS, Information and Electronic Warfare Systems (IEWS), formerly Sanders (a Lockheed Martin Company), for military applications where unobtrusive, high performance antennas are required for both satellite and terrestrial communications. SkyCross has exclusive commercial licensing rights to all non-restricted antenna technology from BAE SYSTEMS' IEWS as of the date of the license agreement, as well as future improvements to this technology.

SkyCross is a member CTIA and members of its engineering team participate in the IEEE 802.11 wireless standards committee. In addition, several employees have written a number of articles and publications on antenna theory and design.

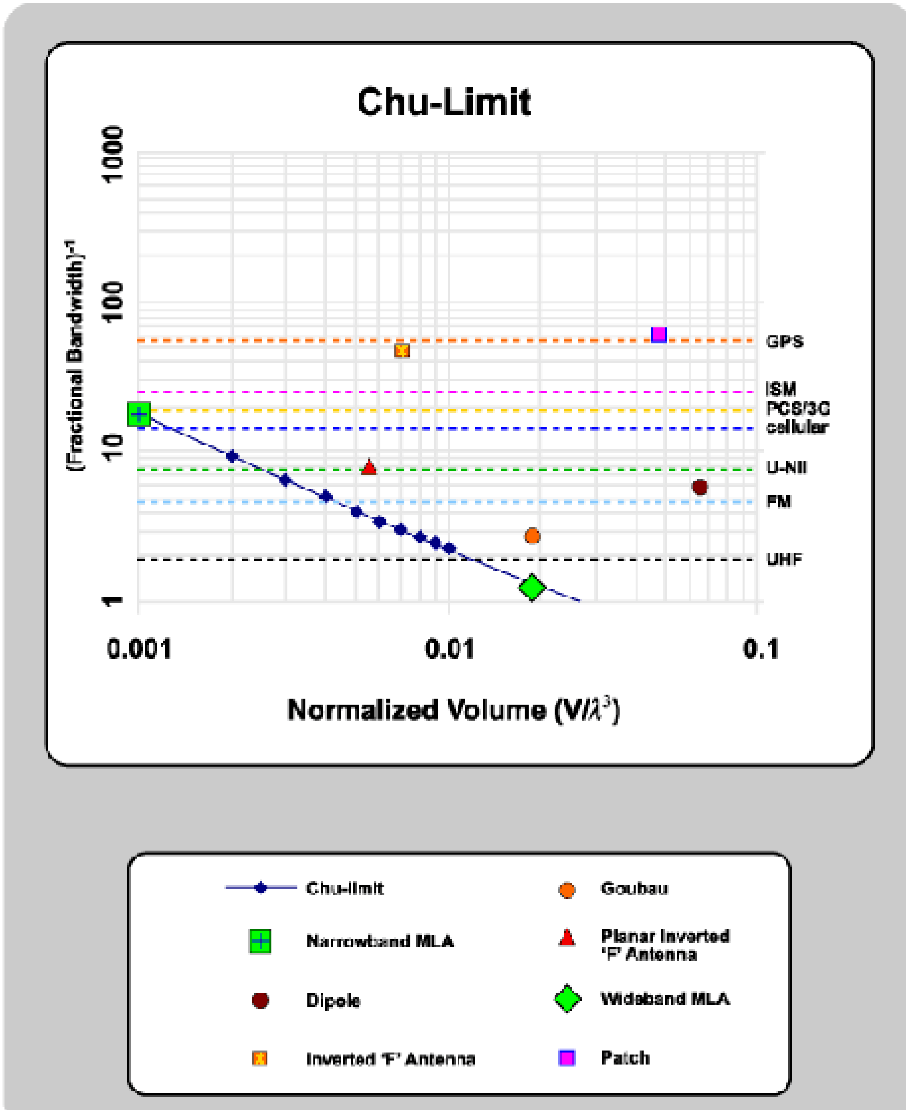

Figure 1. Fractional Bandwidth vs. Normalized Volume