Program Description and Objectives

By this application, ICO USA Service Group[1] ("IUSG") requests Commission authorization of an experimental program designed to verify the function of handset and portable transceiver prototypes intended for use with the proposed 2 GHz Mobile Satellite Service ("MSS") of ICO Services Limited[2] ("ICO"). The experimental program is also designed to test the interoperability of these user terminals with feeder link gateway stations — in particular, ICO's North American gateway station.[3]

In general terms, the experimental program, as designed, will verify the function of the ICO satellite payload, user terminal transceiver and feeder link gateway. The program will also validate the link margins that have been designed into the system to cope with varying propagation conditions. The specific objectives of the experimental program include the following:

- validation of the Time Division Multiple Access ("TDMA") access method in the user link as the basic communication system approach for the ICO system;
- validation of the predicted performance of the ICO S-band transmit and receive satellite 163-beam Direct Radiating Array antennas;
- validation of the predicted performance of the communication payload forward transponder, from the feeder link gateway-to-satellite C-band receiver-to-user terminal, and return transponder, from the user terminal-to-satellite S-band receiver-to-gateway;

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1 IUSG is a consortium of telecommunications oriented companies comprised of investors in ICO that are investigating the provision of MSS in the United States by means of the ICO satellite constellation. See Exhibit 3 infra.

2 On September 26, 1997, ICO filed with the Commission a Letter of Intent indicating its intention to provide MSS in the U.S. market through one or more service partners and seeking access to spectrum in the 2 GHz frequency band. ICO is a company established under the laws of England and Wales, and ICO space segment is subject to authorization by the United Kingdom.

3 COMSAT Corporation has applied for the license to operate the transmit/receive gateway station in Brewster, Washington, to be used in conjunction with the ICO MSS system. See FCC Public Notice, Report No. DS-1840 (released May 13, 1998).

- demonstration of the ICO system's ability to assign different transmit power levels to: (1) different satellite beams, in accordance with geographic variations in user density; and (2) different users in the same beam, in accordance with the user's propagation condition and location;

- verification of the essential operating characteristics of the C-band feeder forward link (from gateway-to-satellite) and feeder return link (from the satellite-to-gateway) backhaul communication system;

- demonstration of the user terminal transceiver with respect to call setup and takedown, power control, as well as its performance during voice transmission;

- validation of the predicted performance of voice quality of the ICO vocoder in the presence of realistic propagation conditions, and verification of the ICO vocoder voice quality versus bit error rate;

- validation of the predicted estimate of the link margin requirement for realistic propagation conditions;

- demonstration of the operation of the gateway with respect to: (1) interaction with the user terminals in support of call setup, takedown, beam-to-beam hand over (i.e., assignment of time slots, frequency subbands), power control; and (2) its ability to interface with the public switched telephone network;

- demonstration of the ICO system's ability to hand over calls from one satellite beam to another and satellite-to-satellite handover; and

- validation of the predicted estimate of the capacity of a given satellite beam via representative loading of the other satellite beams operating on the same frequency subband.

The experiment proposed by IUSG will provide valuable information on several key components of the ICO system prior to commencement of service, which is scheduled to begin in the year 2000. Equally important, the information obtained from the experiment will promote timely development of the ICO system and help ensure delivery of its widely anticipated service to the public as scheduled.

ICO has consented to this experimental program and will assist and cooperate with IUSG in its implementation.

Technical Parameters of the ICO System

The following tables provide the technical parameters of the ICO system.

Table 1 — Orbital characteristics of the ICO system

Number of satellites	10-12 (12 satellites including 2 spares)
Number of planes	2
Number of satellites per plane	5-6
Orbital altitude	10390 ± 40 km
Orbital inclination	45° ± 0.5°
Ascending node separation between planes	180° ± 0.5°
Phase between in-plane satellites	72°/60° ± 0.5°
Phase offset between planes	0° ± 0.5°
Right ascension of ascending node	Change per day; nominally 0.24° precession/day
Apogee/perigee	Circular orbit

Table 2 — Mobile link and feeder link frequencies

Parameters	Mobile Link Frequencies	Feeder Link Frequencies
Earth-to-space direction	1985-2015 MHz[4]	5150-5250 MHz
Space-to-Earth direction	2170-2200 MHz	6975-7075 MHz
Polarization	RHCP	RHCP and LHCP

[4] In the United States, which is the area of operation for the experimental program proposed herein, ICO will only use the 1990-2015 MHz frequency band for the user return link (Earth-to-space direction).

Table 3 — ICO satellite: S-band antenna beam parameters

Number of beams	163 beams
Beam size	3.343°
3 dB beamwidth	3.860°
Beam re-use	4
Re-use center to center spacing	6.686°
Re-use sidelobe spacing	5.015°

Table 4 — ICO satellite: nominal S-band maximum EIRP allocations for each ring of spot beams

Parameters	Unit	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5
SSPA combined output power	dBW	28.5	28.5	28.5	28.5	28.5
Output losses	dB	0.7	0.7	0.7	0.7	0.7
Antenna average gain	dBi	30.6	29.6	28.9	28.7	28.2
EIRP	dBW	58.5	57.4	56.7	56.6	56.1
Power robbing at worst case gain setting	dB	0.4	0.5	0.6	0.7	0.7
Useful EIRP	dBW	58.1	56.9	56.1	55.9	55.4

Table 5 — ICO satellite: nominal S-band G/T allocation for each ring of spot beams

Parameters	Unit	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5
Average antenna gain	dBi	30.4	29.4	28.7	28.5	28.1
System noise temperature	dBK	25.5	25.0	24.3	23.9	23.8
G/T without losses	dB/K	4.9	4.4	4.4	4.6	4.3
Losses at low processor gain	dB	2.3	2.4	2.6	2.8	2.8
G/T at low processor gain	dB/K	2.6	2.0	1.8	1.9	1.5

Table 6 — Key characteristics of an ICO satellite

S-band coverage (mobile link): Beam type Number of beams Minimum elevation angle	 Spot beam 163 beams 0°
C-band coverage (feeder link): Beam type Number of beams Minimum elevation angle	 Global beam 1 beam 5°
Nominal orbital life	12 years
Dry mass	≤ 2350 kg
Mass at launch separation	≤ 2750 kg
Station keeping frequency	> 90 days

Table 7 — C-band gateway Earth station parameters

Parameters	Transmit (Uplink)	Receive (Downlink)
Frequency	5150-5250 MHz	6975-7075 MHz
Polarization	RHCP and LHCP	RHCP and LHCP
Number of antennas	5	
Tracking range	360° in azimuth 5° to 90° in elevation angle	
Antenna diameter	7.6 m	
EIRP power density	N/A	-46.6 dBW/Hz
Receive G/T	≥ 31.0 dB/K	N/A

Table 8 — Signal format and channel performance for voice and data services

Signal format	Voice	Data
Net bit rate	3.6 kbps (nominal)	2.4 kbps
Coding	Rate 3.4; Viterbi L=7	Rate ½; Viterbi L=7
Coded bit rate	4.8 kbps	4.8 kbps
Framing/in-band signaling	1.2 kbps	1.2 kbps
TDMA rate (6 slots)	36 kbps	36 kbps
Eb/No	1.9 dB (for 4% BER)	4.5 dB (for 10-5 BER)
Implementation margin	0.5 dB	0.5 dB
Required C/No	48.0 dBHz	50.6 dBHz

Table 9 — Parameters for a typical ICO hand-held user terminal

Physical parameters: Volume Weight	 < 300 cc < 300 g
RF parameters: EIRP Average Peak/burst G/T Polarization	 < -4 dBW < 6.8 dBW -23.8 dB/K RHCP
Operational parameters: Talk time Idle time	 > 1 hour > 24 hours

Table 10 — Technical characteristics of the various user terminals and services to be used in the experiment

Terminal	Antenna gain (dBi)	G/T (dB/K)	EIRP peak (dBW)	Service	Bit rate (kbps)	BER
Hand-held	2.0	-23.8	< 6.8	Voice Data	4.8 2.4 - 9.6	4% 10-5
Ruggedized (transportable)	3.5	-21.5	< 6.8	Voice Data	4.8 2.4-9.6	4% 10-5
Private vehicle	3.5	-21.5	< 12.0	Voice Data	4.8 8.0-38.4	4% 10-5
Commercial vehicle	6.5	-18.0	< 12.0	Voice Data	4.8 8.0-38.4	4% 10-5
Semi-fixed	10.5	-14.0	< 12.0	Voice Data	4.8 8.0-38.4	4% 10-5

ICO USA Service Group
FCC Form 442
Exhibit 2

ICO USA Service Group ("IUSG") requests waiver of Section 5.152 of the Commission's rules, which requires that each class of station in the experimental services shall transmit its assigned call sign at the end of each complete transmission, or at least once every thirty minutes for experimental service transmissions that are continuous, frequent or extended. This requirement is inapplicable to the experimental service proposed herein by IUSG because the prototype handsets and portables to be used in the experiment — like cellular telephones — will not have unique call signs.

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Exhibit 3

The constituent members of the ICO USA Service Group are:

- British Telecommunications, PLC;
- Hughes Telecommunications and Space Company;
- Telecomunicaciones de Mexico; and
- TRW Inc.