Constellation Communications, Inc.

LOW EARTH ORBIT SATELLITE SYSTEM

For Voice, Data and Facsimile

Presented to EMBRATEL

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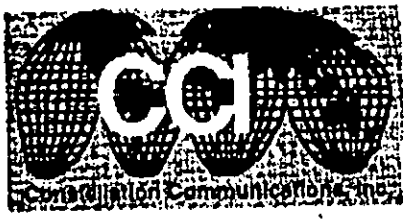

Executive Summary

Constellation Communications, Inc. ("CCI") plans to establish a low-Earth orbit ("LEO") satellite system specifically designed to meet the mobile communications requirements of Brazil and other Equatorial countries. The principal elements of this planned system are summarized below.

Principle Characteristics:

CCI's planned LEO system will provide low-cost mobile communications services (including cellular-quality voice, data and fax) to areas of the world where terrestrial communications alternatives are inadequate or do not exist. The CCI system will have seamless interconnection with the public switched terrestrial network ("PSTN"), permitting CCI system users to tie-in with the local, and regional national telecommunications network, as well as anywhere else in the world.

The initial CCI system, to be operational by the end of 1996, will be a single ring of 11 satellites in orbit around the Earth's equator at an altitude of 2000 km. The system will provide continuous, mobile communications service within a core equatorial band of countries located between 23 degrees North and South Latitude. This includes all areas in Latin America from Mexico City to Rio de Janeiro; all areas in the Asia-Pacific region from Calcutta, India down to the middle of Australia; and all areas in the Africa-Middle East region from the middle of Saudi Arabia to the top of South Africa. In essence, the core service area for this single ring of satellites includes:

- more than 100 countries in Latin America, the Asia-Pacific and Africa;
- more than 35 percent of the world's total land mass; and
- more than 40 percent of the world's total population.

With varying degrees of user cooperation, such as operating from locations with clear line-of-sight to the satellites and using high gain antennas, the service area can be extended as far as 32 degrees North and South latitude. This area includes locations as far as Dallas, Texas to the North and all of Brazil to the South. The total cost to implement the equatorial system is less than US $250 million, with an additional US $40 million required to cover operational expenses until the system's revenues provide total self-sufficiency in the second full year of operation.

CCI's target market is the wide range of prospective users who need basic communications capability for infrastructure and economic development, including government agencies (such as military, environmental, emergency medical and civil engineering), industries operating in remote areas (such as mining, oil and gas, lumber and transportation), small businesses (such as farming and fishing) and communities and individuals located in sparsely populated and remote regions. For these users, CCI's system will provide a "telecommunications bridge" between them and the existing terrestrial telecommunications infrastructure, tying-in previously unreachable areas with the rest of the nation and the rest of the world. CCI's services will be low-priced for those with

limited budgets, as opposed to those such as the international business traveler for whom price is not a constraint.

CCI's equatorial system makes inherent sense for Brazil and for other equatorial countries. In particular, the system's orbit at 0 degrees latitude is the only orbit that enables a single ring of LEO satellites to provide continuous service to the world's equatorial regions. Since all 11 satellites can be launched at the same time using a single launch vehicle, the system can become completely operational several months after deployment. In contrast, a LEO system which is intended to cover higher latitudes in addition to the equatorial regions would require between 40 and 66 satellites, and would have to be deployed in multiple planes by multiple launch vehicles. It would take between one and two years for such a system to become operational after commencing deployment. CCI's approach is the least cost, least risk approach to bringing mobile communications service to the equatorial regions as quickly as possible.

With the operational experience, satellite production facilities, and subscriber base in place to support the equatorial system, CCI will be well-positioned to expand its system to provide global coverage. The global system would consist of five rings of eight satellites each in circular orbits of at least 40 degrees inclination, and would extend CCI system coverage to areas between at least 60 degrees North and South latitude. The global system would use the same types of satellites and orbital altitude as the equatorial system, and could be operational as early as 1998.

CCI Corporate Background

CCI was established in 1991, and is incorporated in the State of Delaware, with principal offices located in Fairfax, Virginia. It is one of five companies eligible to receive a license from the Federal Communications Commission to provide mobile services via a LEO satellite system in the United States ("US"). CCI expects to be awarded its US license by June 1994, and is pursuing operating agreements for provision of services in target markets worldwide. In addition, CCI has been awarded a license to establish an experimental satellite system, that it plans to deploy by the end of 1994 for use as an engineering testbed and marketing tool during the construction of CCI's commercial system.

CCI is currently owned and controlled by its founding US companies -- Bell Atlantic Corporation, E-Systems, CTA, Inc. and Pacific Communications Sciences, Inc. As CCI secures Strategic Partners from outside the US, the company's ownership and control will be redistributed primarily in equal amounts among its telecommunications Strategic Partners, who will be responsible, among other things, for financing the system implementation. The US telecommunications Strategic Partner is Bell Atlantic Corporation.

Bell Atlantic Corporation is a US Regional Bell Operating Company ("RBOC") with assets of approximately $30 billion, and operating revenues for 1992 of more than $12 billion. It provides telephone network services in seven states, owns and operates cellular telephone systems throughout the US (more than 700,000 subscribers), and is involved in telecommunications ventures in more than 20 countries worldwide.

E-Systems, Inc. is a major worldwide developer of high-tech electronic systems and products. Its 1992 sales were in excess of $2 billion, and it has been on the Fortune 500 list since 1982. The company has systems integration and engineering expertise in all aspects of ground and space communications systems, including radio transceivers and modems, power amplifiers and filters, antenna systems, spread spectrum and other relevant technologies.

CTA is a major systems engineering house, specializing in flight simulators, computer software and space-based electronics, Its subsidiary, Defense Systems, Inc. ("DSI") is one of the world's premier developers of small satellites. It has designed, manufactured and operated more than 20

low-Earth orbiting micro-satellites in the past 4 years, with a 100% success record. Among these, it constructed and launched a constellation of seven LEO satellites for digital voice communications services -- the first such constellation flown. Another CTA subsidiary, International MicroSpace, Inc., is developing a new launch vehicle, whose first launch under contract with the US Government is scheduled for third quarter of 1994.

Pacific Communications Sciences, Inc. ("PCSI"), a wholly-owned subsidiary of Cirrus Logic Inc., has technical expertise in four core technologies (voice compression, modulation and coding, systems/software, and radio & MMIC). The company's activities embrace two broad business areas: narrowband private networks, and wireless computing and communications. PCSI has played major roles in developing the INMARSAT Standard "M" user terminal, the Aussat III system architecture, subsystems for commercial air-to-ground telecommunications (InFlight Phone Corporation), VLSI chipsets for TDMA-based digital cellular phone systems, as well as PCN, cordless phones and digital cellular networks.

CCI is in the process of securing four major telecommunications companies with strong presence in South America, Asia Pacific, Africa and Europe, to join Bell Atlantic Corporation -- CCI's North American telecommunications partner -- as CCI Strategic Partners to own and operate the CCI space segment. Collectively, these Strategic Partners will have substantial ownership and control of CCI, as well as be responsible for coordinating the provision of CCI services. CCI space segment capacity will be sold on a wholesale basis to authorized terrestrial service providers, who will be responsible for providing service to retail subscribers on a national basis.

System Description

The CCI system consists of a space segment, a ground segment, and a user segment. CCI in coordination with its Strategic Partners will establish the specifications for each of these system segments to insure that reliable and high quality services are provided to the users of the CCI system. CCI will also be responsible for implementing the system. Operational responsibilities will be distributed by CCI, as appropriate, among itself, its Strategic Partners, and its service affiliates in individual countries.

CCI is designing its system to use code division multiple access ("CDMA") techniques for both its inbound (subscriber-to-gateway) and outbound (gateway-to-subscriber) transmissions. CDMA provides national service providers operational flexibility to determine how many gateway earth stations to construct and operate and where to locate them. In this way, the national service providers can optimize their ground segment to make most efficient use of existing ground network facilities for connection to the public switched telephone network ("PSTN"). With CDMA, each country's gateways can be operated independently of those operated by other countries, and services, features and billing arrangements can be tailored to the particular needs of each country. In addition, the CCI CDMA design will utilize power control techniques on both the inbound and outbound transmission paths to provide compensation for range variations and path obstructions and to insure efficient use of available satellite power and capacity. By using CDMA techniques, the CCI system is also able to share the frequency spectrum with terrestrial and other satellite radio facilities.

Space Segment

The first generation of CCI satellites will have 7 or more antenna beams that cover the 5,150 km diameter area served by the satellite. The beams will be connected to simple frequency changing transponders to reduce the size, complexity and cost of the satellite and increase system reliability and flexibility. The initial capacity of the satellites will be at least 750 voice circuits for non-directional user terminal antennas. System capacity will be increased in later generations by adding

more satellites to the system (which also increases reliability and elevation angle), by adding satellites with higher power, by increasing the number of spot beams, or by some combination of these.

The satellites will transmit to users in the 2483.5-2500 MHz band and receive from users in the 1610-1626.5 MHz band. These bands were allocated for use by LEO systems by the 1992 World Administrative Radio Conference. Spread spectrum transmission techniques will be used to assure compatibility with other satellite systems and ground-based radio systems in these bands.

The CCI system will have a primary and backup Satellite Control Center ("SCC"), each of which consists of telemetry, tracking and command ("TT&C") earth station facilities and the ground-based computers needed to determine satellite ephemeris, to monitor spacecraft status and performance, and to control the operation of the spacecraft in orbit, including the accurate positioning the satellites within their assigned orbits with respect to the other satellites in the CCI system. The SCC also interfaces with the launch site during launch operations to insure a smooth transfer of control from the launch service provider to CCI.

- **Ground Segment**

The CCI ground segment consists of gateway earth stations operated by the national carrier(s) using the CCI system to provide service within a particular country and regional Network Control centers ("NCC"s) operated by CCI or its Strategic Partners.

The CCI CDM system design allows multiple gateway earth stations to access each satellite. One or more gateways can be located in each country to optimize satellite system coverage and interconnection with the PSTN and other terrestrial networks. Each country can operate its own ground segment independent of the requirements of the other countries served by the CCI system.

A gateway earth station requires three steerable antennas, approximately 6 meters or less in diameter. One antenna is operational at any given moment, a second is needed to acquire the next satellite to which calls will be handed when the currently active satellite reaches the horizon. A third antenna is provided as a back-up.

Each gateway earth station interfaces with the PSTN. Outbound voice, data and facsimile signals are converted at the gateway to the digital signal format used in the CCI system, and the inverse conversion is provided for inbound signals from subscriber units. The gateways also provide call set-up and break-down through the PSTN switch, maintain billing information, and commission new subscriber terminals for access to the CCI system.

The NCCs are interconnected with the gateway earth stations and the CCI SCC facilities to maintain constant monitoring of the communications payloads of each satellite and to insure efficient routing of traffic over the CCI system and assignment of system resources among gateway earth stations. The NCCs also coordinate communications between gateways and SCC and support system-wide administrative operations, such as roaming support, exchange of billing information, and collection of network statistics and traffic analyses.

- **User Segment**

The user segment consists of the mobile subscriber terminals, as well as customer premise facilities for specialized applications. The basic service offered over the CCI system is full duplex, cellular-quality telephony, including voice bandwidth data and facsimile. This service will extend all of the basic features of the PSTN to the rural and remote areas served by the CCI system.

In the first generation of CCI satellites, the CCI system will support a variety of subscriber unit configurations, including vehicle-mounted mobile terminals, portable terminals, and fixed terminals in remote areas. CCI does not believe that it is necessary for its first generation system to provide direct satellite links to pocket-sized subscriber units. Instead, a pocket-sized cordless telephone can be used to link a person with a nearby satellite unit installed in the user's vehicle. For users who must travel on foot for a greater distance from a vehicle, the initial CCI satellites will support direct access to portable, shoulder-carried subscriber units that directly access the CCI satellites. This approach to the design of its first generation satellites allows CCI to keep its costs and risks low while still providing a full range of mobile communications service. Direct access to satellites by pocket-sized subscriber units will be provided by CCI's second generation satellites.

In some areas of the world, the CCI system will be used to provide basic telephone service to remote rural areas that are impractical to serve by wireline. Such terminals would be located at fixed sites, and because of their low power consumption, such rural pay telephones can be solar powered.

Although there will be a variety of installed configurations of CCI subscriber units, the radio portion and much of the baseband and signal processing circuitry will be common to all terminals. The antenna used for basic mobile services will be non-directional and will be configured with a patch or other simple antenna design, and the transmitter power level is comparable to that of a cellular telephone. Dynamic power control is provided on both inbound and outbound links to compensate for range variations and path obstructions. The user terminal will also determine its location, either by means of an external radiodetermination system such as GPS or Omega, or by means of Doppler ranging on the CCI outbound signal. In addition, user terminals can be dual-mode, capable of operating either with the CCI LEO satellite system or with a local ground-based mobile radio system.

Subscriber units will be manufactured and sold by various companies, subject to type approval by CCI to insure compatible operations with the CCI signaling and communications protocols. The cost of a subscriber unit is estimated to be US $500, so that it can be sold at a retail price to the user below US $1500.

CCI Business Principles

CCI's LEO system plans are driven by several fundamental business principles that are intended to maximize its chances of business success. First, the primary business orientation of CCI is the provision of high-quality telecommunications services at affordable prices. To ensure this, the principal Strategic Partners will be telecommunications network operators, rather than manufacturers whose main interest is in selling hardware. All of the major hardware elements of the space segment will be put out for open international competitive bid.

Second, in order minimize economic risk, the initial satellites in the CCI system will each have a modest capacity (at least 750 full duplex voice circuits) to match cost with traffic level in the early days of the system implementation. Additional capacity can be added as traffic levels in the system increase, and the revenue from such traffic can be used to finance the capacity expansion. In order to maximize economies of scale and ensure total compatibility between CCI's equatorial and global systems, both will use the same space, ground and user segment hardware and software. When the satellites reach end of life, they can be replaced with more expensive ones that have greater capability to meet the requirements of a growing market.

Third, in order to minimize technical risk, CCI will use proven technology to the maximum extent possible, and keep all of the complex technical elements of the system on the ground. The satellites will have simple frequency changing transponders; they will not have intersatellite links, and all of the switching and processing will be on the ground.

CCI Business Plan

The first phase of CCI's system, the equatorial system, has been designed to be profitable with a conservative system-wide subscriber base -- beginning with 30,000 in the first year of operation and gradually increasing to 400,000 in the fifth year -- with retail usage charges much less than current mobile satellite services, including a large mark-up for the national service providers. Even with this conservative estimate of subscriber growth, CCI's profit potential and ability to withstand price competition from other LEO systems is impressive. For example, with a one-time connect fee of US $25, a monthly access fee of US $25, and a usage fee of US $0.25 per minute, CCI's return on investment ("ROI") will be approximately 23 percent. If the usage fee is raised to US $0.50 per minute, the ROI increases to 31 percent, and if the usage fee is raised to US $1.00 per minute, the ROI increases to approximately 43 percent. These are wholesale rates, and CCI expects that the national carrier will double them in providing retail services to the end-user.

CCI is currently conducting a formal technical review and final specification development program. The roles of the companies currently involved in CCI are: (1) systems integrator -- E-Systems, Inc.; (2) space segment engineering -- CTA/DSI; (3) user terminals -- PCSI; (4) terrestrial networks and interconnection -- Bell Atlantic Corporation; and (5) launch service requirements -- International MicroSpace, Inc. CCI is currently in discussions with telecommunications entities from South America, the Asia Pacific, Africa and Europe regarding their participation in CCI as Strategic Partners. These entities and their affiliates will also be expected to participate fully in the CCI development program once Strategic Relationships have been established.

CCI has completed its LEO system requirements document, and is about half way though the development of system specifications. The program is on schedule, and is projected to be completed by June 1994. The final result will be complete system and performance specifications suitable for issuing Requests for Proposals ("RFPs") for all major hardware elements, to be open for international competitive bidding.

CCI Planned International Ownership and Organizational Structure

CCI is intended to become a truly international organization, with equal ownership and control by four or five Strategic Partners with strong presence in North America, South America, the Asia-Pacific, Africa, middle East and Europe. In order to ensure that CCI's principle focus is on the provision of high-quality telecommunications services, these Strategic Partners will be telecommunications network operators. Bell Atlantic Corporation is the North American Strategic Partner and CCI is currently in discussions with Strategic Partner candidates from the other regions.

Each of CCI's Strategic Partners will have equivalent rights to ownership and control of CCI (approximately 15 to 20 percent). Each Strategic Partner will have membership on the CCI Board of Directors, and will participate fully in all strategic decision making. Further, to the extent permissible by law, each Strategic Partner and its affiliated entities will be full participants in CCI's technical development and experimental satellite programs. They will also be integrally involved in shaping CCI's organizational, financial and marketing plans.

Further, each Strategic Partner will have lead responsibility for coordinating the provision of CCI services in the area of the world where its presence is strongest.

CCI will complement, rather than compete with, existing service providers in each country, by selling them space segment capacity on a wholesale basis, and relying on their existing operations and ability to market and provide CCI's services to the retail subscribers within their territories.

Outline of Proposal to EMBRATEL for Strategic Partnership in CCI

EMBRATEL (or appropriate legal entity) will be CCI's Regional Strategic Partner for South America, as follows:

Ownership in CCI:

Initial investment of US $3 million;

Right of first refusal to maintain an ownership share of CCI equivalent to that of CCI's other major Strategic Partners (15-20%), by capital contribution.

Membership on CCI Board of Directors:

Membership on CCI's Board of Directors;

Full participation in all strategic decision making, including additional Strategic Partner selection.

Participation in CCI Development Program:

Full participation in CCI's development program, including:

- Technical development program for CCI system;
- Experimental satellite program;
- Structuring the international organization;
- National and international marketing;
- International legal/regulatory aspects.

Coordinate participation of other Brazilian entities (government and private) in CCI development program.

Operational Role:

Coordinator for South American operations, with lead responsibilities including:

- Negotiate agreements with selected service providers in region for using CCI system;
- Coordinate site selection, building and operation of gateway stations in region;
- Establish terrestrial circuit routing in the region to maximize network connectivity;
- Negotiate multilateral retail billing policies (including roaming) among participating service providers in region;
- Reasonable compensation for serving as regional Coordinator and Gateway operator.

Additional Elements:

CCI commitment to work toward development and use of Alcantara as launch site for replacement satellites.