



# ***The Teledesic Network***

Mark A. Sturza  
Teledesic Corporation

# *TELEDESIC*

## ◆ Founded:

- June 1990

## ◆ Headquarters:

- Kirkland, Washington, USA

## ◆ Principle shareholders:

- Craig McCaw, founder of McCaw Cellular Communications, world's largest wireless communications company
- Bill Gates, founder of Microsoft, world's largest computer software company

# Craig McCaw Quote

*“Today, the cost to bring modern communications to poor and remote areas is so high that many of the world’s people cannot participate in our global community. Forcing people to migrate into increasingly congested urban areas in search of opportunity is economically and environmentally unsound. All of the world can benefit from efforts to expand access to information technologies.”*

## *Bill Gates Quote*

*“The Internet is the most important single development in the world of computing since the IBM PC was introduced in 1981.”*



## ***Teledesic represents the combined vision of Craig McCaw and Bill Gates***

- ◆ **Universal Broadband Access**
- ◆ **US FCC license and ITU Broadband Low-Earth-Orbit (LEO) service designation in place**
- ◆ **Boeing selected as prime contractor for 288 LEO satellite constellation**
- ◆ **First revenue by 2002**

# ***Teledesic is a networking company, not a supplier of satellite hardware***

- ◆ Boeing selected as prime contractor
  - The world's largest provider of space, defense and aerospace equipment
  - System cost not to exceed \$9 billion
  - Boeing invested \$100 million in Teledesic



# ***Teledesic will not compete with Big LEO or Little LEO systems***

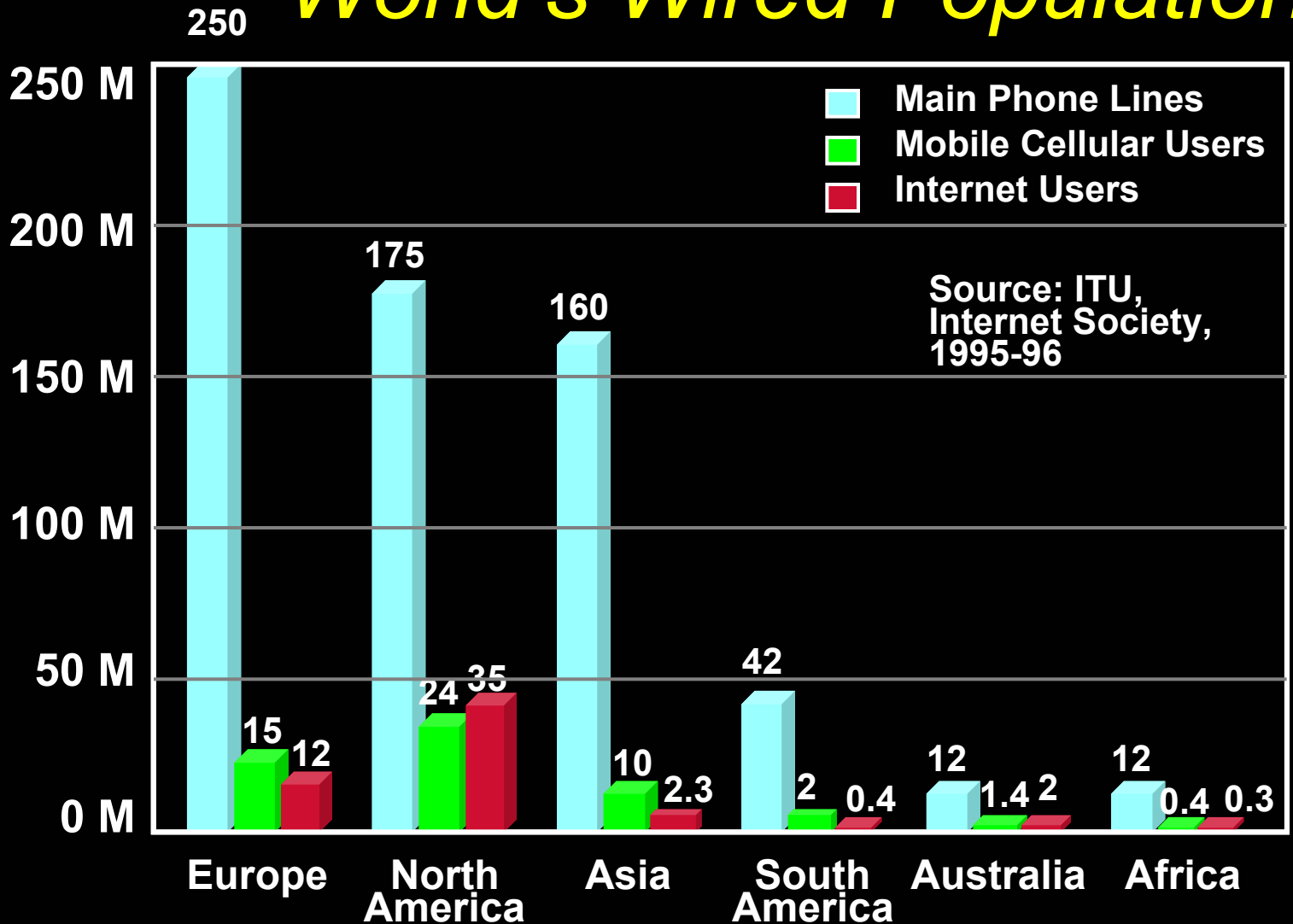
	Little LEOs	Big LEOs	Broadband LEOs
Example	Orbcomm	Iridium	Teledesic
Terrestrial Counterpart	Paging	Cellular	Fiber
Frequency	< 1 GHz	1 – 3 GHz	30/20 GHz

A satellite view of the Earth from space, showing the curvature of the planet and the blue atmosphere. The landmasses are visible in shades of brown and green, and the oceans are a deep blue. The image is centered on the Earth, with the title text overlaid in the middle.

# ***Demand for Broadband***



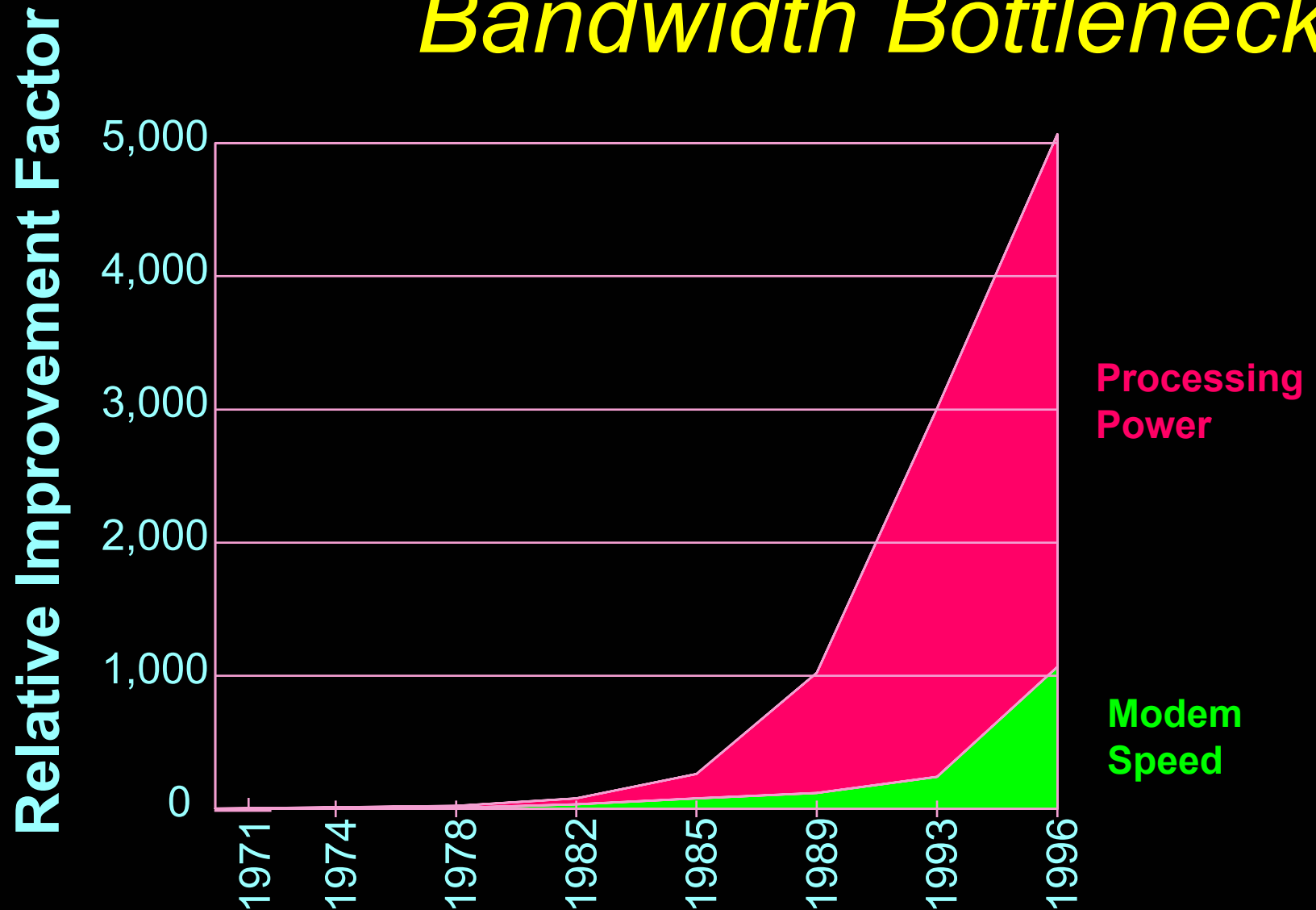
# World's Wired Population



# *Lack of Infrastructure*

- ◆ Half of the world's population lives more than two hours from the closest telephone
- ◆ Four billion people around the world are without a telephone
- ◆ 50 million people worldwide are on waiting lists for telephones, the average wait is 1.5 years
- ◆ Tokyo has more telephones than all of sub-Saharan Africa
- ◆ China plans to add 80 million telephone lines over the next decade
- ◆ Even where it's available, not all existing analog infrastructure can be upgraded to support advanced digital services

# Bandwidth Bottleneck



# *Regulatory Summary*

- ◆ **WRC '95 identified 500 MHz Links within the Ka band for NGSO satellite systems**
  - 400 MHz available for immediate use
  - 100 MHz frozen until WRC '97
- ◆ **US FCC designated same spectrum in its 28 GHz Band Plan**
- ◆ **March 1997, FCC licensed Teledesic to build, launch, and operate Teledesic Network**
- ◆ **WRC '97 made all 500 MHz available**

A satellite view of the Earth from space, showing the curvature of the planet and the blue of the oceans. The image is centered on the Atlantic Ocean, with North and South America visible on the left and right sides respectively. The text "Teledesic Market" is overlaid in the center of the image.

# ***Teledesic Market***

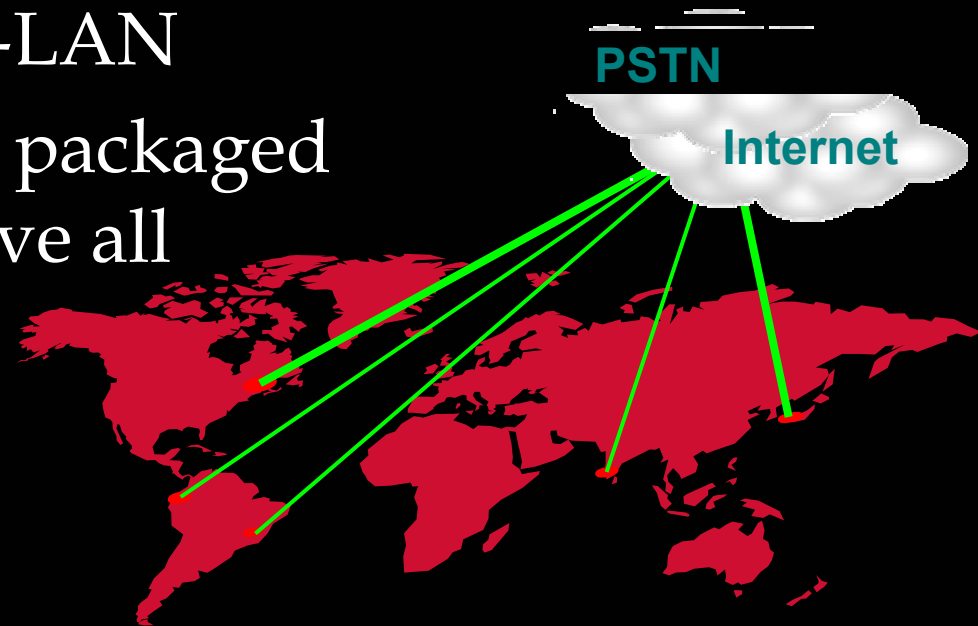
# *Internet-in-the-Sky*

- ◆ Internet/ Intranet Connection
- ◆ Telemedicine
- ◆ Corporate Networking
- ◆ Gateway
- ◆ Video-conferencing
- ◆ Distance Learning
- ◆ Cellular Backhaul
- ◆ Telecommuting

# Corporate Networks

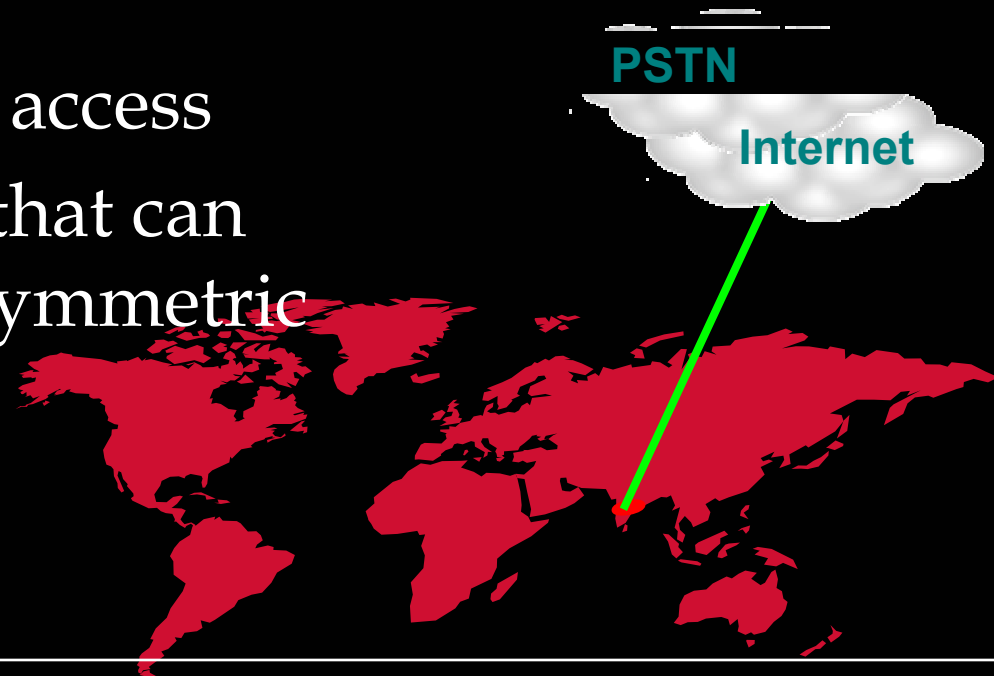
## Typical customer in 2007:

- Five sites served with Teledesic Standard Terminals (TSTs)
- 256 kbps per site
- voice, video, LAN-LAN
- cheapest, simplest, packaged solution able to serve all site locations



## Typical customer in 2007:

- Single site, TST, small enterprise in developing world
- 144 kbps per site
- voice, video, LAN access
- cheapest solution that can deliver adequate symmetric speeds

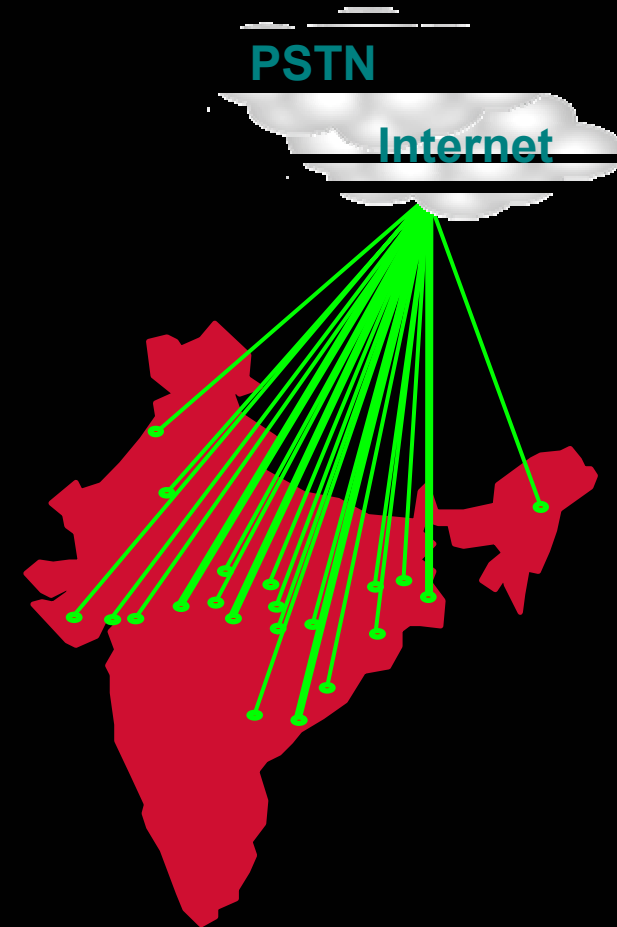




# Trunking

## Typical customer in 2007:

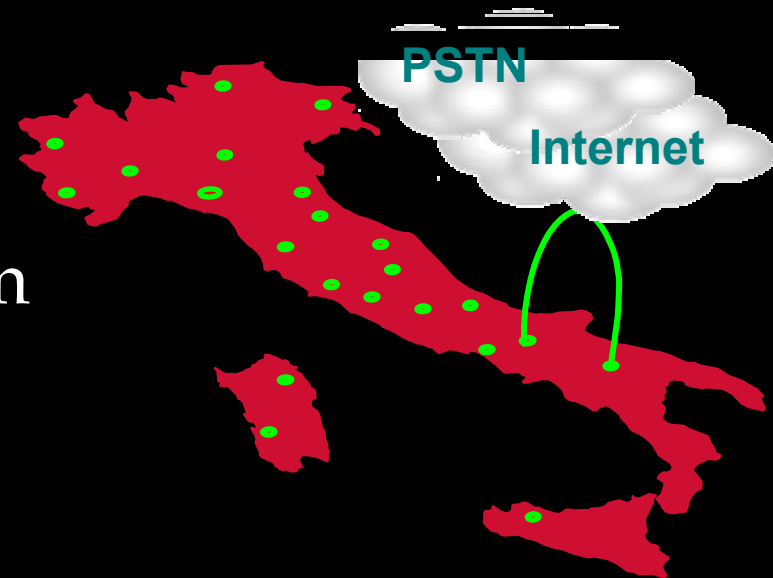
- 50 remote wireless base station sites served with TSTs
- 256 kbps per site
- voice, data
- cheaper than purchasing microwave equipment or leasing from another operator



# Back -Up

## Typical customer in 2007:

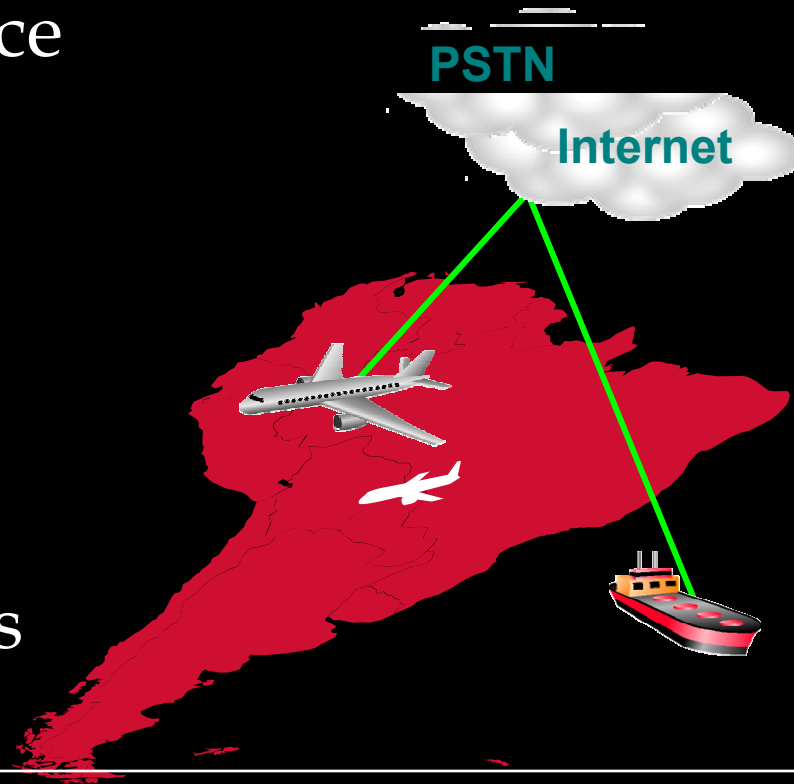
- Network operator with 30 nodes served with TSTs
- terminals used infrequently
- voice, data
- cheaper than purchasing redundant microwave equipment or leasing from another operator, “earthquake-proof” infrastructure



# Aviation and Maritime

## Typical customer in 2007:

- Airline with 50 aircraft TST equipped, reselling service to passengers
- 144 kbps per site
- voice, messaging. LAN access, file transfer
- global coverage, service affordability, high speeds



# Residential Access

## Typical customer in 2007:

- TST at weekend home of affluent professional
- 144 kbps per site
- voice, video, LAN access
- cheapest solution that can deliver adequate symmetric speeds

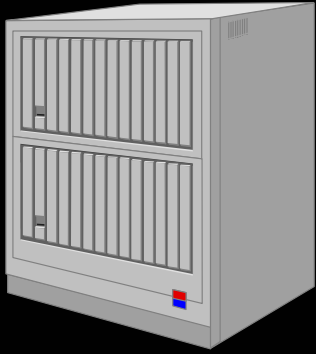


A satellite view of the Earth from space, showing the curvature of the planet and the blue atmosphere. The image is centered on the North Pole, showing the Arctic region and surrounding landmasses. The text "Teledesic Network" is overlaid in the center of the image.

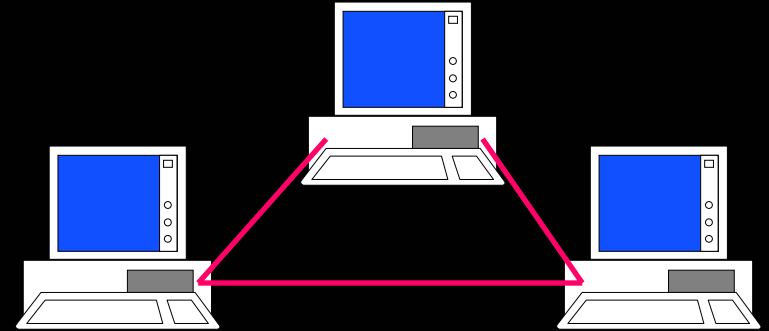
# ***Teledesic Network***

# Network Evolution

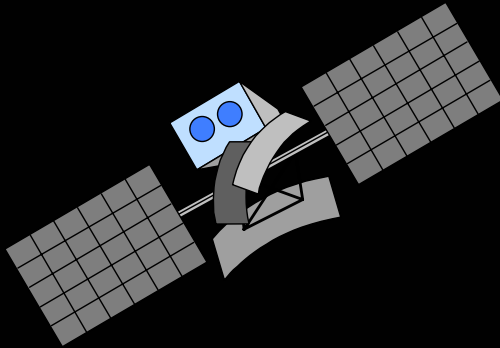
Mainframe



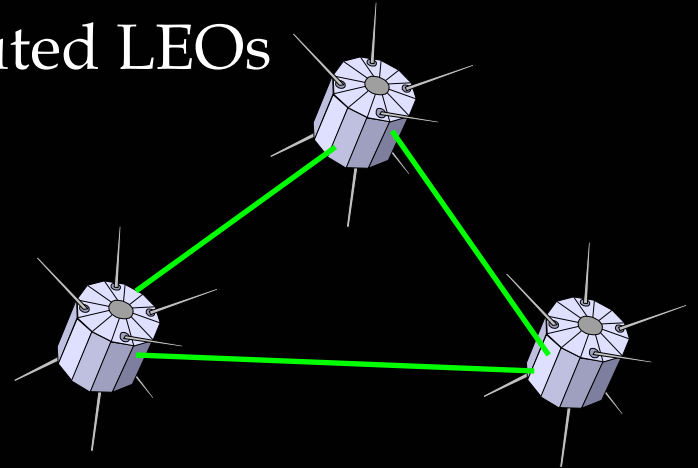
Distributed PCs



GEO Satellite



Distributed LEOs



# *Global Broadband Wireless*

- ◆ Why use satellites?
  - Ability to provide service with cost independent of location.
- ◆ Why LEO satellites?
  - Seamless compatibility with terrestrial networks.
- ◆ Why Ka-band?
  - Lowest frequency with the spectrum to build global broadband network.

# *Global Broadband Wireless (cont.)*

- ◆ Why high mask angle?
  - Provides high link availability to enable high service quality.
- ◆ Why 288 satellites?
  - A high mask angle combined with low Earth orbit altitude requires a large number of satellites to provide continuous global coverage.



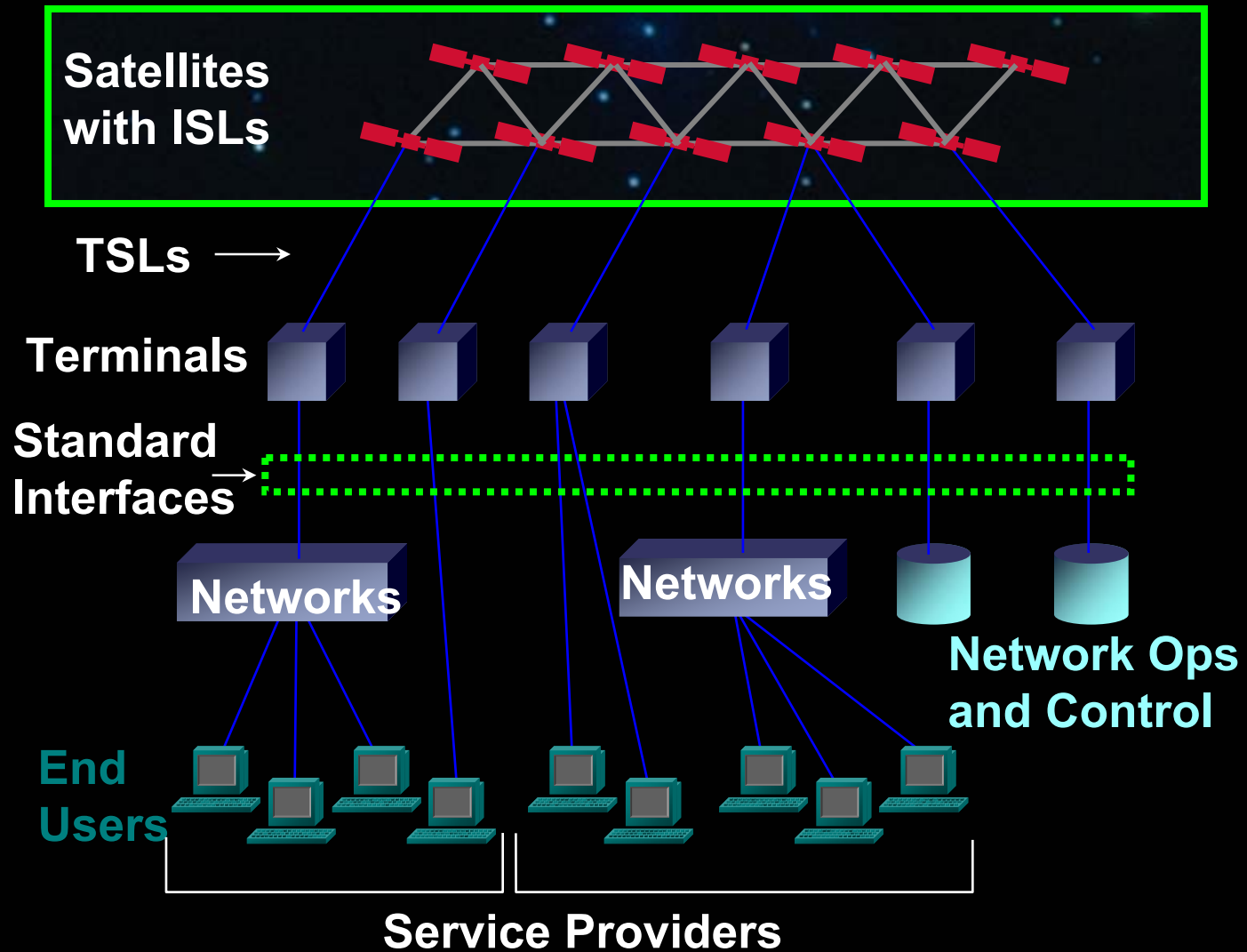
# *Design Considerations*

- ◆ High data rate (broadband) fixed and mobile service
- ◆ Continuous global coverage
- ◆ Fiber-like delay
- ◆ Bit error rates less than  $10^{-10}$
- ◆ Mitigate effects of rain attenuation and blockage
- ◆ Rapid network repair
- ◆ Geodesic (mesh) network interconnect

# *Service Description*

- ◆ Two-way switched broadband access
- ◆ End-to-end fiber like QoS
- ◆ Affordable global access to advanced communications

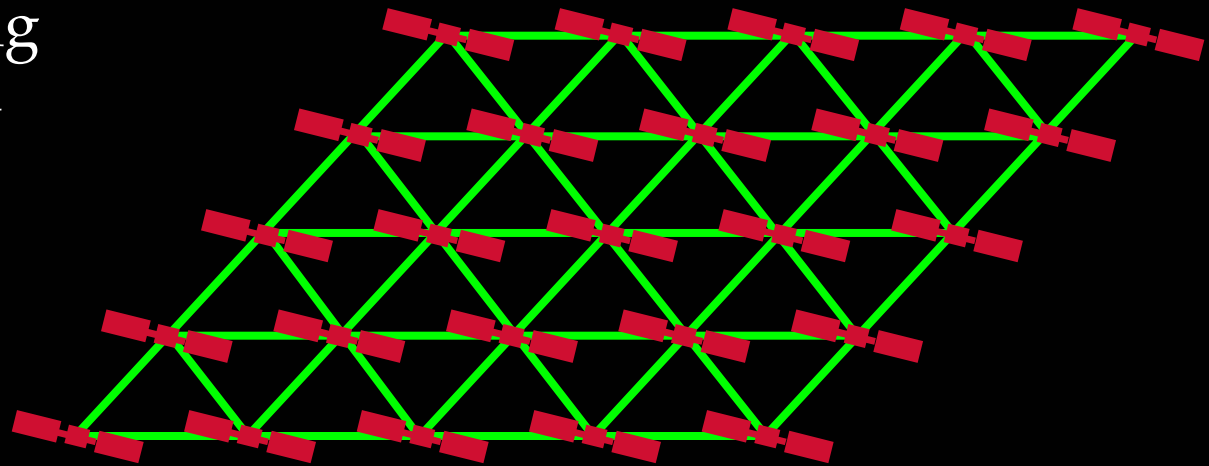
# Network Overview



# Network Services

- ◆ Multiple Quality of Service (QoS) Classes
  - CBR, VBR, ABR
  - Best Effort
- ◆ Data Delivery Mechanisms
  - Virtual Circuits
  - Datagram
- ◆ Service Tailoring
- ◆ Congestion Control

- ◆ **Geodesic (mesh) topology**
  - Each satellite is a switch node
  - Intersatellite links to 8 adjacent nodes
  - Distributed control
- ◆ **Advantages:**
  - High capacity
  - Self-healing
  - Low delay
  - Robust
  - Flexible

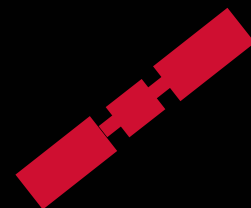
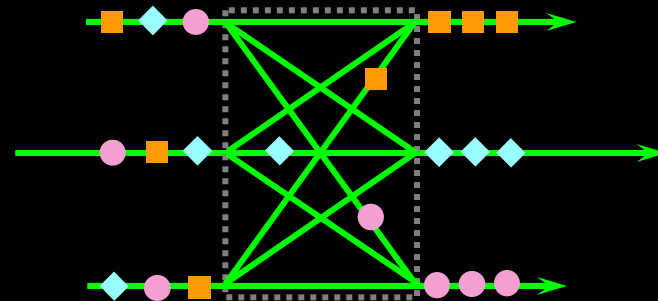
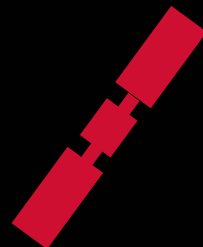


# Network Node

- ◆ Internet like (IP) routing
- ◆ Each node is a fast packet switch
- ◆ ATM like switching
- ◆ All communication in form of fixed-length packets
- ◆ Switch routes packets along least-delay path to destination

- ◆ Advantages:

- Low delay
- Flexible
- One network for all applications



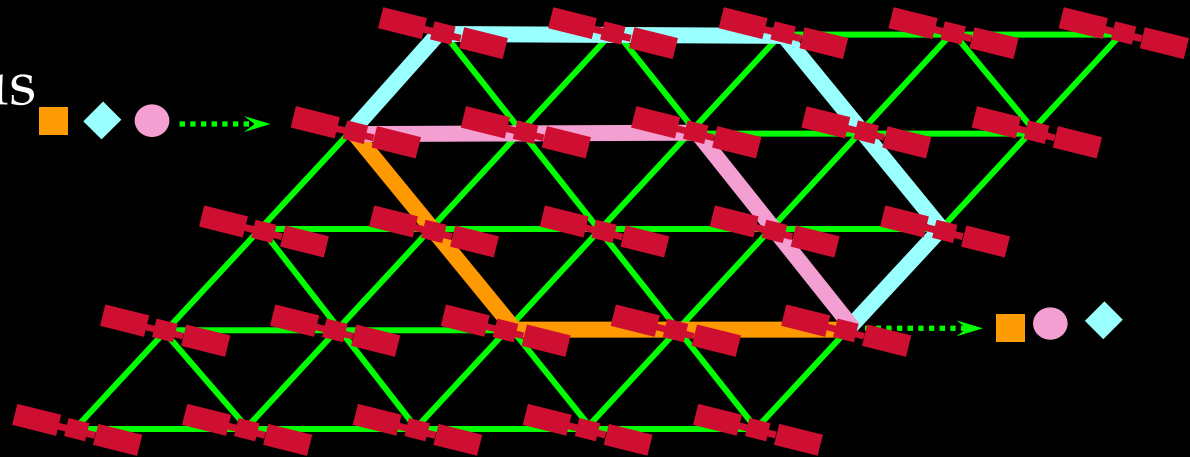
# Adaptive Routing

- ◆ **Distributed adaptive routing software**

- Selects least delay path to destination
- Adapts to changes in
  - ◆ Network topology
  - ◆ Network congestion

- ◆ **Advantages:**

- Autonomous
- Robust
- Low delay





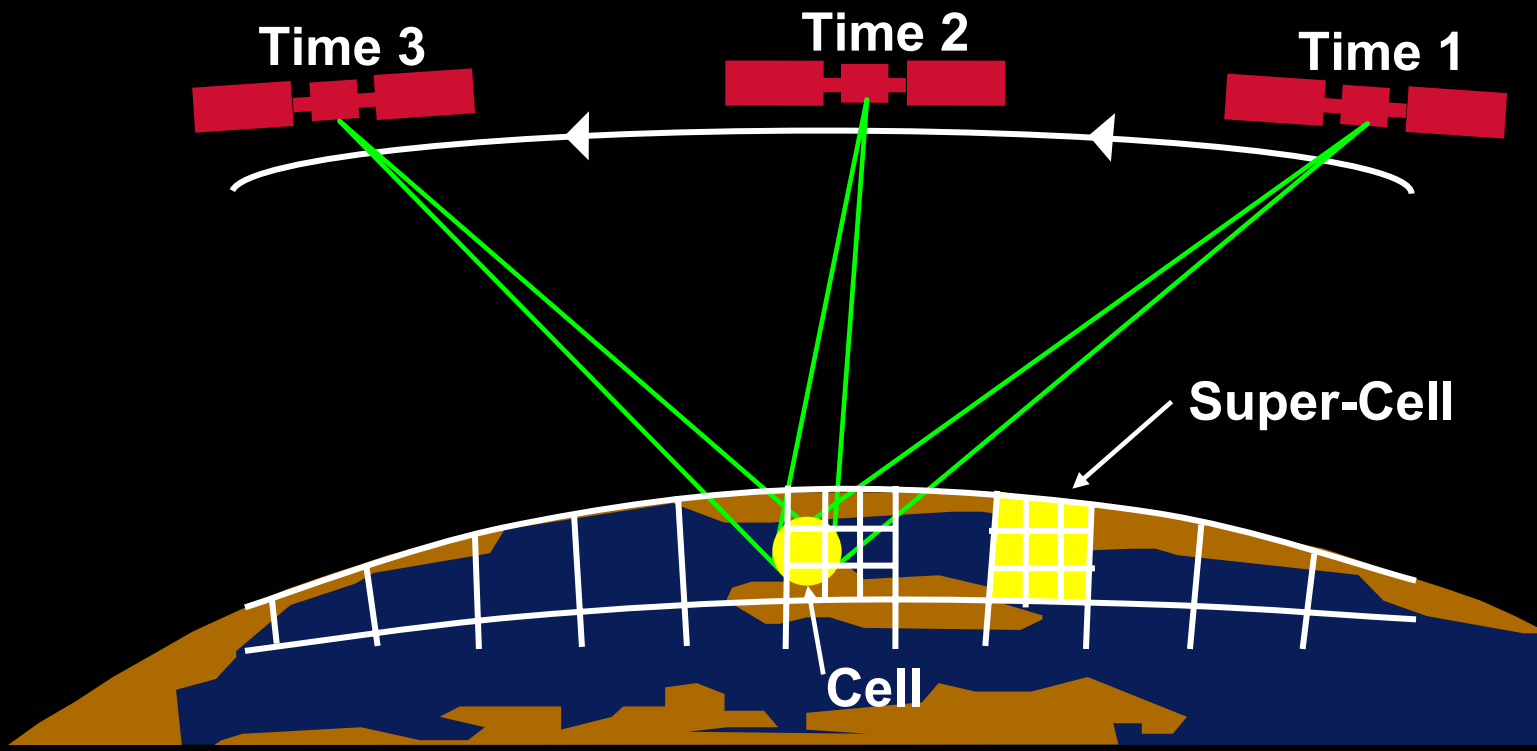
# ***Teledesic System***



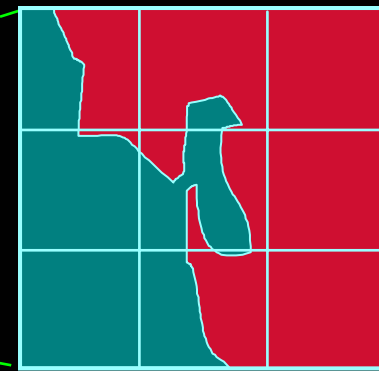
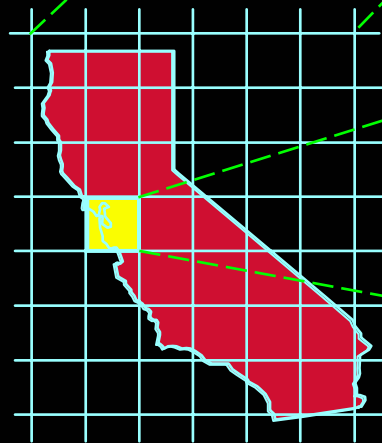
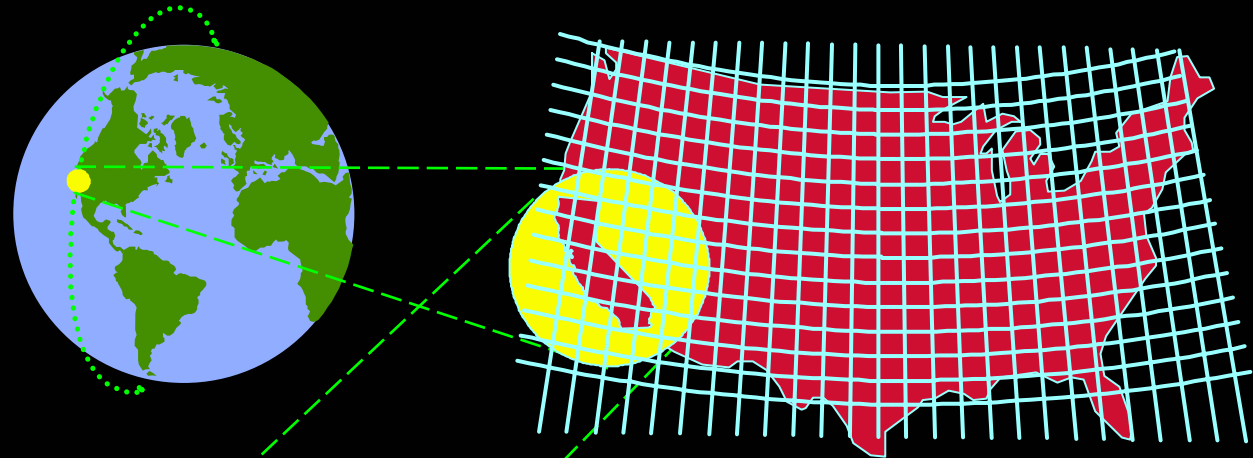
# Constellation Parameters

<b>Total Number of Satellites</b>	<b>288 + spares</b>
<b>Number of Planes</b>	<b>12</b>
<b>Satellites per Plane</b>	<b>24</b>
<b>Altitude</b>	<b>1,375 km</b>
<b>Eccentricity</b>	<b>Circular</b>
<b>Inclination</b>	<b>84.7°</b>
<b>Inter-Plane Spacing</b>	<b>15.36°</b>
<b>Intra-Plane Satellite Spacing</b>	<b>Uniform</b>
<b>Inter-Plane Satellite Phasing</b>	<b>Random</b>
<b>Elevation Mask Angle</b>	<b>40°</b>

# Earth-Fixed Cells



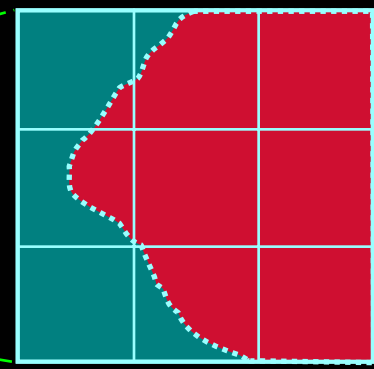
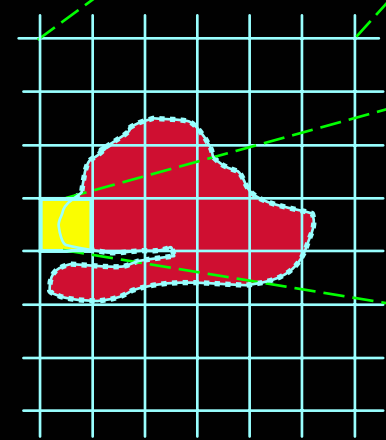
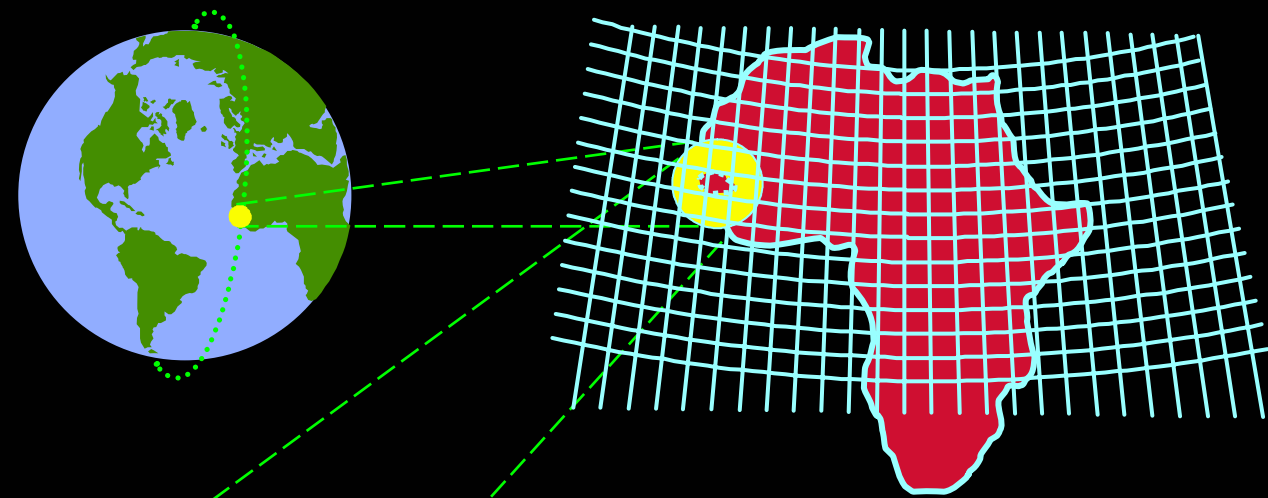
# Earth-Fixed Cells (San Francisco, USA)



.....  
Cell  
.....

.....  
**Super Cell**  
.....

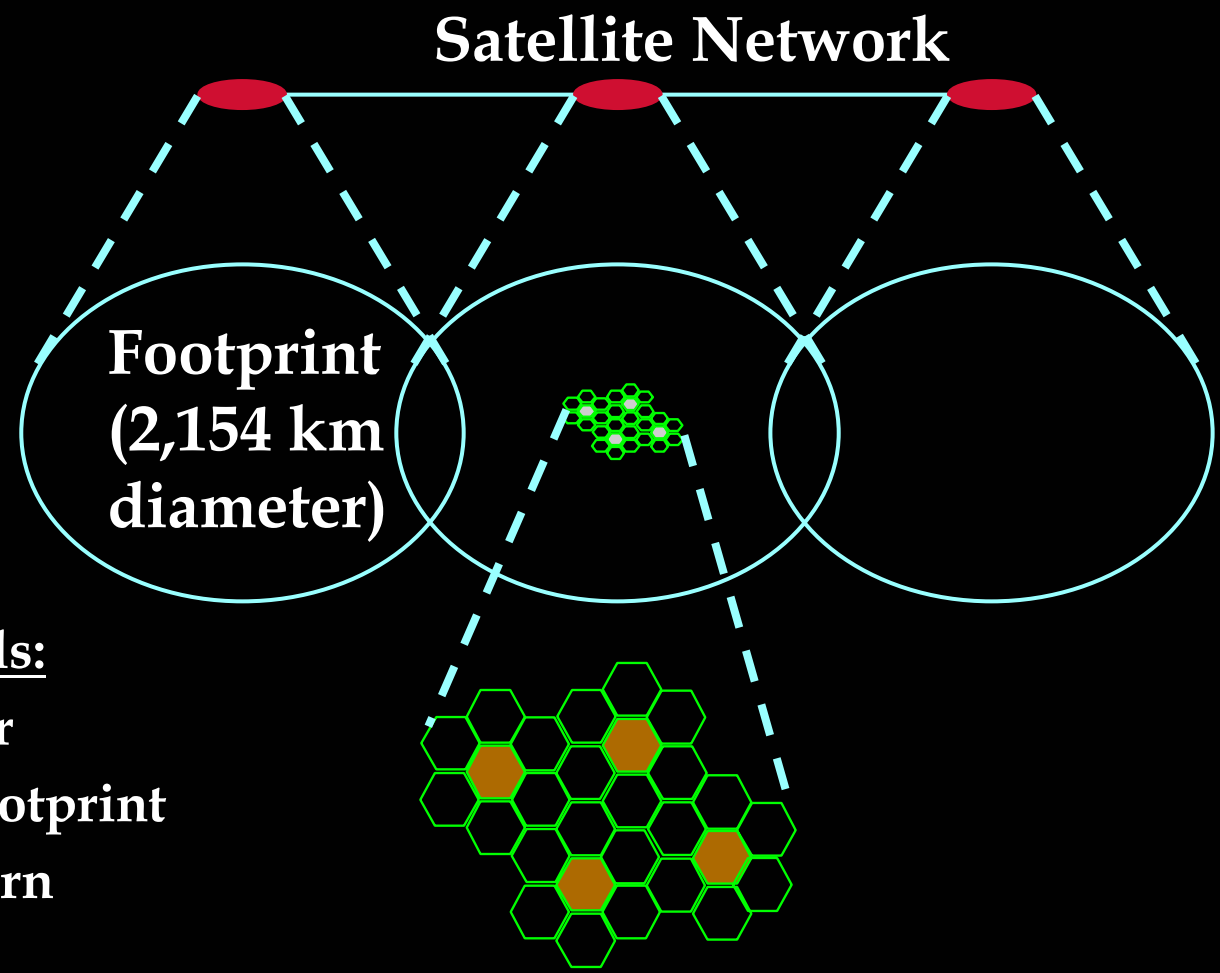
# Earth-Fixed Cells (Dakar, Senegal)



Cell

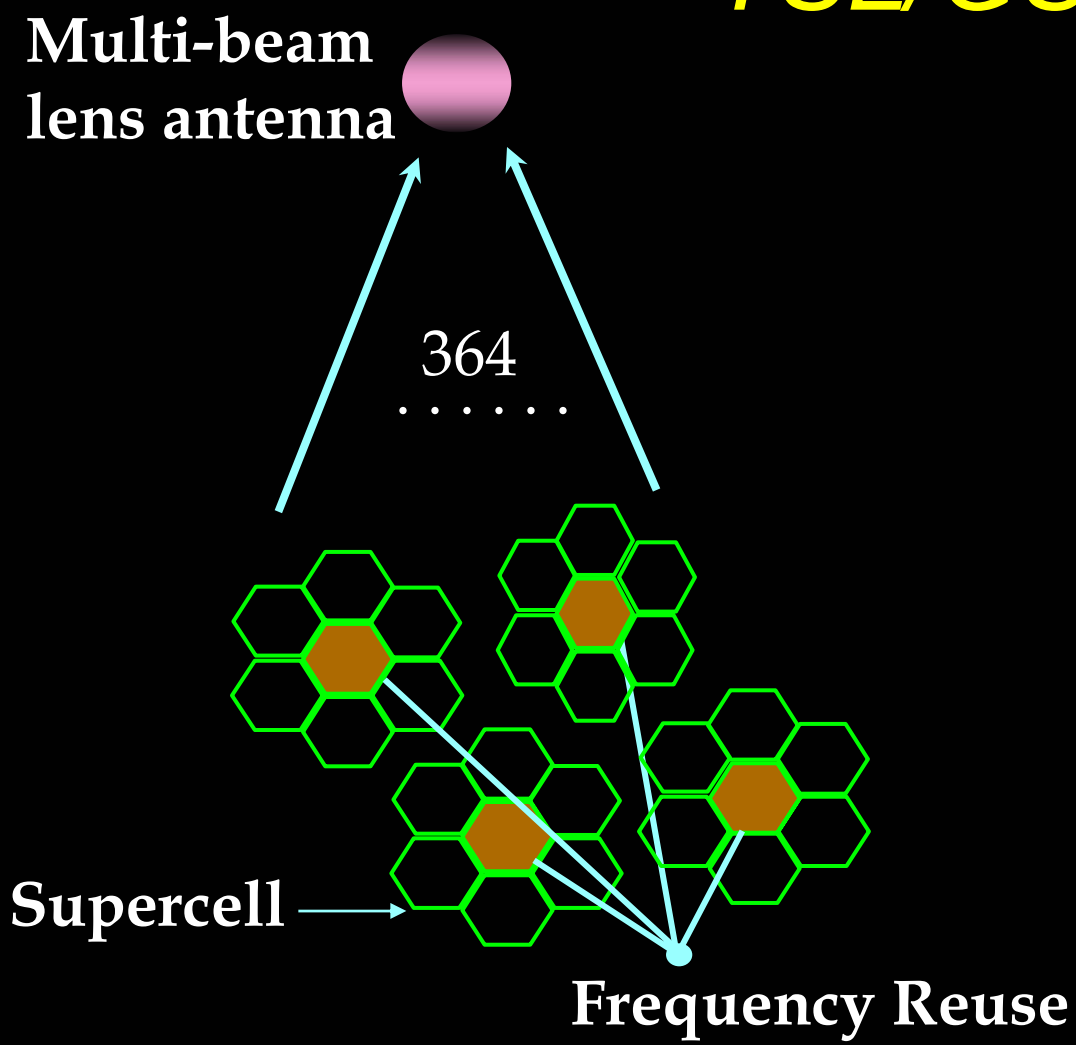
Super Cell

# Cell Structure



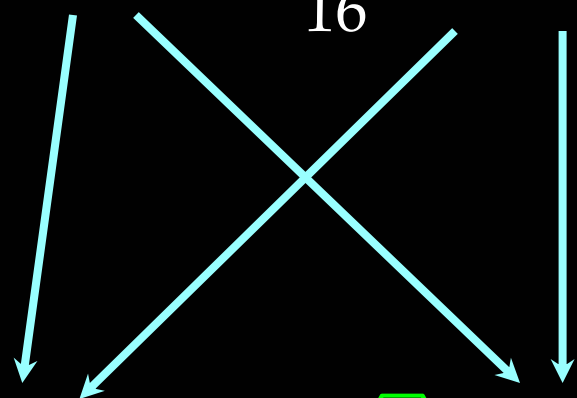
Earth-fixed cells:  
80 km diameter  
340 cells per footprint  
1:7 re-use pattern

# TSL/GSL Uplinks

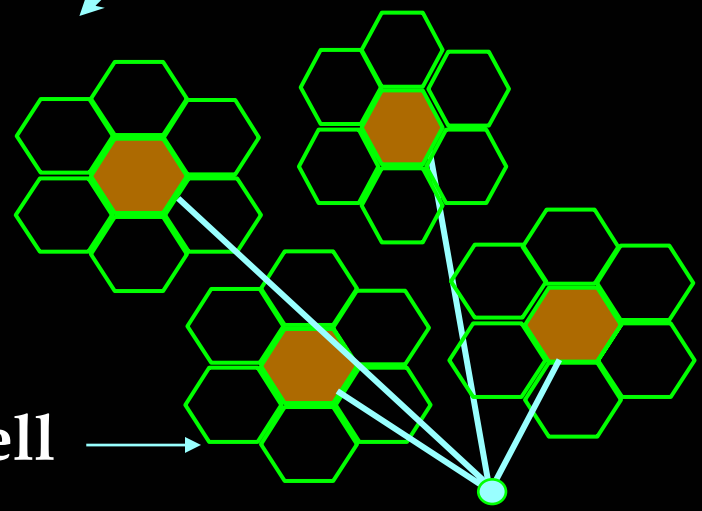


# TSL Downlinks

Scanning beam antennas



16



Supercell

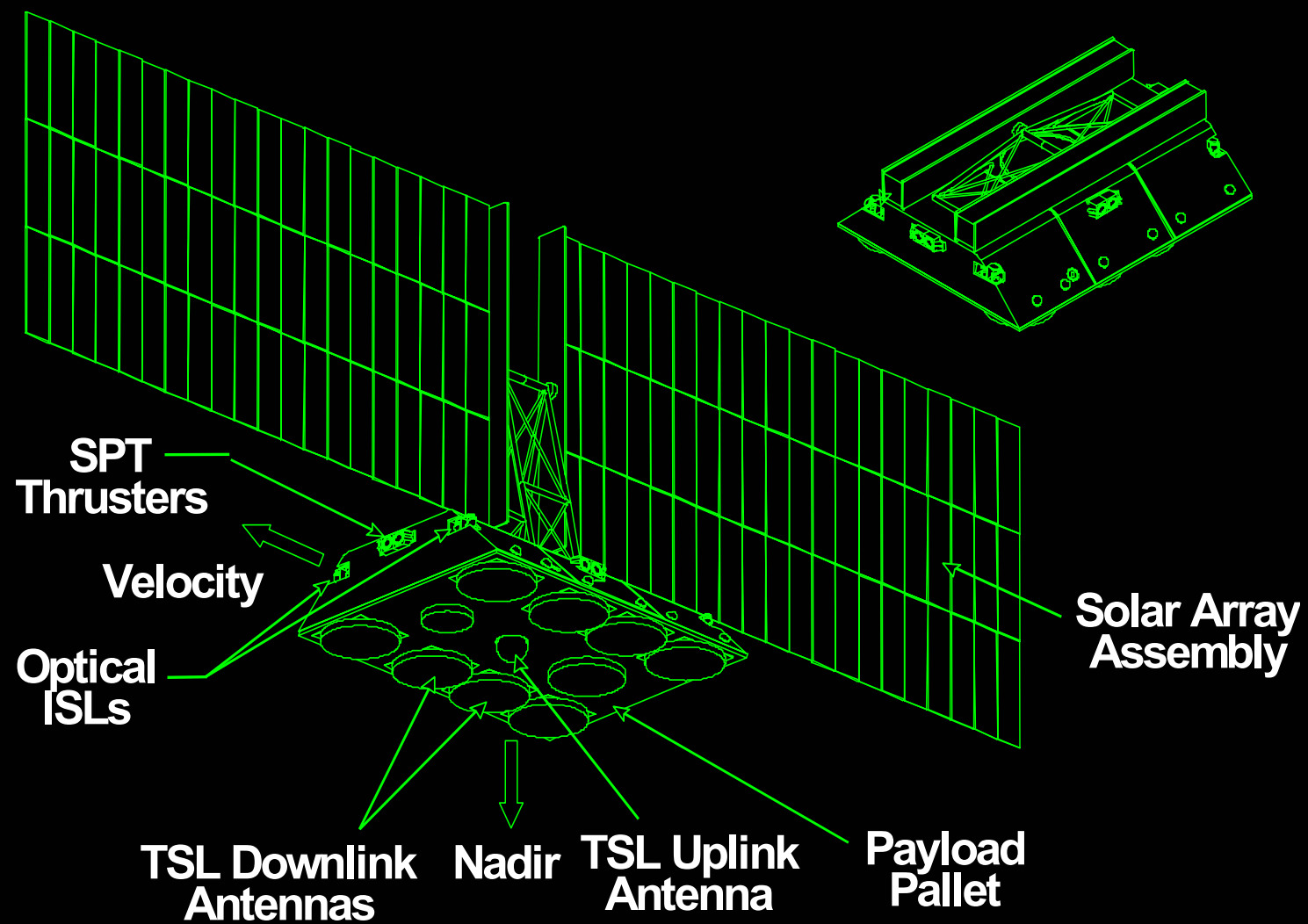
Frequency Reuse

# *Terminals*

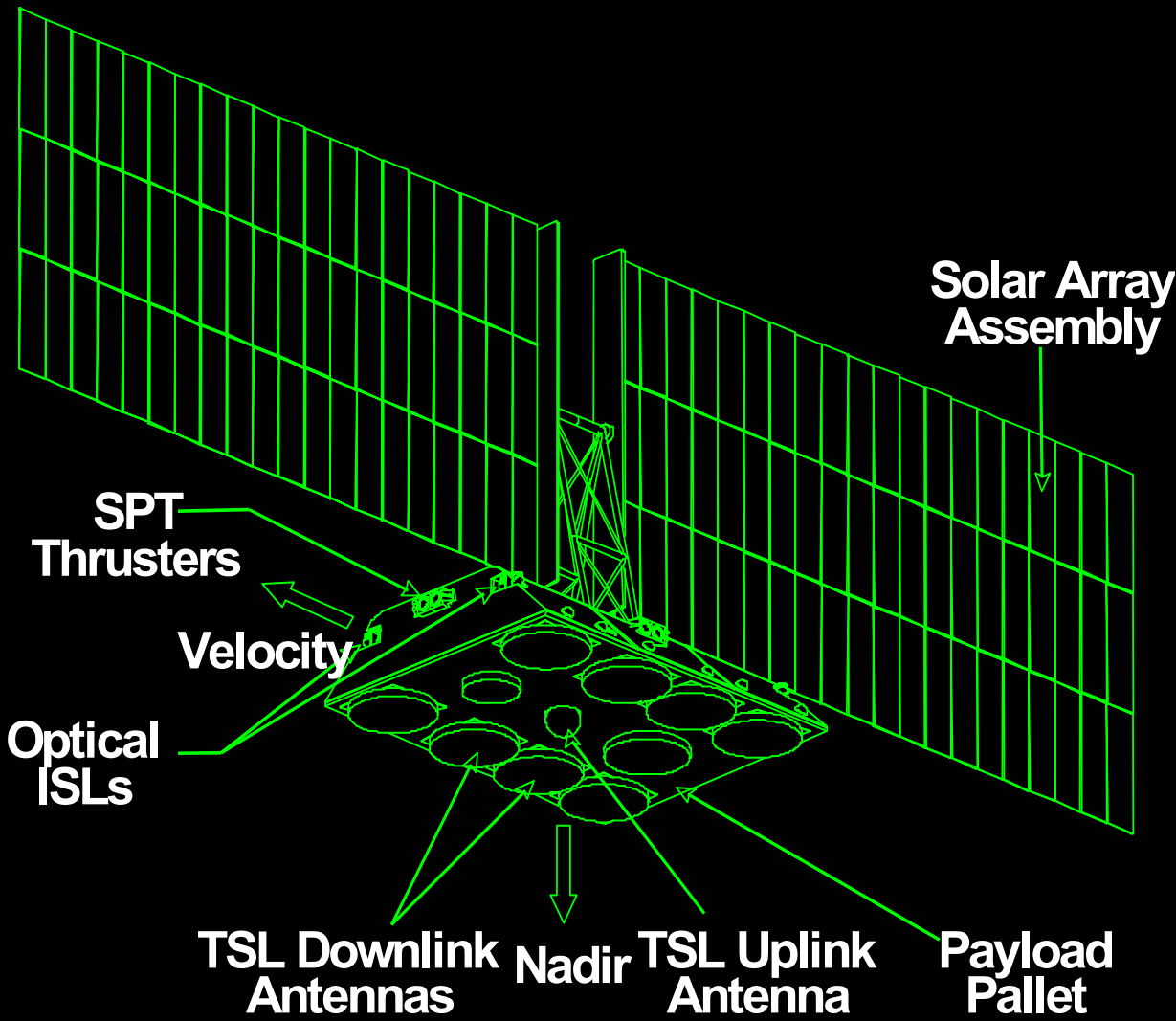
- ◆ The Teledesic Network supports a family of subscriber terminals providing on-demand data rates
- ◆ Standard Terminals include both fixed-site and transportable configurations - 16 kbps to E1 (2.048 Mbps)
- ◆ The Network also supports a smaller number of fixed-site GigaLink Terminals - OC-3 to 1.2 Gbps (OC-24)



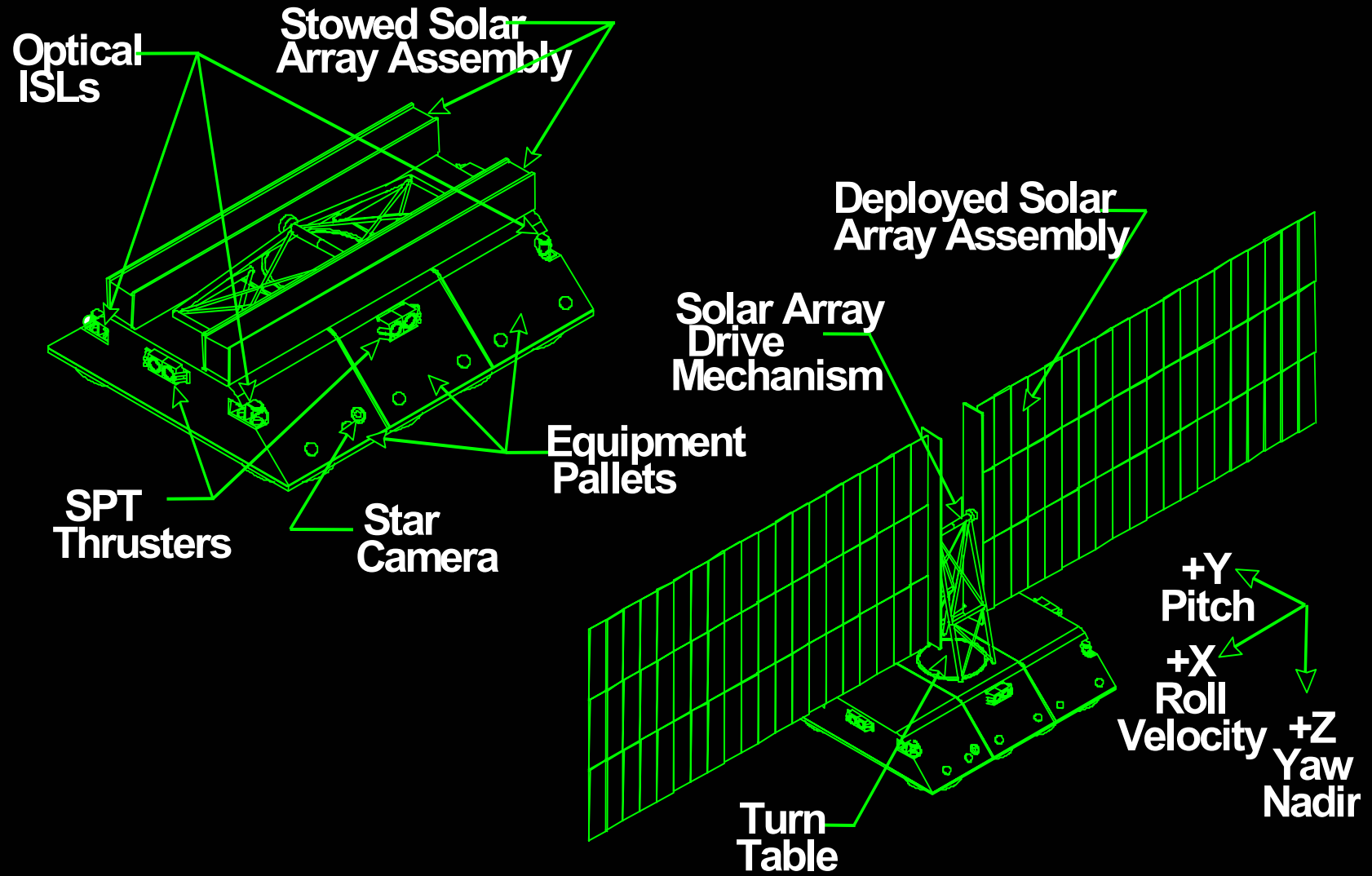
# Satellite Bus Configuration



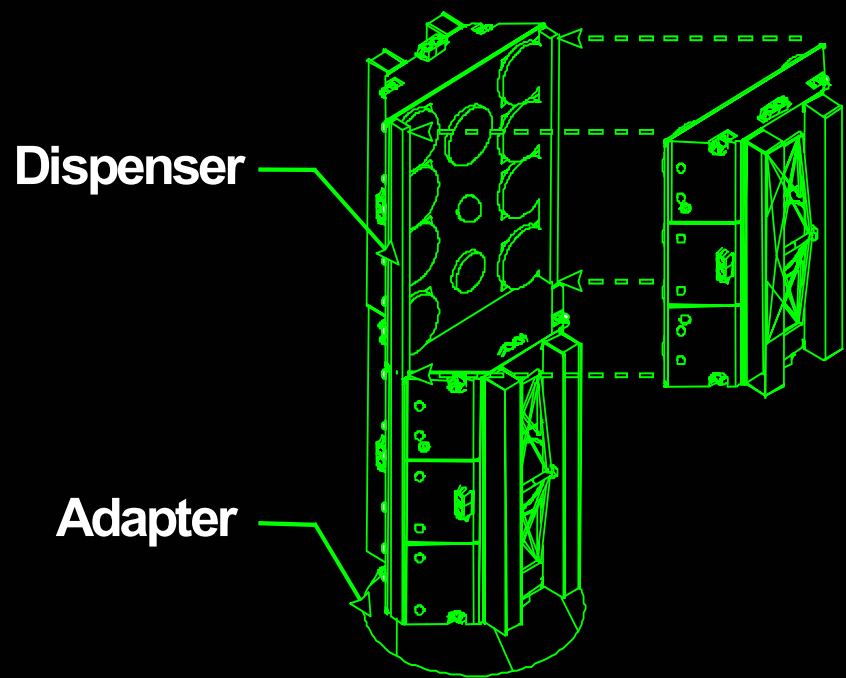
# Teledesic Satellite



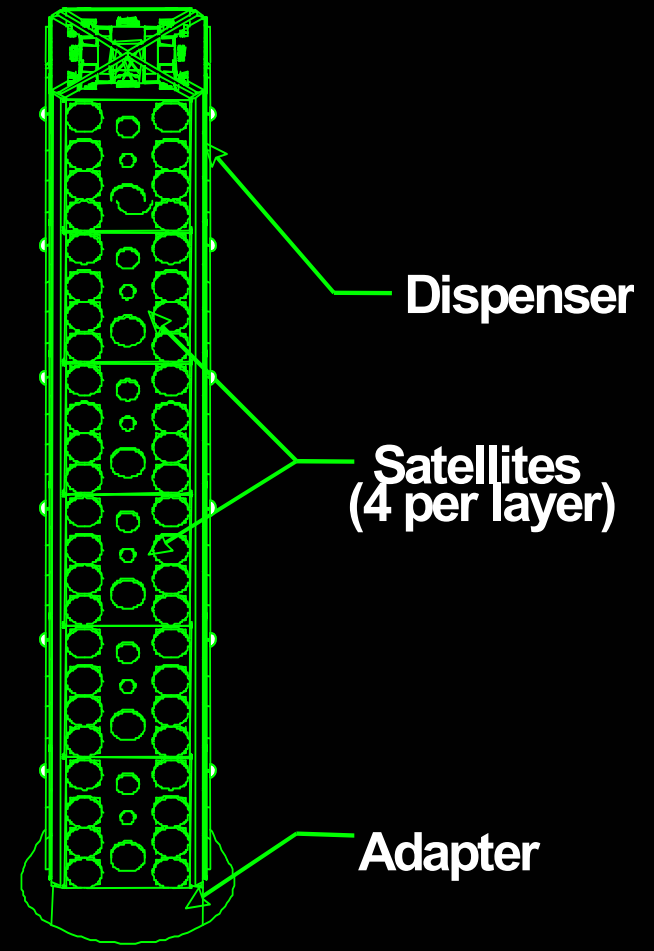
# Teledesic Satellite Details



# Launch Dispenser



Medium Launch Vehicle



Heavy Launch Vehicle



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