The Use of the Equatorial Orbit for Telecommunications and Navigation Satellites

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Content

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- The first GEO Satellites
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Satellite Orbits
Geostationary Orbit

- First mentioned by Hermann Noordung in 1929

- Arthur C. Clarke  **Extra Terrestrial Relays**

  *Wireless World*, October 1945, pages 305-308
• A Satellite at the Earth Surface flies at a speed of 7 km/s
• A Satellite 36,000 km above the Earth Surface flies at a speed of 3 km/s
A Satellite 36,000 km above the Earth Surface rotates once about the Earth in 24 hours.
First GEO Satellite
Syncom 1 1963
First GEO Satellite
Syncom 2 1963
Olympics Tokyo 1964
Three GEO cover the Earth
Transcontinental Communication

Backbone Connectivity

National ISP

Gateway Station

E/S Equipment

Gateway Station

CSU/DSU

Internet

Router

Regional ISP

Local ISP

End Users

Local ISP

Regional ISP

Router

Regional ISP

National ISP

Internet

Router

Router

CSU/DSU

Local ISP

Local ISP
Spinning Satellites
Three Axis Stabilized Satellites
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TV Broadcast

Diagram showing the process of TV broadcast:

- Network Program Provider
- TV Signals
- Uplink
- Teleport
- Satellite
- Home
- Off Air Transmitter
- Cable Headends
- Receives Network
Around 100 Million Satellite TV Receivers Deployed in Europe

Global Revenues Around $75 Billion
Interconnection of Remote Sites

- Design Bureau
- V/C system
- NGM Indoor Unit
- Server
- VoIP

Test vehicle

Accompanying van with satcom facilities

WLAN Measurement data transfer
Interconnection of Remote Sites with Terrestrial Telecom Network
Transfer of patients’ vital data at high speed
• Electronic X-ray and CT images
• Ultrasound scanner data, etc.

Provision of video conference and telephony services between a remote hospital and an expert centre
• Tele-consultancy among physicians
• Second opinion
Interconnection of hospitals via satellite

Fast transmission of CT, radiology images, ultrasound scanner data

Consultancy of medical experts via video conference
  • Fast decision about further treatment of patients
  • Second opinion

Monitoring of surgery in broadcast TV quality (MPEG-2)

Tele-Training of medical personnel
Telemedicine

Graz Hospital – Mayo Clinic
Graz Hospital – Munich
Graz Hospital - Pristina
Ideal communications tool

- in case of natural disaster
- in areas with inadequate infrastructure
Normal telecom infrastructure often disrupted
Satellite communications suitable for re-establishment of temporary infrastructure
Rapid information for decision makers (emergency centers)
Potential Solution: Flying Base Station

- Navigation Satellite
- Geostationary Satellite
- Ground station
- Secure, reliable data link 400...2000 kbit/s
- Image Processing Geo coding

Camera, SAR Radar

Disaster Area

Emergency centre
Flown in by helicopter or transport aircraft
Operational in 20…30 minutes
Automatic installation, easy line-up
Disaster Communications

Users

Emergency organisations

• Emergency Centers
• Red Cross
• Fire Brigade
• Police
• Ministery of the Interior

Military (humanitarian aid)
High quality and video and audio from lecture site (MPEG-2, MPEG-4)
Data, Application Sharing (PowerPoint, MATLAB,...)
Integrated distance learning tools available

Lower quality video from remote sites
Audio important
Minimum: chat function from remote sites
All IP network structure advantageous
Tele Training

Lecturer’s site

Camera and sound system

Remote participants

NGM Indoor Unit
Tele Training

Lecturer's site

Camera and sound system

NGM Indoor Unit

Remote participants
Mobile Communication
INMARSAT IV

- 2 Satellites at 53°W & 64°E

- Provides around 85 percent landmass coverage
Mobile Communication
ACES
Mobile Communication
Thuraya
a → S₁ : Measured range (pseudo-distance)
a ← R : Receiver clock bias
S₁R : Estimated range from point R to satellite S₁
GPS

GLONASS
Chinese Regional Navigation System

4 GEO’s called Beidou

12 inclined GEO’s

9 Satellites at 22,000 km

4th Beidou (Big Dipper) Satellite launched 3 February 2007
Beidou 1A, 1B, 1C
Beidou
Compas Operating Principle
Free Service:

10 m location tracking accuracy

clock synchronization accuracy of 50 ns

measure speeds within 0.2 m/s
Thank You