New Technologies: PLC & HAPS part 2

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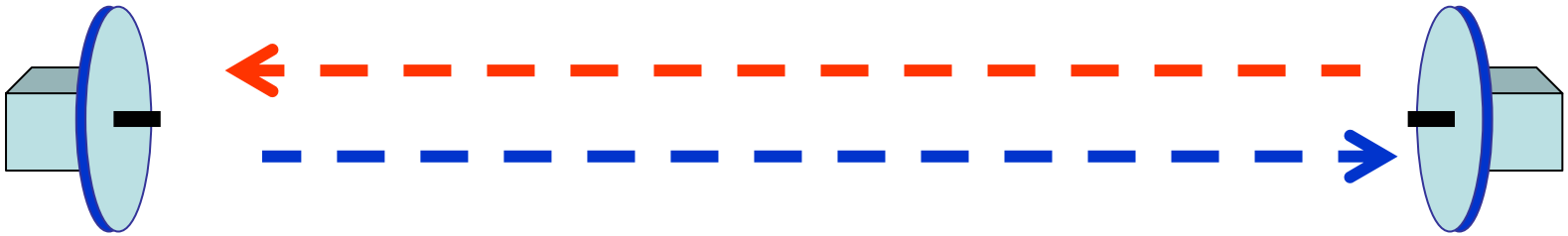
Note: These are preliminary notes, intended only for distribution among the participants. Beware of misprints!

Digital divide

Hope in radio



Radio waves carry information to fixed & mobile users at no cost

- 300’000 km/s
- Ubiquitous - accessible at any place, any time…*
- Deployment cost & time
- Free, no right-of-way- no deployment/ installation/ maintenance…
- Indestructible - no theft, snow, wind, flood, earthquake, tornado, trees…
- No cable production/ transport/ warehousing…

*Over the Earth’s surface

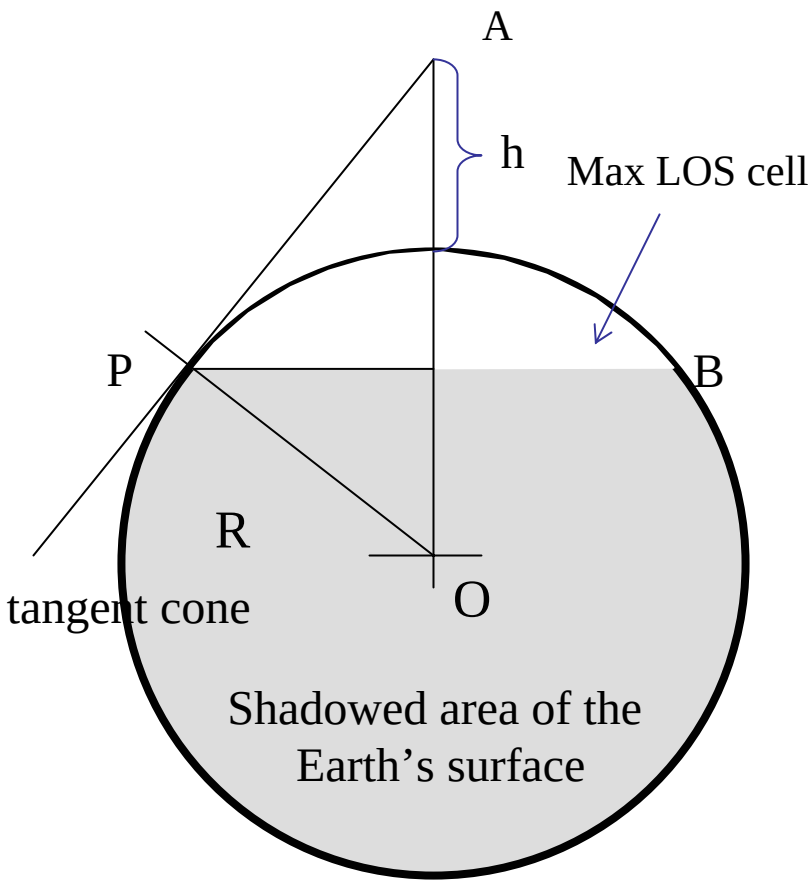
Two aspects

- Humanitarian:
  - all people should be offered universal access to information infrastructures
- Economic:
  - Wealthy markets are saturated; to keep business running needed are:
    - New services
      - E.g. new multimedia wideband interactive applications
    - New markets
      - E.g. the “poor” market: 85% of the world’s population
      - Or nomadic users market: 15% of the population

Outline

- Introduction
- Stratospheric radio: what is it?
- Few current projects
- Conclusion

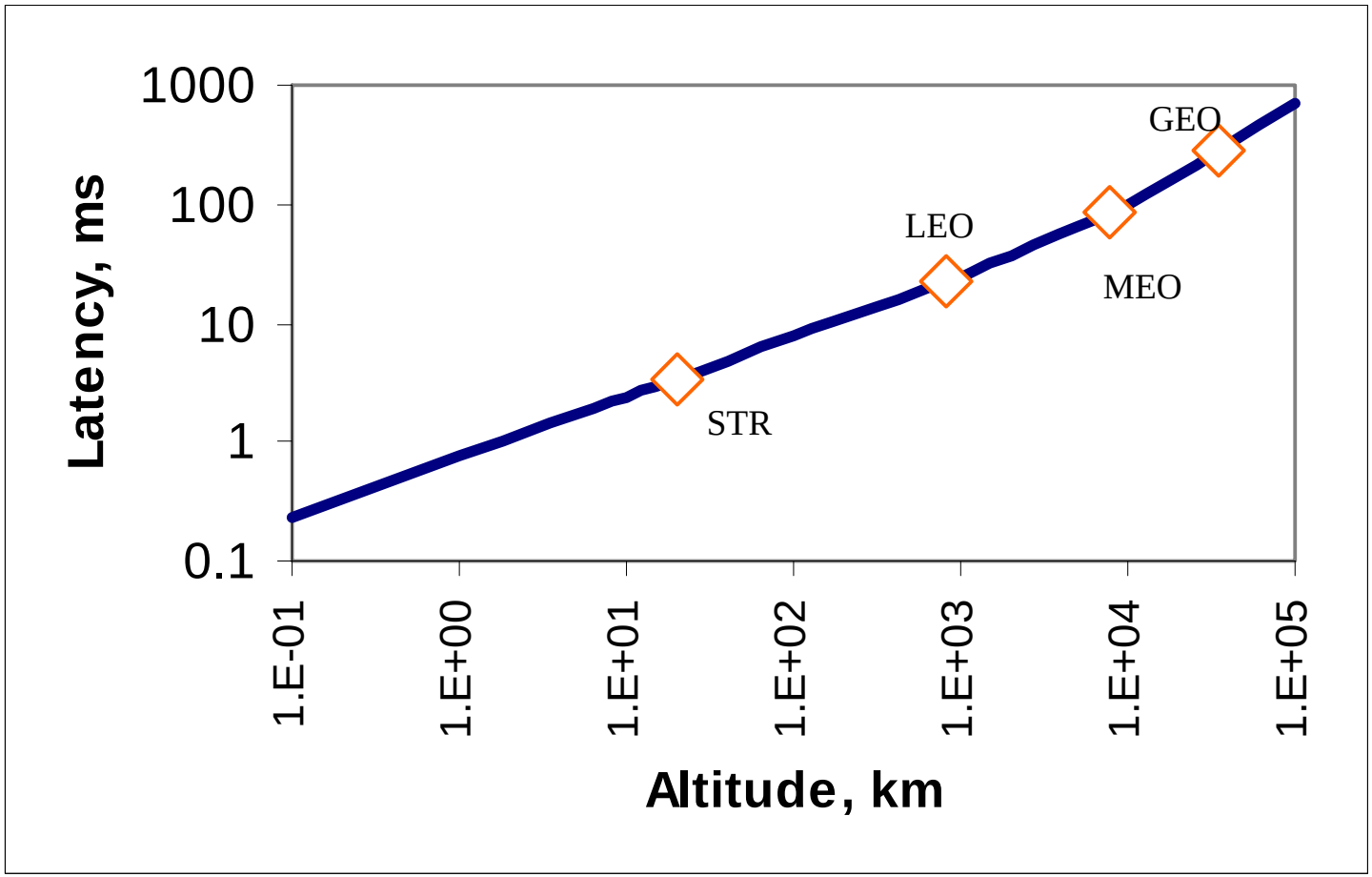
Line-Of-Sight (LOS) area



Launch of GEO satellites

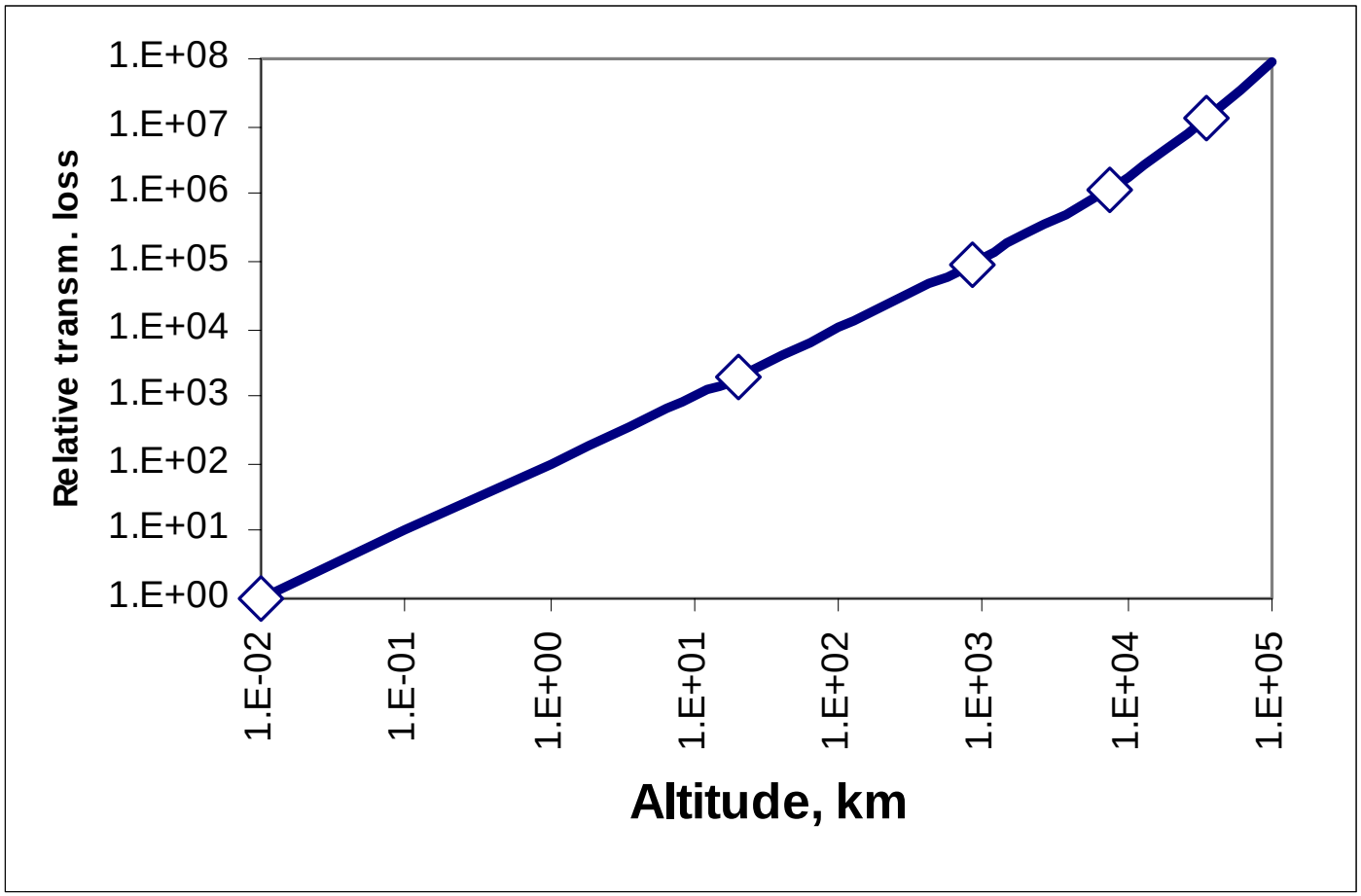
Source: ESA - (Ariane 5)

Signal latency restrict interactive applications



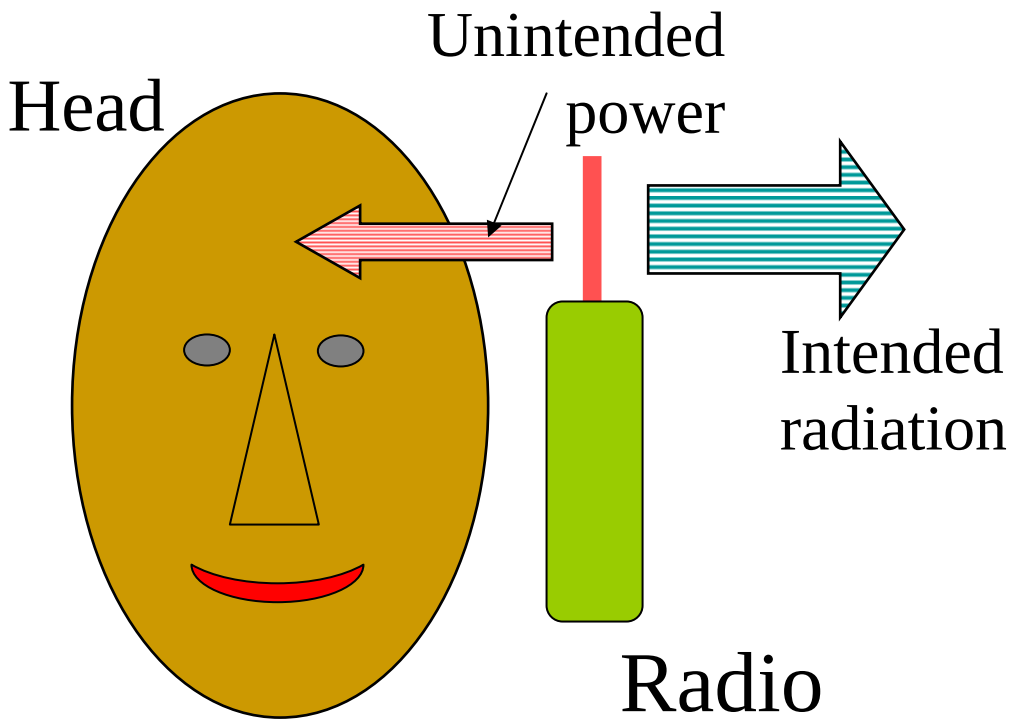
The time required for a signal to travel from one point on a network to another.

More power for higher altitudes



Power limits for hand-held radio

Radio waves interact with living tissue



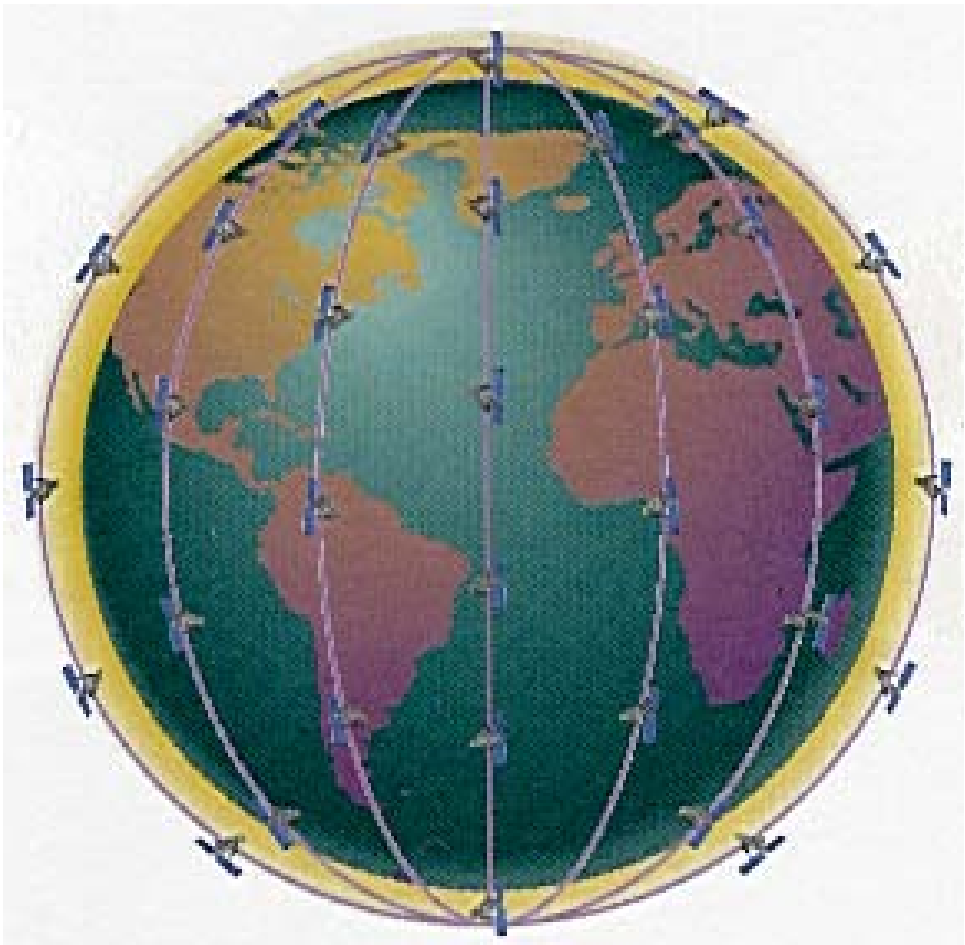
Limits: $2.7 mW/cm^2$ (6min.)
or 8W/kg (for any gram of tissue)

Source: J. Lin: Wireless communication radiation and its biological effects, Global Communications Interactive 1998

Launch of LEO satellites

(Source: Orbital Science Corp., 1998)

Low-Earth-Orbit Constellations

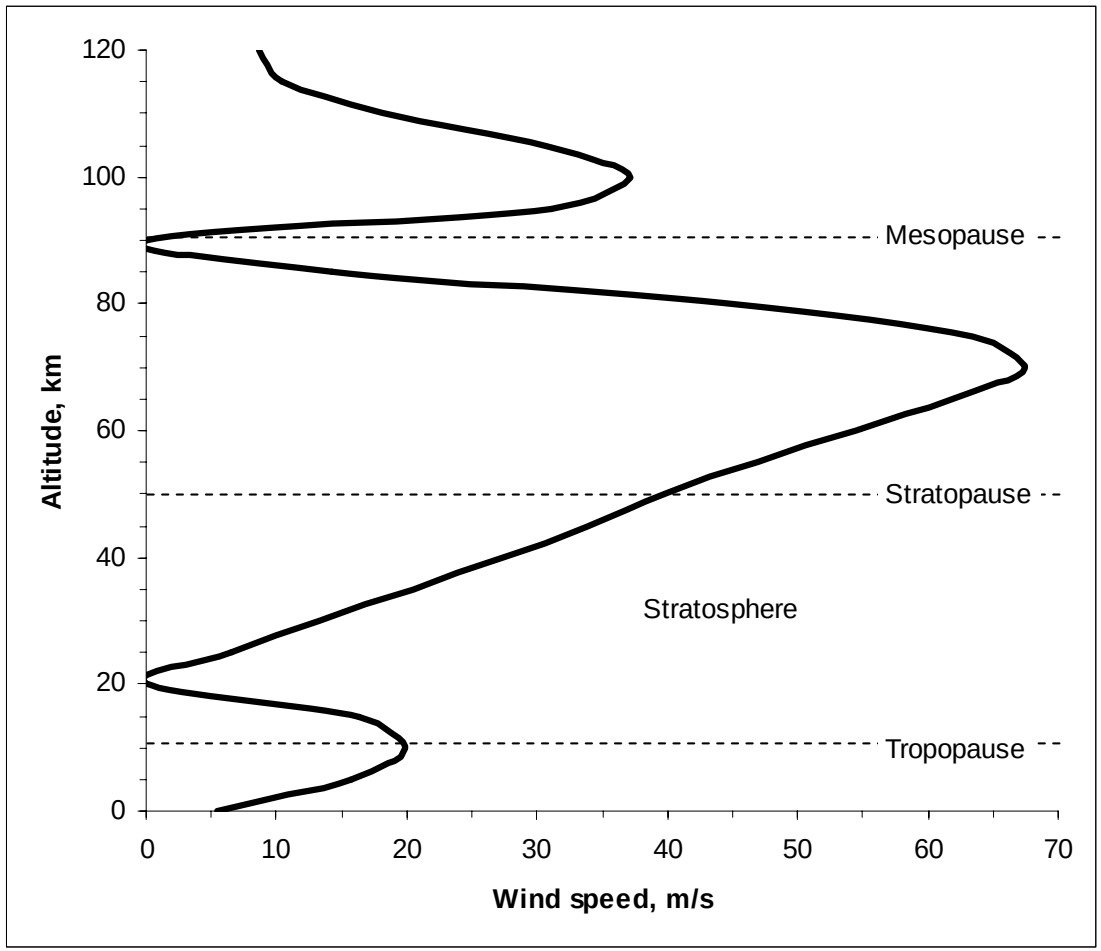


- At lower altitudes satellites move relative to the earth
- Satellite constellations are needed to assure continuous communications

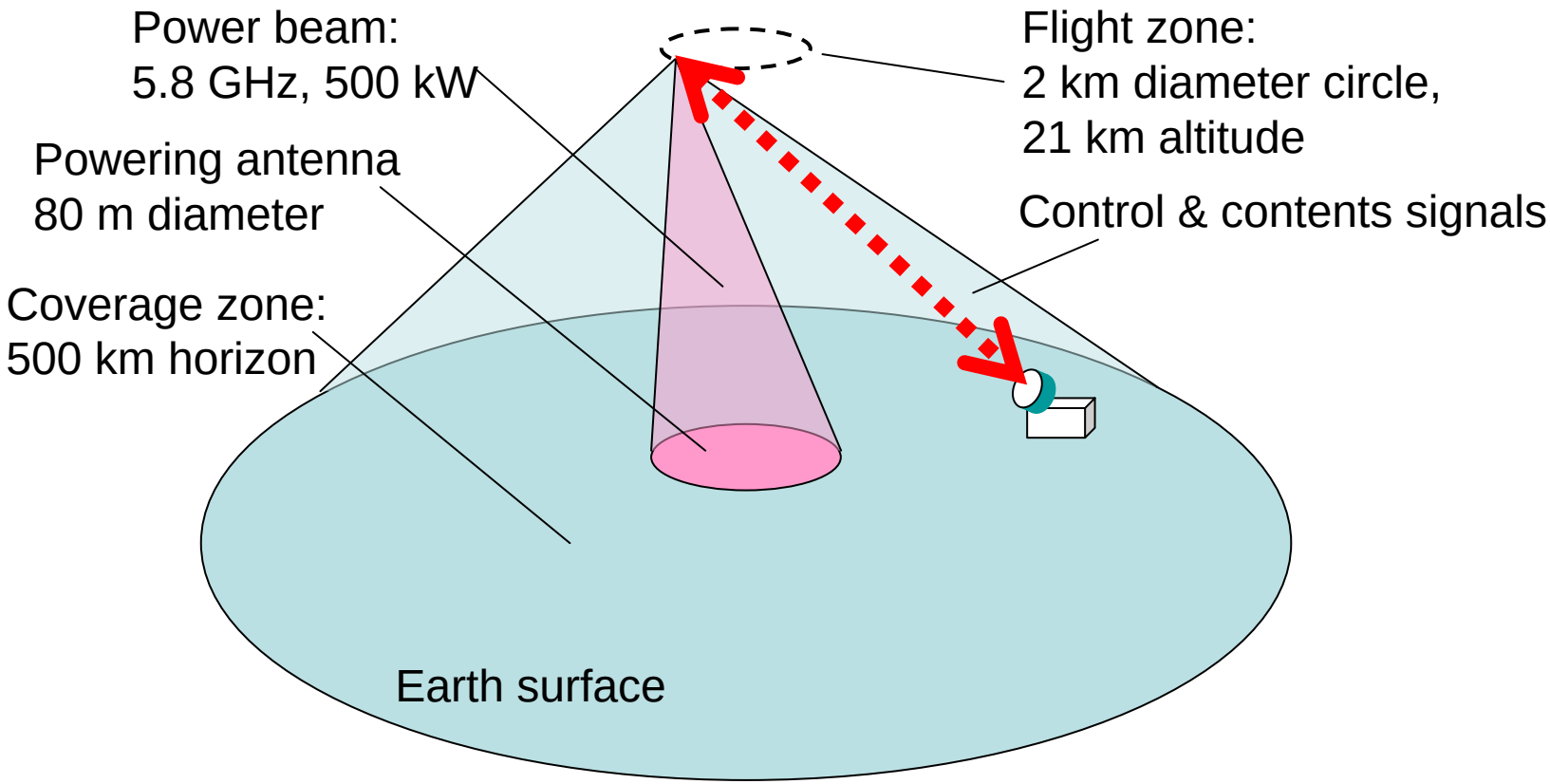
What is stratospheric radio?

- A way to keep antenna fixed at stratospheric heights (~20 km) with multiple applications:
  - Civilian Telecommunications Fixed & Mobile:
    - Broadband data – Multimedia – Interactive services - Direct broadcasting – Video on demand – Emergency - etc. …
  - Exploration, Environment, Navigation, Transportation, Military, …

Why stratospheric heights?



1987 SHARP: The first experiment



On 17 Sept. 1987, the Canadian Stationary High Altitude Relay Platform (SHARP) prototype makes history by flying for twenty minutes, powered by microwaves (An official flight takes place on October 7)

SHARP (model)

Source: http://www.friendsofcrc.ca/SHARP/sharp.html

1997: 10 years passed…

- The SHARP project was abandoned, but some limited research continued
- In 1997 - real “explosion” of projects
- A number of organizations are now involved
  - China, Germany, Hungary, Indonesia, Italy, Japan, Korea, Slovenia, Spain, Switzerland, UK, USA…

What happened in 1997?

- HAPS recognized by the ITU Radio Regulations Board as a new category of radio stations
(The author stays 2nd from left)

This decision has removed obstacles/ uncertainties in financing the development of that new technology

WRC Geneva 1997

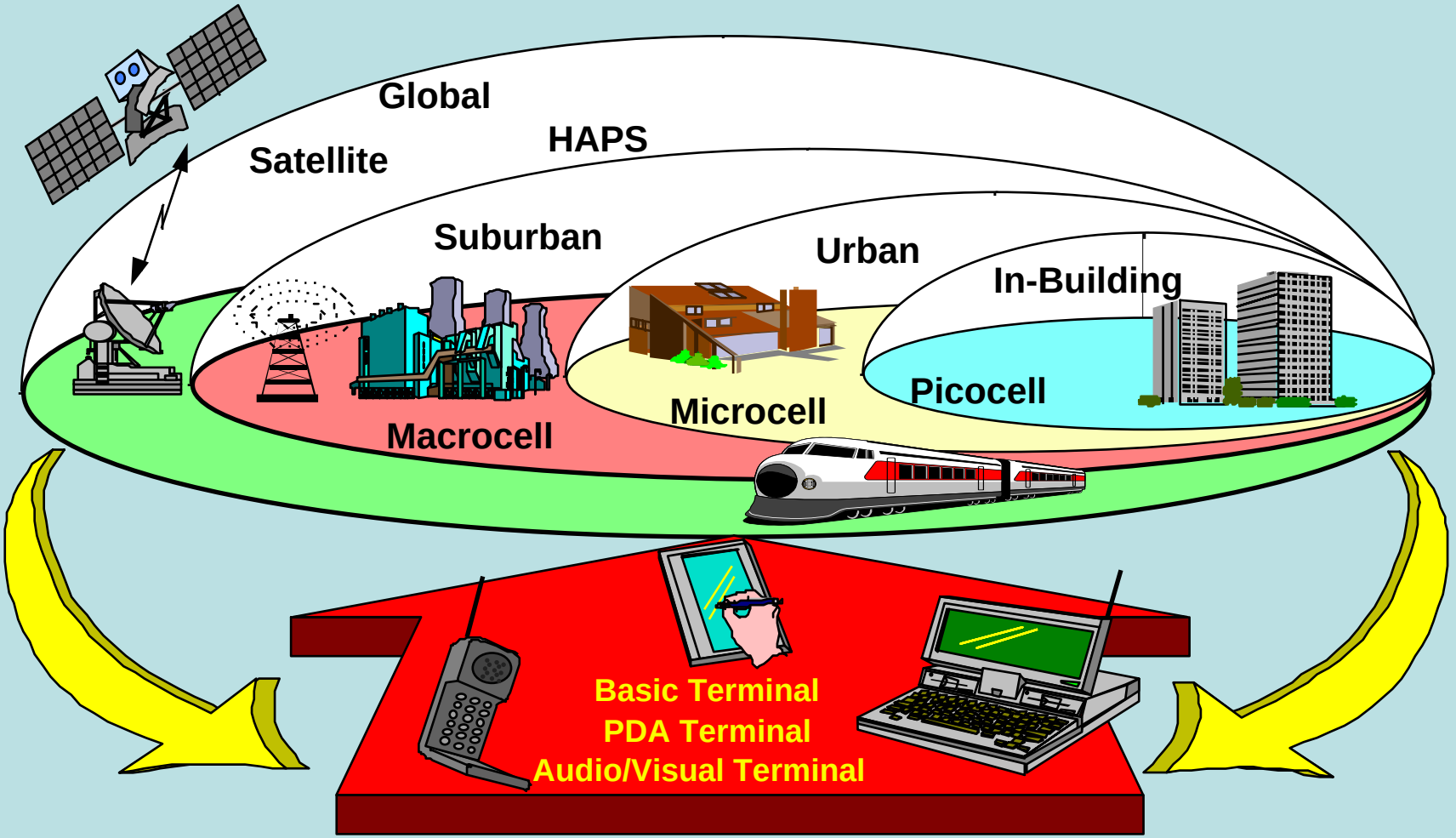
- The decision of RRB has been confirmed by consensus of all ITU Member Countries at the World Radiocommunication Conference (WRC) Geneva 1997

WRC Istanbul 2000

The ITU Radiocommunication Assembly and World Radiocommunication Conference Istanbul 2000:

- allocated frequency bands near 20 GHz for HAPS and
- made appropriate provisions in the international treaty (Radio Regulations)

IMT-2000: flexible, multifunctional



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2 categories

- Aerodyne:
  - A heavier-than-air aircraft deriving lift from motion relative to surrounding air
- Aerostat:
  - A balloon or dirigible, deriving its lift from the buoyancy of surrounding air rather than from aerodynamic motion.

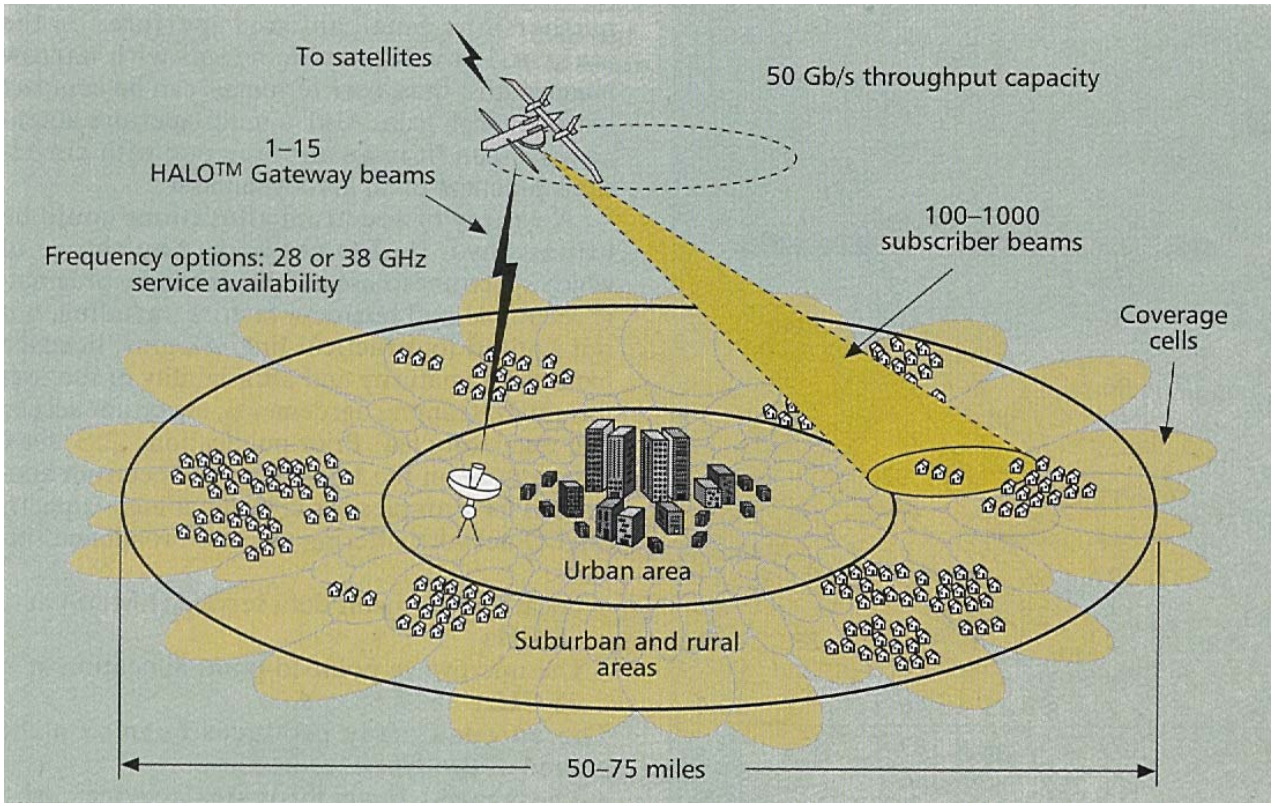
Powering

- Periodical refueling
  - Combustion engine (Gasoline)
  - Nuclear engine (Thermoelectric)
- Receiving energy from the earth
  - Microwaves
  - Laser
- Capturing solar energy (day) + fuel cells (night)

Stratospheric radio family

- HALE: High Altitude Long Endurance
- HAPS: High Altitude Platform Station
- SHARP: Stationary High Altitude Relay Platform
- SPR: Stratospheric Platform Radio
- “Stratospheric Satellite”
- All at the altitude 15 – 30 km

HALO Network



3 Proteus airplanes (900 kg) per city

Source: IEEE Communications Magazine June 2000 p. 143

Proteus

http://www.dfrc.nasa.gov/Newsroom/FactSheets/FS-069-DFRC.html

Predator

NASA Dryden Flight Research Center Photo Collection
http://www.dfrc.nasa.gov/gallery/photo/index.html
NASA Photo: ED02-0185-01 Date: September 7, 2001 Photo by: Dick Jones - Sandia Labs

Unmanned reconnaissance aircraft, Predator B in flight.

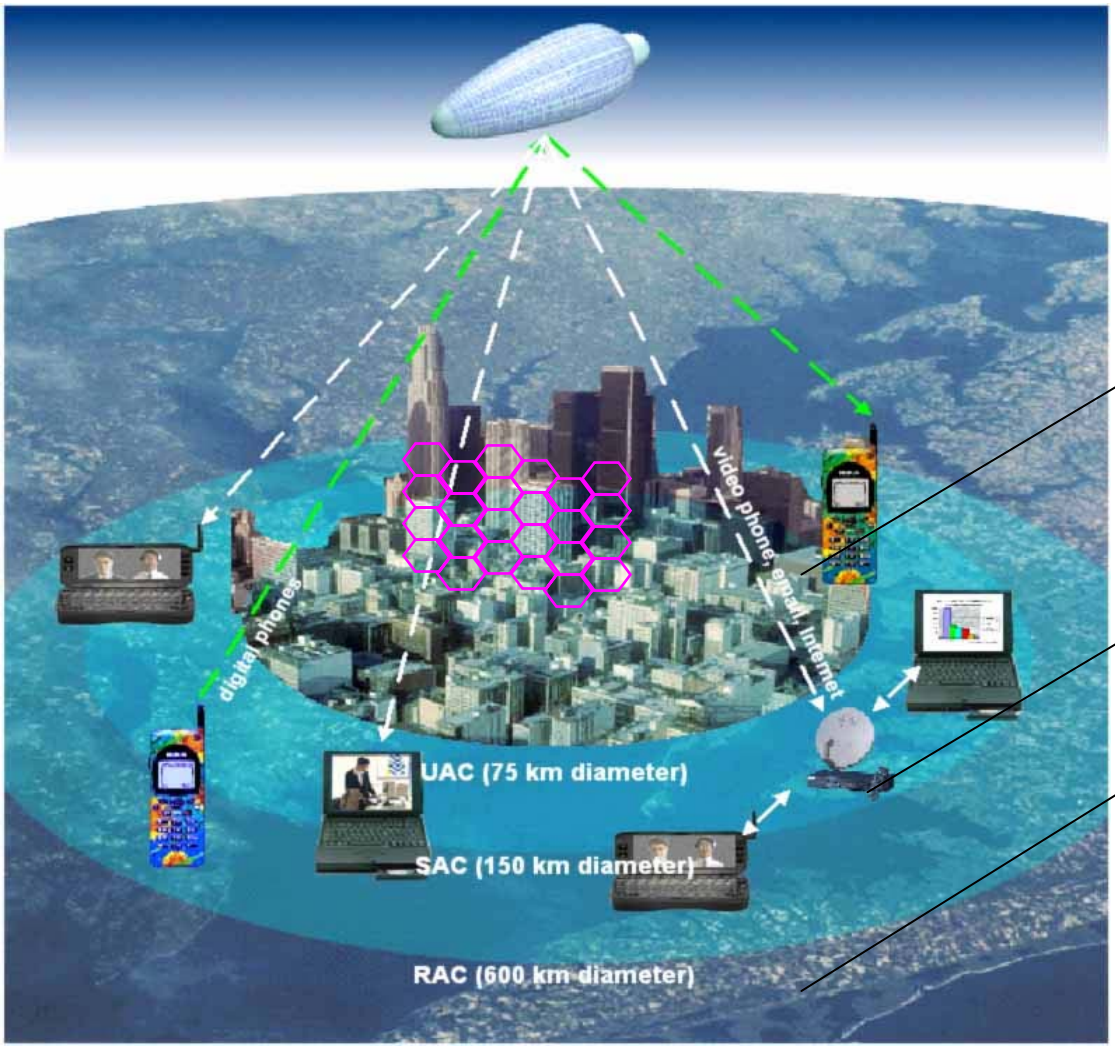
Helios

NASA Dryden Flight Research Center Photo Collection
http://www.dfrc.nasa.gov/gallery/photo/index.html
NASA Photo: ED01-0209-5 Date: July 14, 2001 Photo by: Nick Galante/PMRF
The Helios Prototype flying wing is shown near the Hawaiian islands of Niihau and Lehua during its first test flight on solar power from the U.S. Navy's Pacific Missile Range Facility.

Sad news

- On June 26, 2003, the Helios aircraft was lost in the Pacific Ocean, 29 minutes after takeoff during a test flight (Kauai island, Hawaii)
- The flight was to checkout the operation of a new fuel cell system developed for overnight flight operation in the stratosphere

Sky Station International



2100 Cells

Urban

Sub-Urban

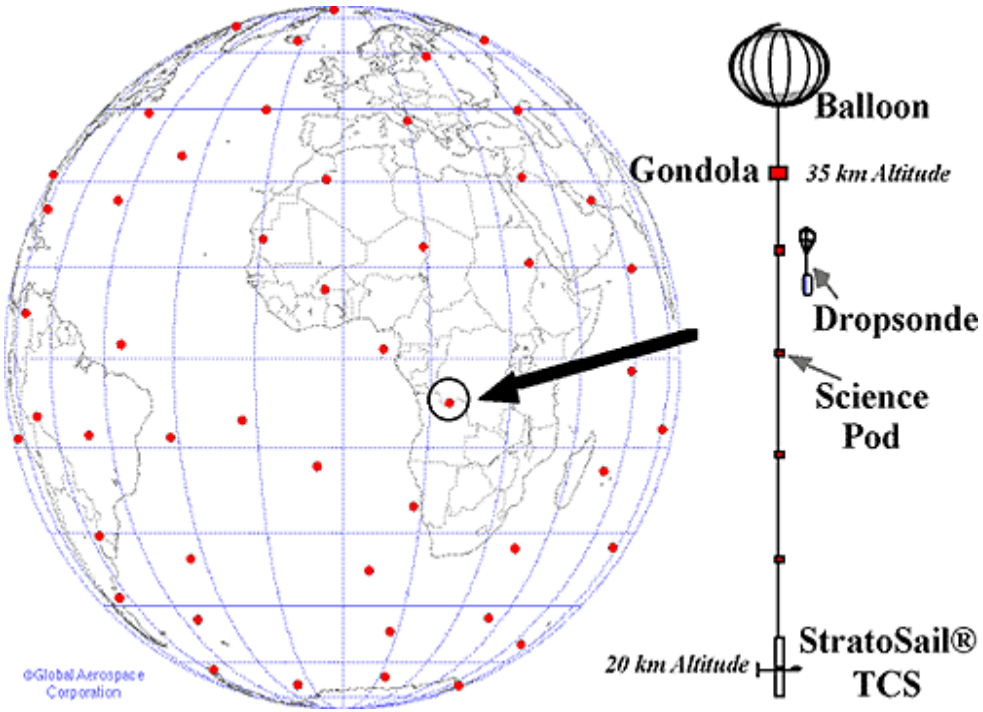
Rural

“Stratospheric satellites”

Model of Fully-Pressurized Balloons In Flight. Picture courtesy of NASA.

- “Super-pressure" balloons powered by solar array.
- Carrying remote sensing or telecom. payloads up to 2 tons
- Can be steered and directed to fly over and monitor specific areas, with a trajectory control
- Would augment and complement many satellites

StratoSat ™



- Constellations of StratoSat platforms would circle the Earth at an altitude of 35 km
- Key features:
  (a) affordable, long-duration balloon systems
  (b) balloon flight path control capability,
  (c) constellation geometry management, and
  (d) a global communications infrastructure.

StratoSat™ (cont)

- Projected life: 3-10 years.
- The projected life-cycle cost < $400,000/ unit, or 10 to 100 times less than aircraft or space satellite communications platforms
- Current project: A constellation of 400 Stratospheric Satellites to cover most of the northern hemisphere. Cost: < $160 million + < $10 million per year of operations costs
- Source: http://www.gaerospace.com/ (June 2002).

StratoSat test flight 10 Mar 2001

- Picture courtesy of NASA

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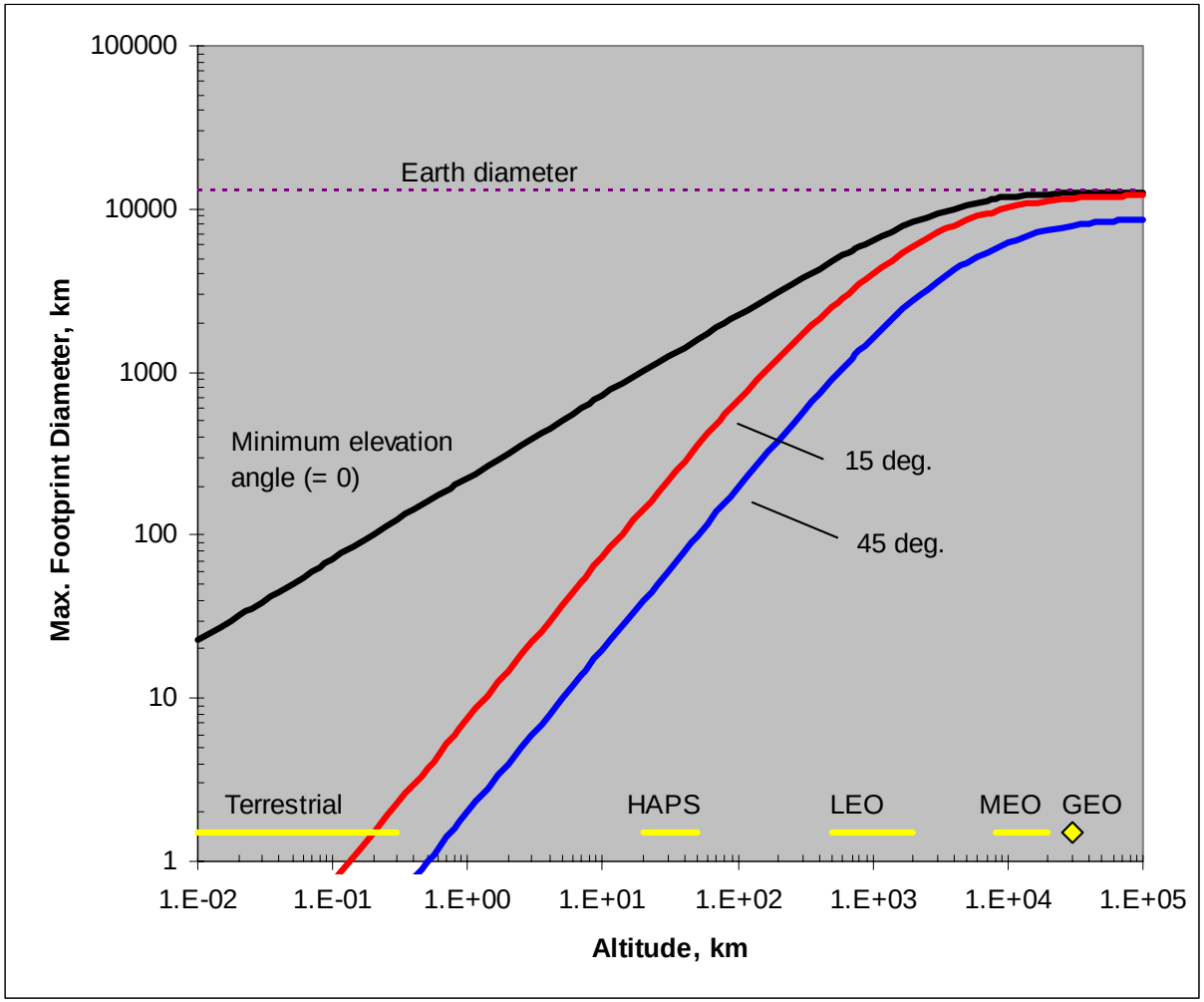
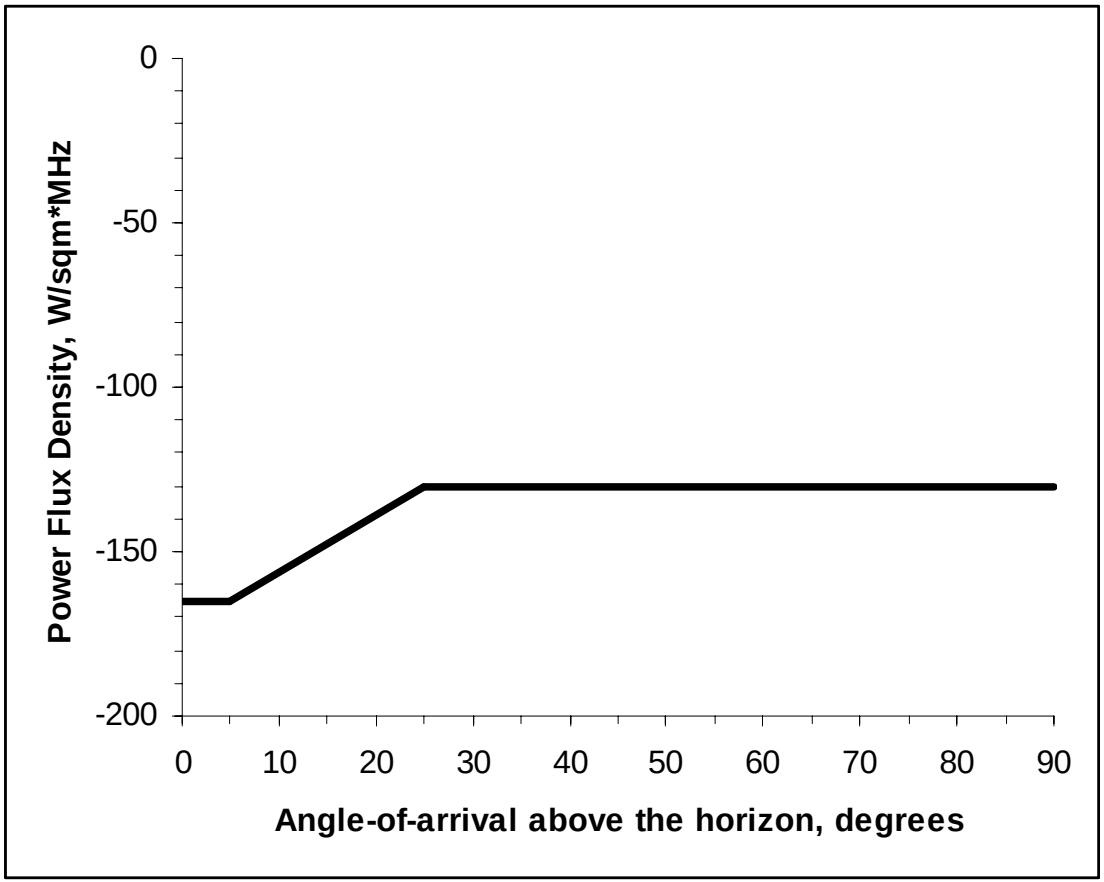
  - SkyTower
  - Helios
  - Data
- Conclusion

Range comparison



Maximum power-flux density



Conclusion

- With all promises fulfilled, stratospheric radio will facilitate the access to modern information structures
  - Emergency telecommunications
  - Nomadic users
  - Sparsely-populated and remote regions
  - Lower-income social strata
- Will impact the business of the existing terrestrial & satellite services
- Will create new EMC problems?

To learn more…

- A number of bibliographic positions and Web references are given in
  - Struzak R: "*Mobile telecommunications via stratosphere*"; http://www.intercomms.net/docs/features.php

Any questions?

Thank you for your attention

- Display of films

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