ICTP-ITU/BDT-URSI School on Radio-Based Computer Networking for Research and Training in Developing Countries
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The role of radiocommunications for development

(Talk at the opening of the School)

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

Outline

- Development and digital divide
- Why radio?
- Short film

Human development - what is it?

- … evolution from a less advanced to more advanced stage ...
- Central element: knowledge creating, gathering, and sharing, and applying it to solve problems
  - *The progress of humanity - since the Stone Age until the XXI century - has been possible thanks to gathering and sharing knowledge …*
- *Involves teaching & learning i.e. collaboration (if we excluding spying)*
  - *J Delors: Learning: the treasure within; Report to UNESCO of the International Commission on Education in the Twenty-first Century, UNESCO 1996*
  - "Knowledge is central to development" - World Bank, 1998, quoted after Sarah Cummings, Richard Heeks & Marleen Huysman; 'Knowledge and Learning in Online Networks in Development - A Social Capital Perspective' (2003); http://www.sed.manchester.ac.uk/idpm/publications/wp/di/index.htm;

- Knowledge bases on information and data that reside in information infrastructures
- Access to knowledge = access to information infrastructures
- Barriers:
    - Physical, Financial, Regulatory, Organizational, Mental, etc.

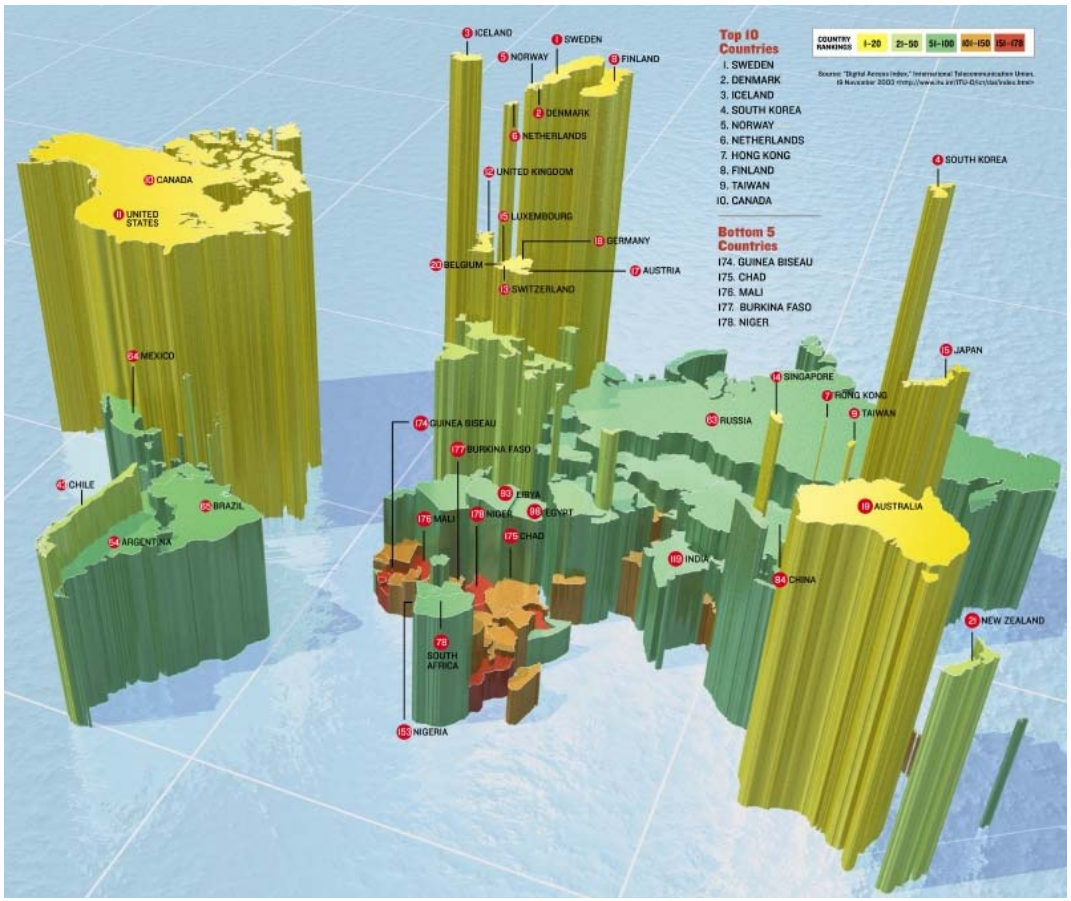
In the last 3 years…

- The amount of new information stored on paper, film, magnetic, and optical media worldwide was ~800 MB per person per year, in average
    - It would take ~10m of books to store it (formatted) on paper.
- It has about doubled during that period

- 92% of all information was stored on magnetic media
- Information stored on paper was only ~0.01%!
- If that trend continues
  - Almost all information will be in electronic format
  - More new information will be created over the next 3 years than has been produced over the ***entire history of mankind***

» http://www.sims.berkeley.edu/research/projects/how-much-info-2003/

“Digital divide”



Map of relative ability of individuals to access IT infrastructures

Digital Access Index (DAI)

Prepared by ITU for WSIS 2003

http://www.itu.int/ITU-D/ict/dai/

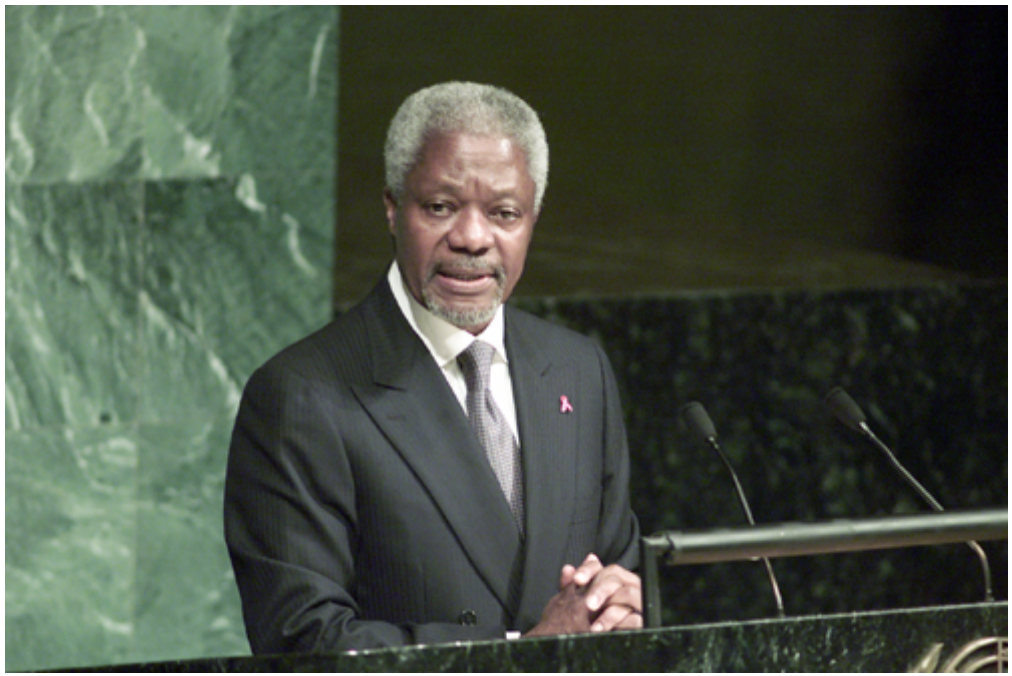
http://www.spectrum.ieee.org/WEBONLY/resource/feb04/0204bmapf1.pdf

http://www.internetworldstats.com/list3.htm

Business perspective

- ICT created a big industry that must continuously grow to keep profits and workplaces
- As markets in wealthy regions approach saturation, new markets are sought
- An inexpensive technology would create new markets in poor regions - 80% of the world population

Humanitarian perspective



- Kofi Annan, 2000
  - We, The Peoples: The Role of the UN in the 21-st Century. Millennium Report (2000)
  - Telecommunications close the ‘digital gap: information-rich vs. information-poor’

UN Secretary General, Report 2000 (http://www.un.org/millennium/sg/report/full.htm)

Challenge

- Assuring universal access to information infrastructure in rural, remote, and under-developed regions is an enormous challenge of the 21st century
- This school is limited to discussions on new radio technologies that could facilitate access to information infrastructures

International collaboration

- It could not be possible without collaboration and support offered by a number of organizations and individuals:
  - ICTP http://wireless.ictp.it/
  - UNESCO http://portal.unesco.org/en
  - ITU http://www.itu.int/home/
  - URSI http://www.ursi.org/
  - World Bank http://www.worldbank.org/

Thanks to all who have contributed!

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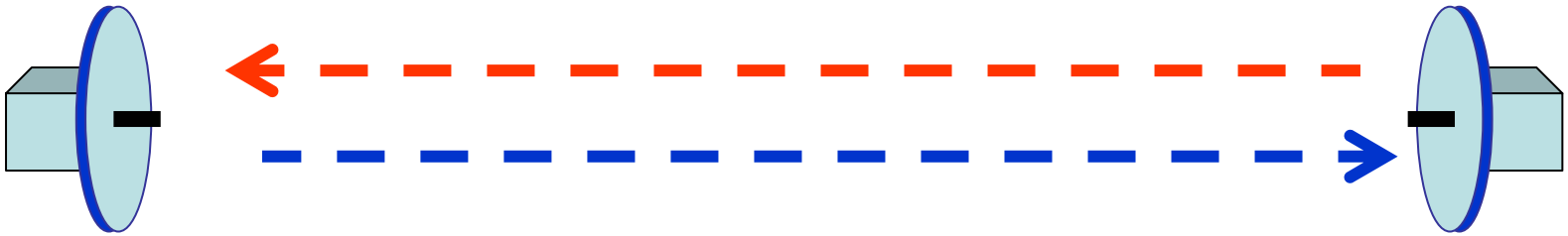
Why radio?

- Because it is unique access technology to local and global information infrastructures
  - In emergency situations - assuring liaison anywhere and anytime
    - » The December 2004 tsunami in South-East Asia evidenced the role of radiocommunications
    - » Other aspects are discussed in R Struzak: Emergency Telecommunications with and in the Field; UN OCHA 2000
- Most future telecommunication devices will be mobile or transportable – wireless
    - » J Zander, SL Kim: Radio resource management for wireless networks; Artech House 2001, p. 315
- In some situations, radio is also the least expensive technology
  - Especially in sparsely-populated and remote regions with no pre-existing wired/ cabled telecommunications

Focus on radio

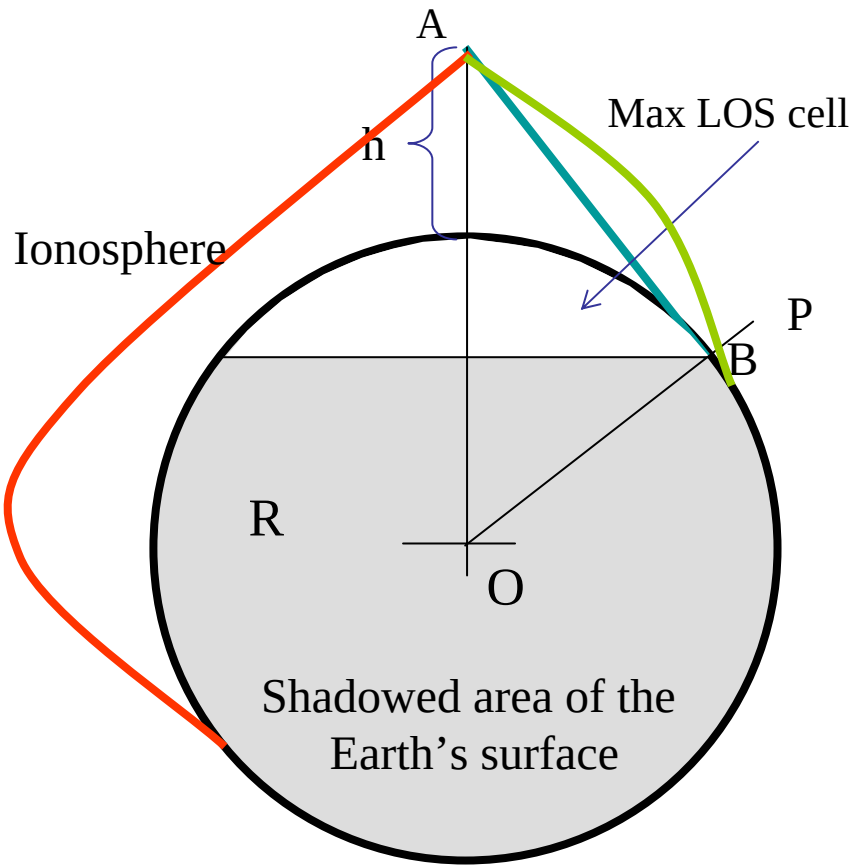


Radio waves carry information to fixed & mobile users at no cost

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

*Over the Earth’s surface

Evolution



- Terrestrial radio
  - Microwave LOS
  - HF ionospheric
- Satellite radio
  - LEO, GEO, MEO
- Stratospheric radio

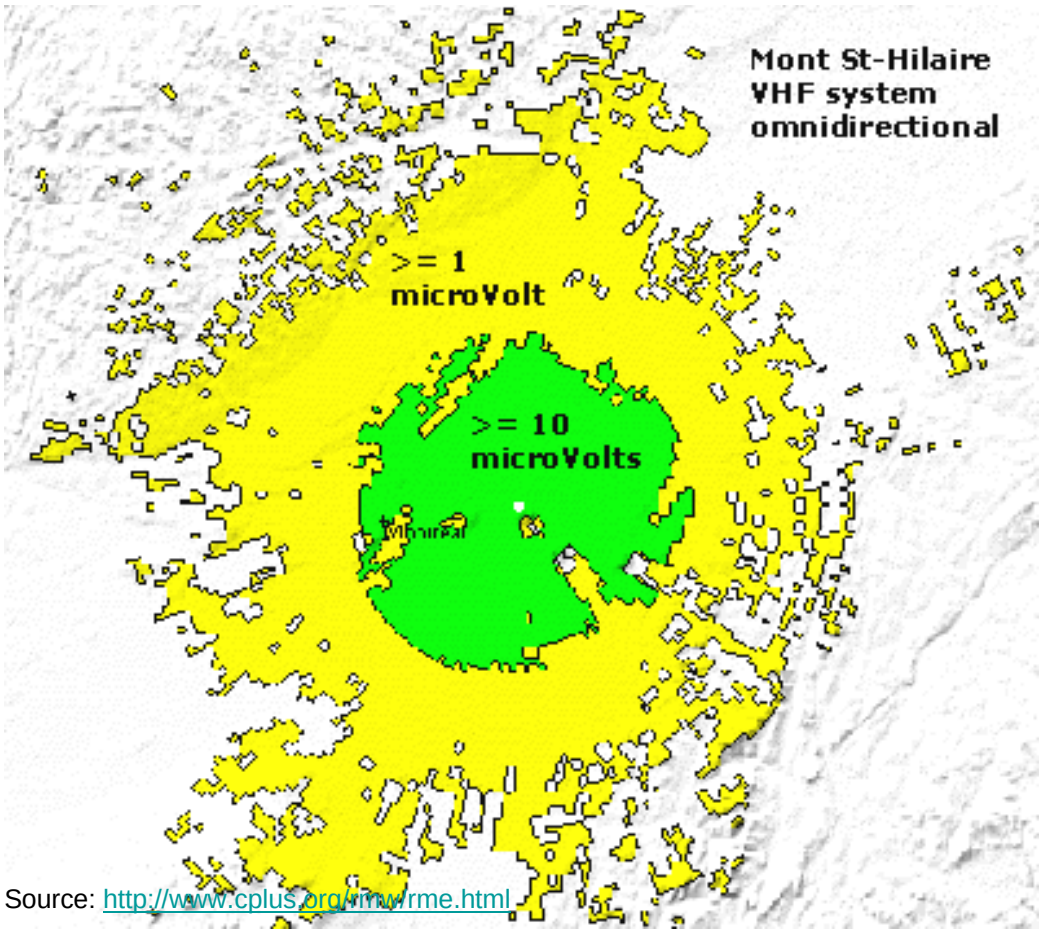
LOS = Line-Of-Sight

Terrestrial radio

- Patrick Gelsinger (INTEL Senior Vice President and Chief Technology Officer), advises developing nations to leapfrog the digital gap using fiber optic cable and terrestrial wireless technology, WiFi and WiMAX
  - » Quoted after Larry Press, "Wireless Internet connectivity for developing nations," *First Monday,* volume 8, number 9 (September 2003), at http://www.firstmonday.org/issues/issue8_9/press/index.html#note4.
  - » See http://www.ieee802.org/16/ and http://www.ieee802.org/20/.

- The school lectures and practical work focus on various aspects of microwave WiFi & WiMAX technologies
  - WiFi stays for "Wireless Fidelity", a set of IEEE 802.11 standards for wireless local area networks (WLAN)
  - WiFi promises communications at speeds up to 11 Mbps within rooms, extendable up to 25 km http://en.wikipedia.org/wiki/Wifi
  - WiMAX an acronym for “Worldwide Interoperability for Microwave Access” a set of IEEE 802.16 standards (2003)
  - WiMAX promises communication over distances up to 50 km at speeds up to 70 Mbps in three architectures, point–to–point, point–to–multipoint and point–to–multipoint plus a neighborhood mesh http://en.wikipedia.org/wiki/Wimax

Terrestrial radio coverage



Source: http://www.cplus.org/rmw/rme.html

- Microwave terrestrial LOS systems suffer from terrain obstacles
- Short-wave systems are narrow-band and suffer from fading

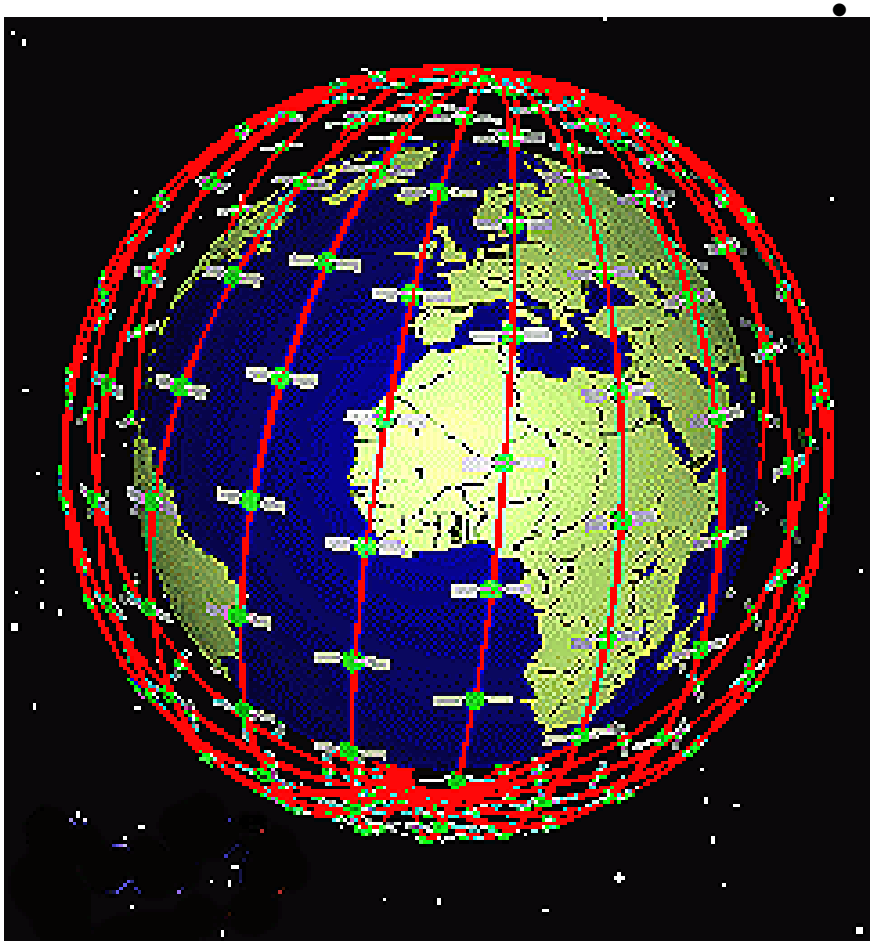
GEO satellites

- GEO-satellite based services are often cheaper than terrestrial ones when the cost is shared by many users
- But they are impractical for some applications (latency)

Source: ESA - (Ariane 5)

- Very small aperture terminals (VSAT) are the cheapest GEO satellite terminals
- There are more than 500,000 VSAT systems operating in more than 120 countries
    - » According to the Global VSAT Forum, [http://www.gvf.org/].
    - We will have later special lectures and practical exercises with a VSAT station.

LEO satellites

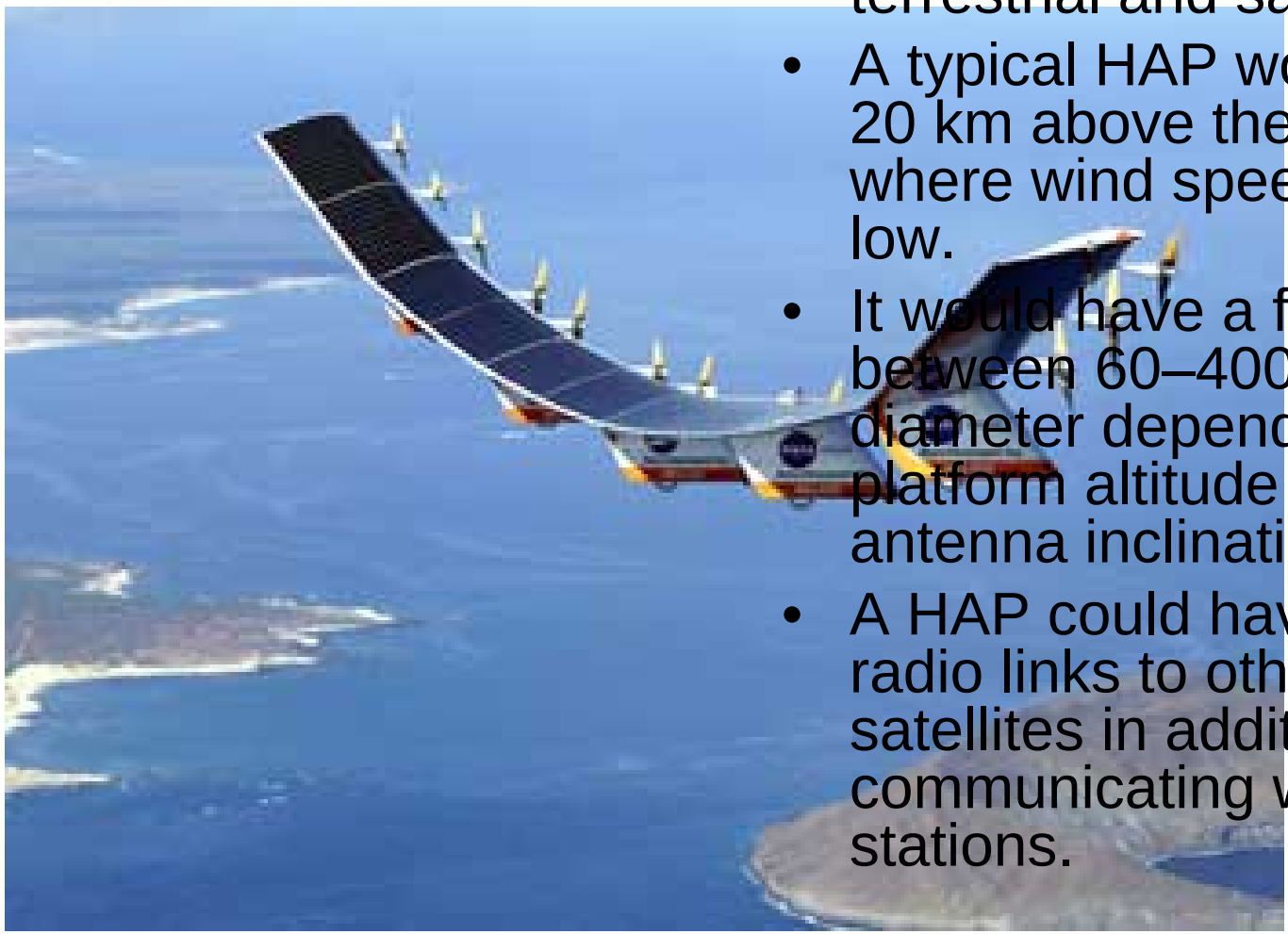


Source: This image was generated using Satellite Constellation Visualizer, at http://sourceforge.net/projects/savi/.

- Low earth orbit (LEO) satellites overcome the latency and cost problems of GEO satellites
- At any point on the earth, a single LEO satellite is visible during a short time period
- That allows for store and forward applications like e–mail, but excludes interactive applications.
- Continuous service can be assured by a satellite constellation in which every point on earth is visible to at least one satellite at all times (plus inter–satellite communication links). But it is a very expensive solution.
  - *For further reading see e.g.: R Struzak:* Satellite industries at the turn of the century; http://www.intercomms.net/AUG03/content/struzak2.php
  - For store-and-forward email see e.g. http://www.vita.org/programs/communication.htm

Launch of LEO (Teledesic) satellite

HAPS



- HAPS are one alternative to terrestrial and satellite links.
- A typical HAP would fly about 20 km above the ground, where wind speed is relatively low.
- It would have a footprint between 60–400 kilometers in diameter depending upon platform altitude and ground antenna inclination.
- A HAP could have optical or radio links to other HAPs or to satellites in addition to communicating with ground stations.

Radio-controlled, solar-powered Helios prototype during its test flight over the Hawaiian Islands on 14 July 2001. (NASA Dryden Flight Research Centre Photo Collection. Courtesy of NASA.)

- The proponents of HAPS technology promise services much cheaper that the terrestrial and satellite systems
- There are a number of R&D projects under way, but no HAP station has been in operation yet
  - » *R Struzak:* Mobile telecommunications via stratosphere; http://www.intercomms.net/AUG03/content/struzak1.php http://www.capanina.org/; http://www.capanina.org/news.php (videos)
  - There will be a short film on one of HAPS technologies at the end of the lecture

Other perspectives

- Ultra-wideband technology (UWB)
  - UWB promises cheap communications below levels of existing signal environment
- Telecommunications via power lines
  - No additional wires required
- The promises and problems of these technologies will be discussed separately during the school

Warning…

- Many predictions made in the past have proved to be dramatically wrong, even when made by experts with impeccable credentials...

"Heavier-than-air flying machines are impossible" [*Lord Kelvin, famous physicists,* 1897]

"Radio has no future" [*Lord Kelvin, famous physicists,* 1897]

"There is no reason for any individual to have a computer in their home" [*Ken Olsen, Founder & President of Digital Equipment Corporation, 1977*]

- Development involves various problems and interests, various needs, various cultures and systems of values, etc.
- These differ significantly among social groups and nations, making mutual understanding and solidarity difficult

- Access technology is only one of the necessary elements
- Technology alone could not bridge the digital gap
    - Liberal market mechanism is unable to assure universal access and eradicate poverty. The 1970-2000 technological boom in the USA did not change the poverty rate (>10%) but increased the income gap between the rich and the poor (by ~50%)
        - » (K. Venkat: Delving into the Digital Divide; IEEE Spectrum Feb 2002, p.16)

- One of obstacles is excessive costs of accessing scientific and technical publications, computer programs, data sets etc. that are protected by intellectual property rights
- Will we make these costs affordable?
- Quiz
  - How many of you would be ready to use free software?
  - How many of you would be ready to offer your work free?
    - » See http://www.earlham.edu/~peters/fos/fosblog.html, http://www.earlham.edu/~peters/fos/timeline.htm, http://www.dli2.nsf.gov/.

Final remark

- Digital divide is a manifestation of poverty - it is meaningless for those who lack safe water, adequate nutrition, basic education, and other essentials…

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Any question ?

Thank you for your attention

Short film

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