AFFORDABLE SPACE-BASED TELECOMMUNICATIONS FOR MONITORING AIR POLLUTION AND ENERGY USE

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  - One-way
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REQUIREMENTS

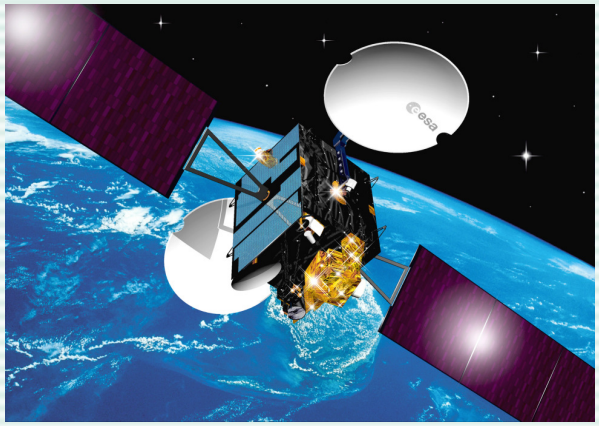
- Environmental or energy usage data need to be collected
- Delivery to processing centre, decision makers
- Distribution of processed remote sensing data to users, decision makers

TELECOMMUNICATIONS REQUIREMENTS

- Space-based tools available, many of them free of charge
- Access via Internet
- In many areas suitable Internet access may not be available

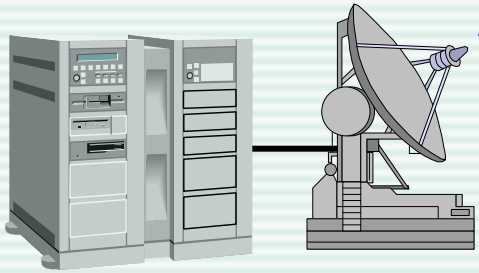
SATELLITE COMMUNICATIONS

- Wide coverage (country, continent, inter-continental)
- Broadcast capability
- High data rates
- Flexibility in network set-up
- Mobility
- Rapid deployment
- Reliability
- Economic solutions available
- Systems for Internet access and (one-way) data dissemination existing

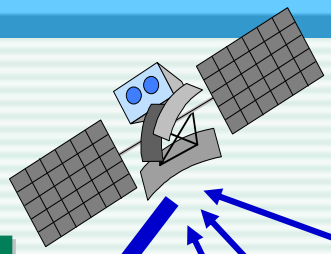


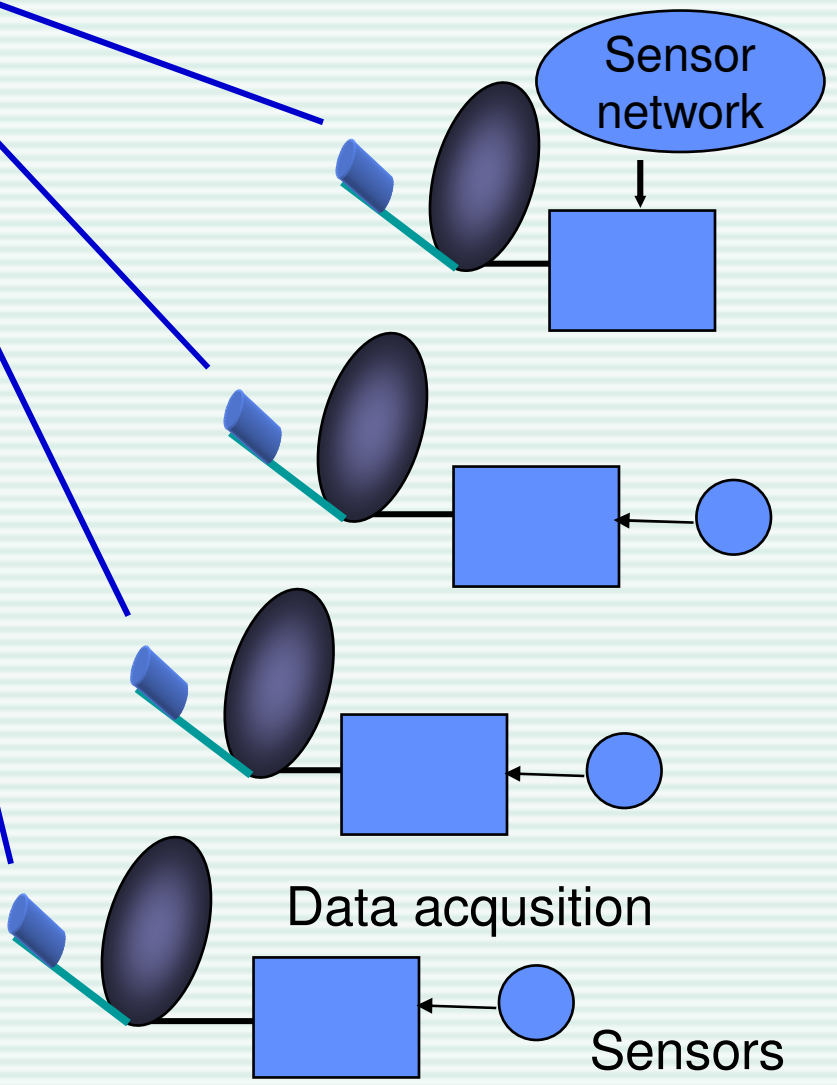
Source: ESA

DATA COLLECTION

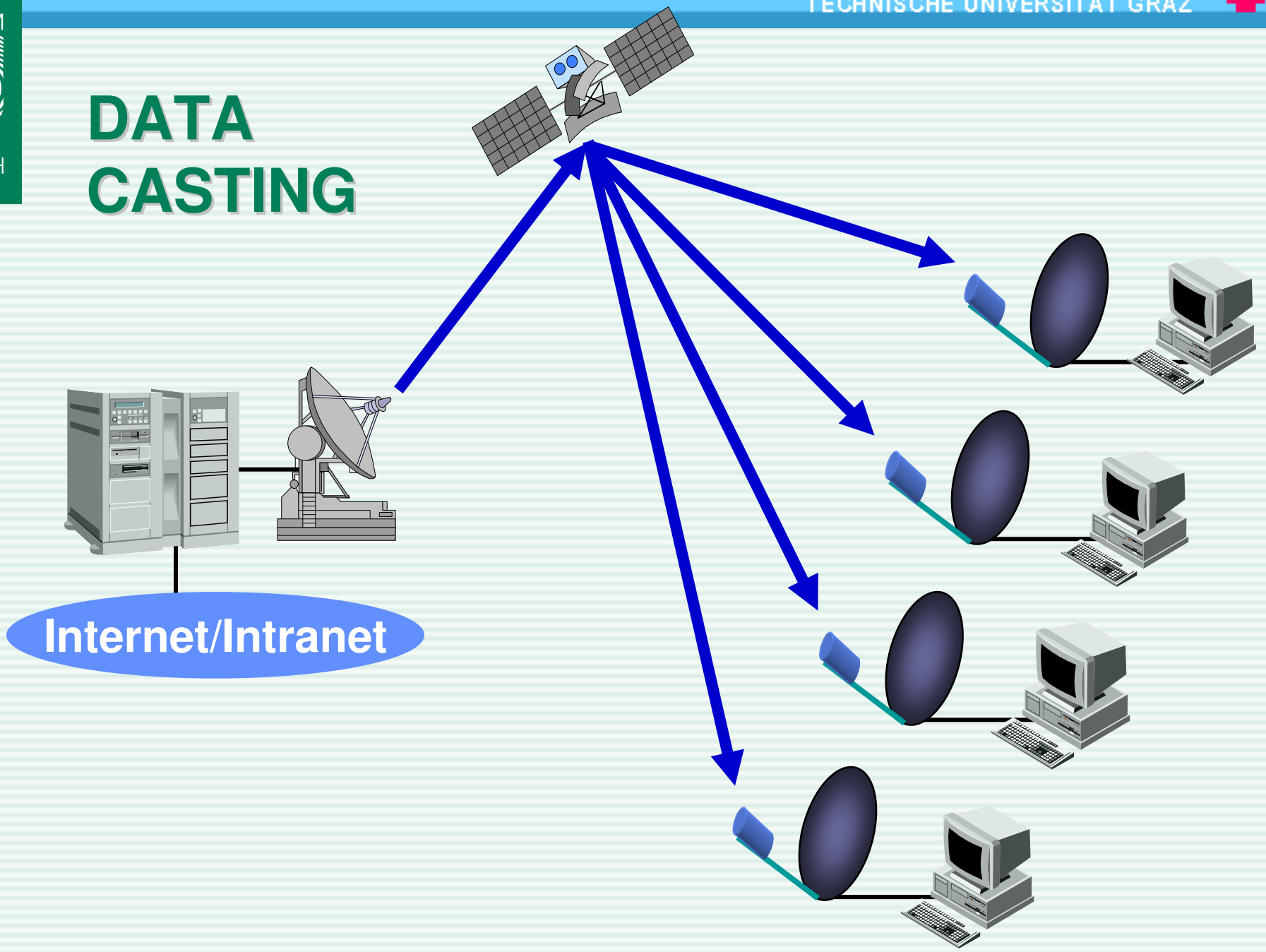


Data collection Centre

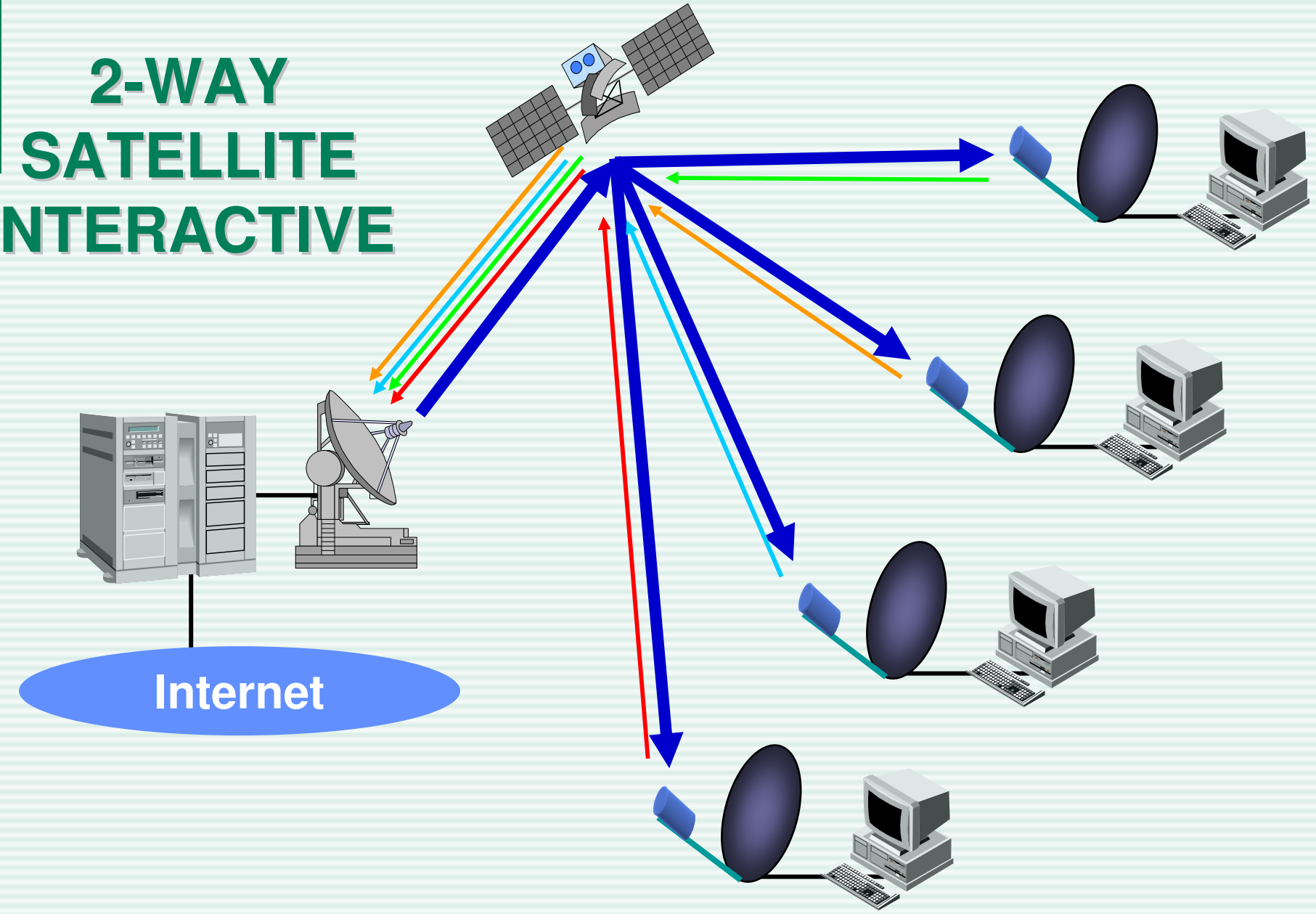




DATA CASTING



2-WAY SATELLITE INTERACTIVE

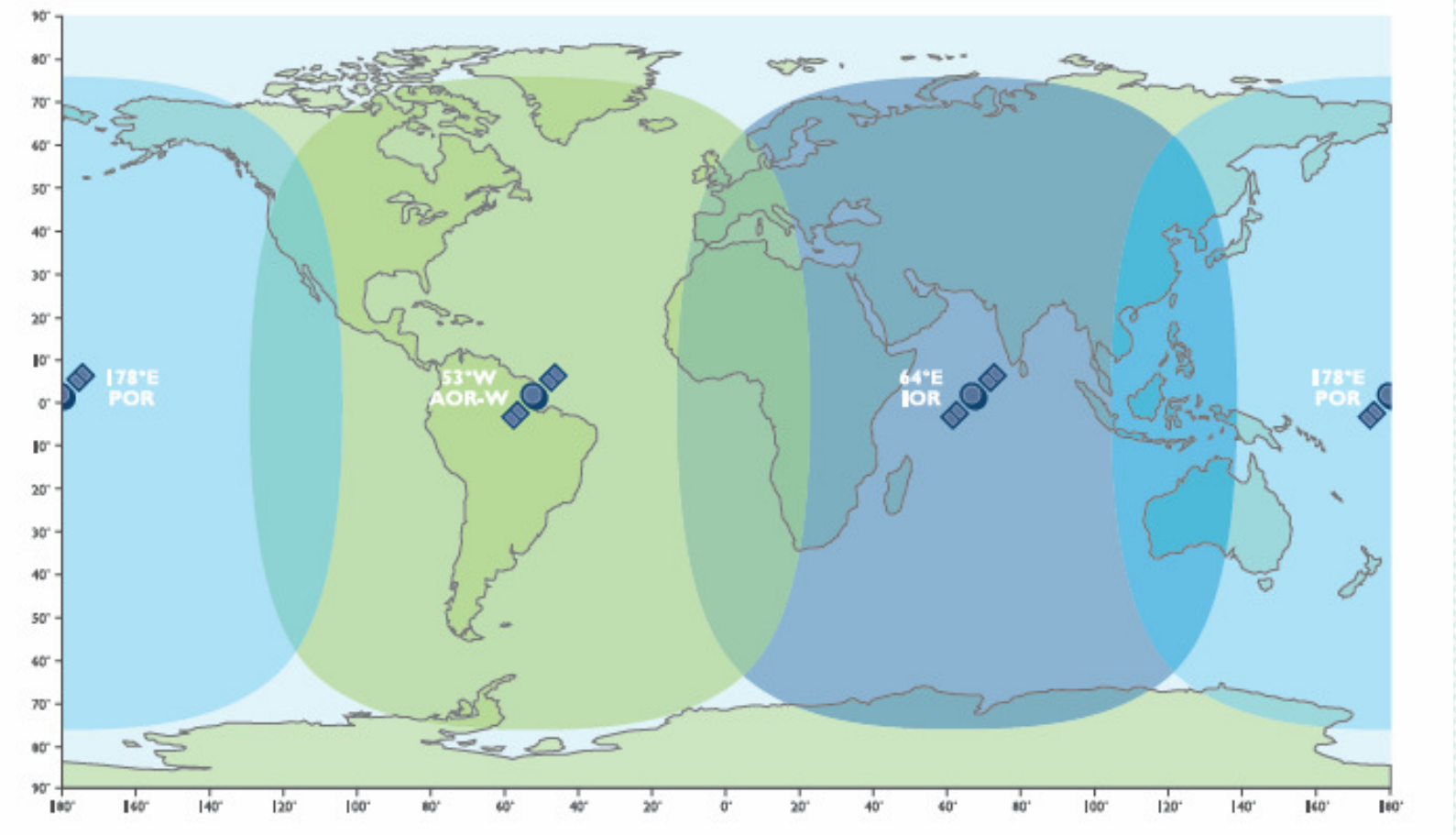


AVAILABLE SYSTEMS

INMARSAT

- **INMARSAT systems since 1979**
  - → 4 generations of satellites
  - → 11 satellites operational (1 spare)
- **Main application: maritime, aeronautical, land-mobile communications**

INMARSAT COVERAGE



Source: INMARSAT

INMARSAT-4

Source: INMARSAT

Spacecraft Power: 12 kW (DC)
Solar arrays: 48 m
Mass: 6000 kg

EIRP: 67 dBW

1 global beam
228 narrow spot beams
19 wide spot beams
630 channels (200 kHz each)

L-Band (1.5 – 1.6 GHz)

INMARSAT BGAN

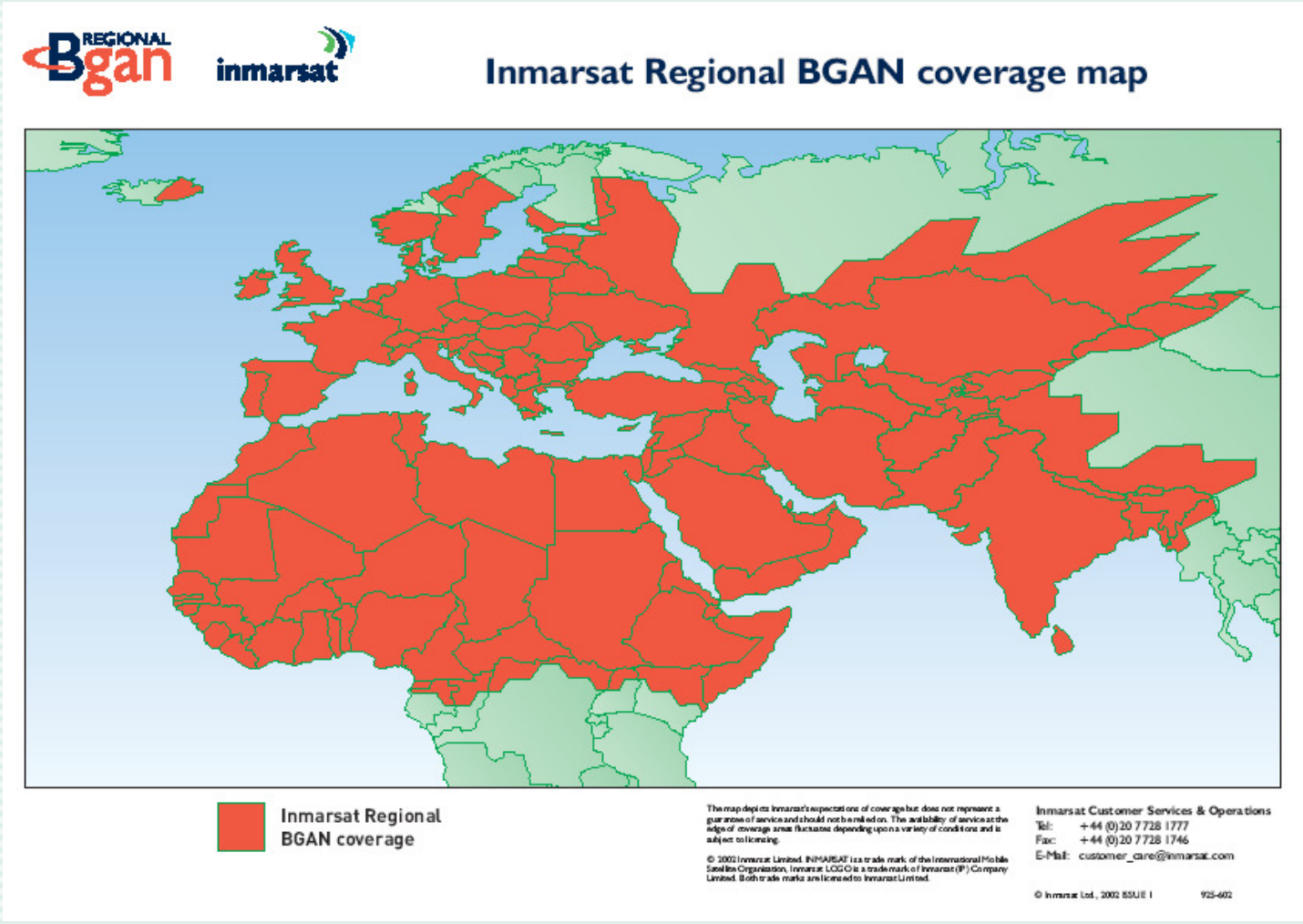
- Laptop-sized terminal
  - → 1.6…1.8 kg
  - → 30x24x4 cm
- Up to 400 kbit/s data rate (two-way)
- Wide coverage

BGAN TERMINAL
Broadband Global Area Network

- 1) Integral antenna
- 2) Compass
- 3) SIM card
- 4)Battery
- 5) External power
- 6) USB
- 7) Indicators
- 8) Ethernet

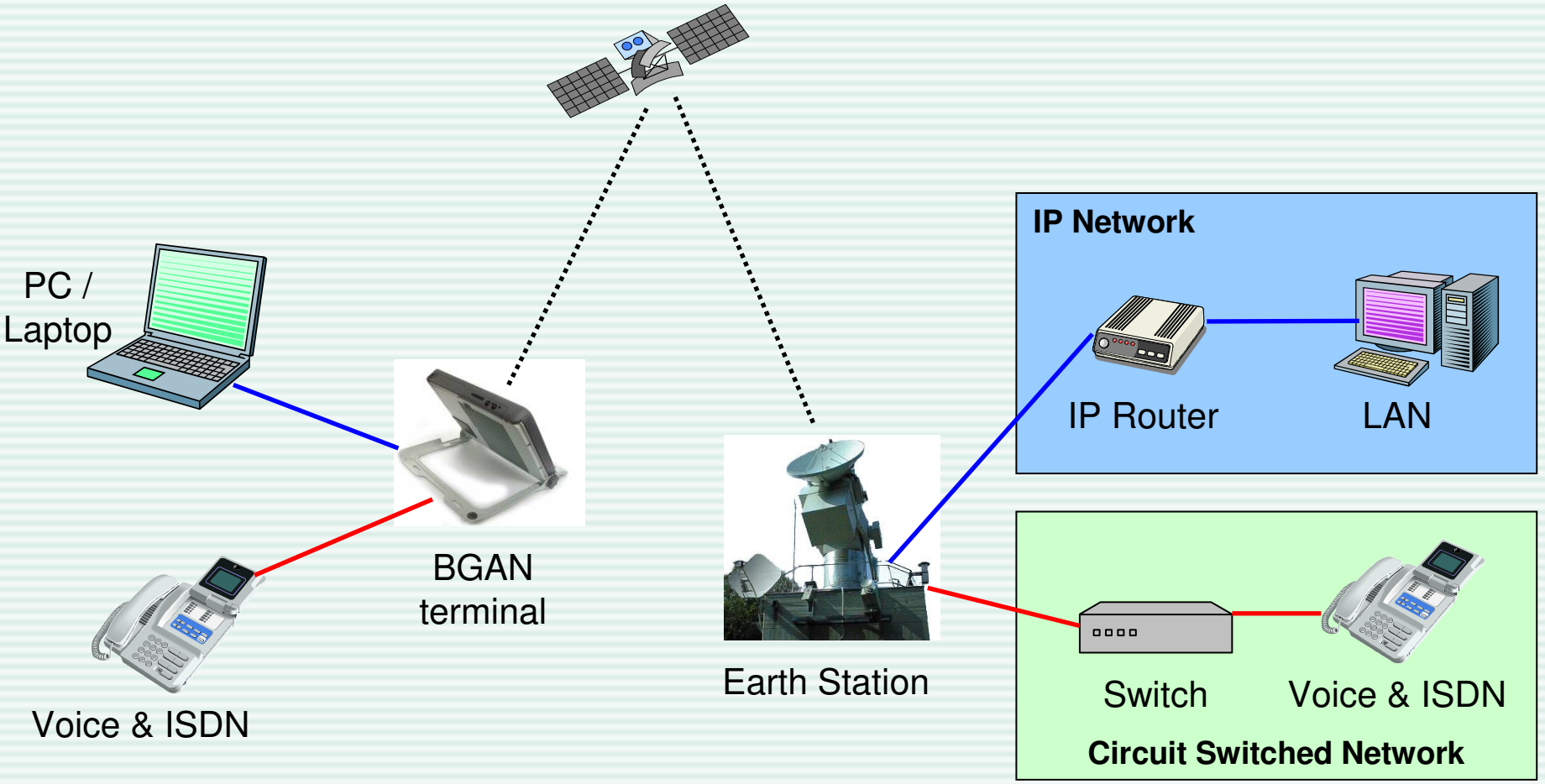
Source: INMARSAT

INMARSAT BGAN COVERAGE



Source: INMARSAT

BGAN SERVICES



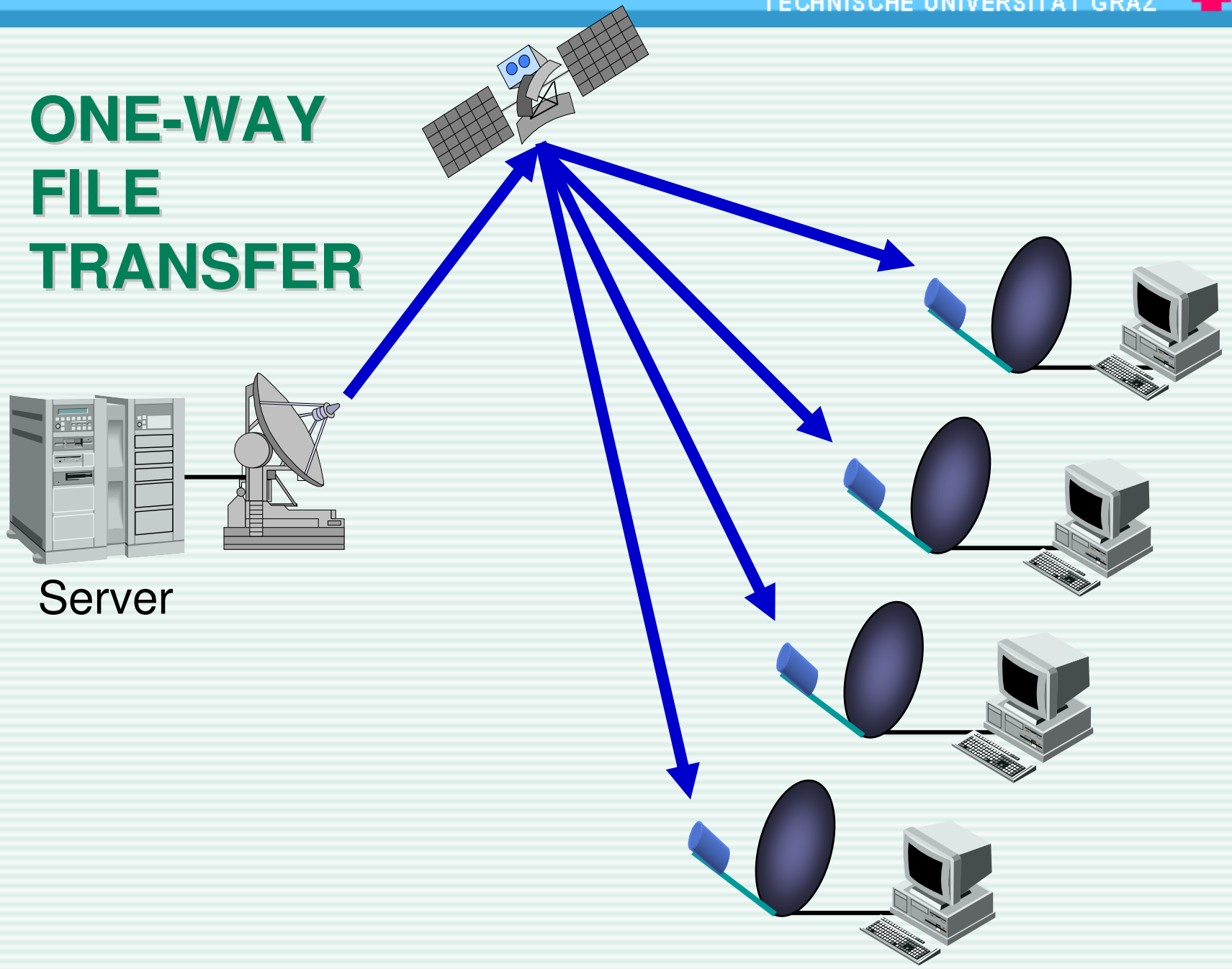
Digital Video Broadcast standard DVB-S

- Adopted nearly in all parts of the world (except US and Japan)
- Any kind of digital data can be transferred
- Multiplex of MPEG-II video/audio and IP packets
- Low-cost hardware for about $ 50 available (PC card)
- Plugs into existing PC or laptop
- Dish + receiver front-end for another $ 50

SUPPORTED APPLICATIONS

- **Delivery of high quantities of data (multicast)**
  - → Image transfer
  - → Internet access with suitable return channel (downloads)
- **Broadcast-quality TV (MPEG-II compressed)**

ONE-WAY FILE TRANSFER



INTERACTIVE TERMINAL

- **DVB – RCS (Return Channel System)**
- **Digital Video Broadcasting Technology (DVB-S,-S2)**
  - forward link Ku-, C-band
  - High bit rates: several Mbit/s
  - typ. in Ku-band (normally used for TV distribution)
- **Return link**
  - C-, Ku- or Ka-band
  - Data rates 144, 384, 2048 Mbit/s
- **Star network, large number of terminals**
- **Designed for high-speed Internet access in areas without DSL or cable connectivity**

TERMINAL

- **Dish sizes: 75, 90, 120 cm**
- **Small transceiver front-end**
- **Small indoor equipment**
- **Lower cost compared to traditional VSATs**
  - → Terminal: currently around $ 2500
    - Target: $ 300 - 500
  - → Hub has been expensive
  - → Work on low-cost hubs

www.emssatnet.com

SATMODE

- ESA development for interactive TV ($ 300 – 500)
- 75 cm dish (TV type)
- Ku-band
- 0.5 W transmitter
- DVB-S in forward link (Mbit/s download capacity)
- About 10 kbit/s in return link
- Suitable for data collection (sensors)
- Fast download of content-rich remote sensing data


VISIOSAT


TX
RX
POWER SUPPLY
LAN

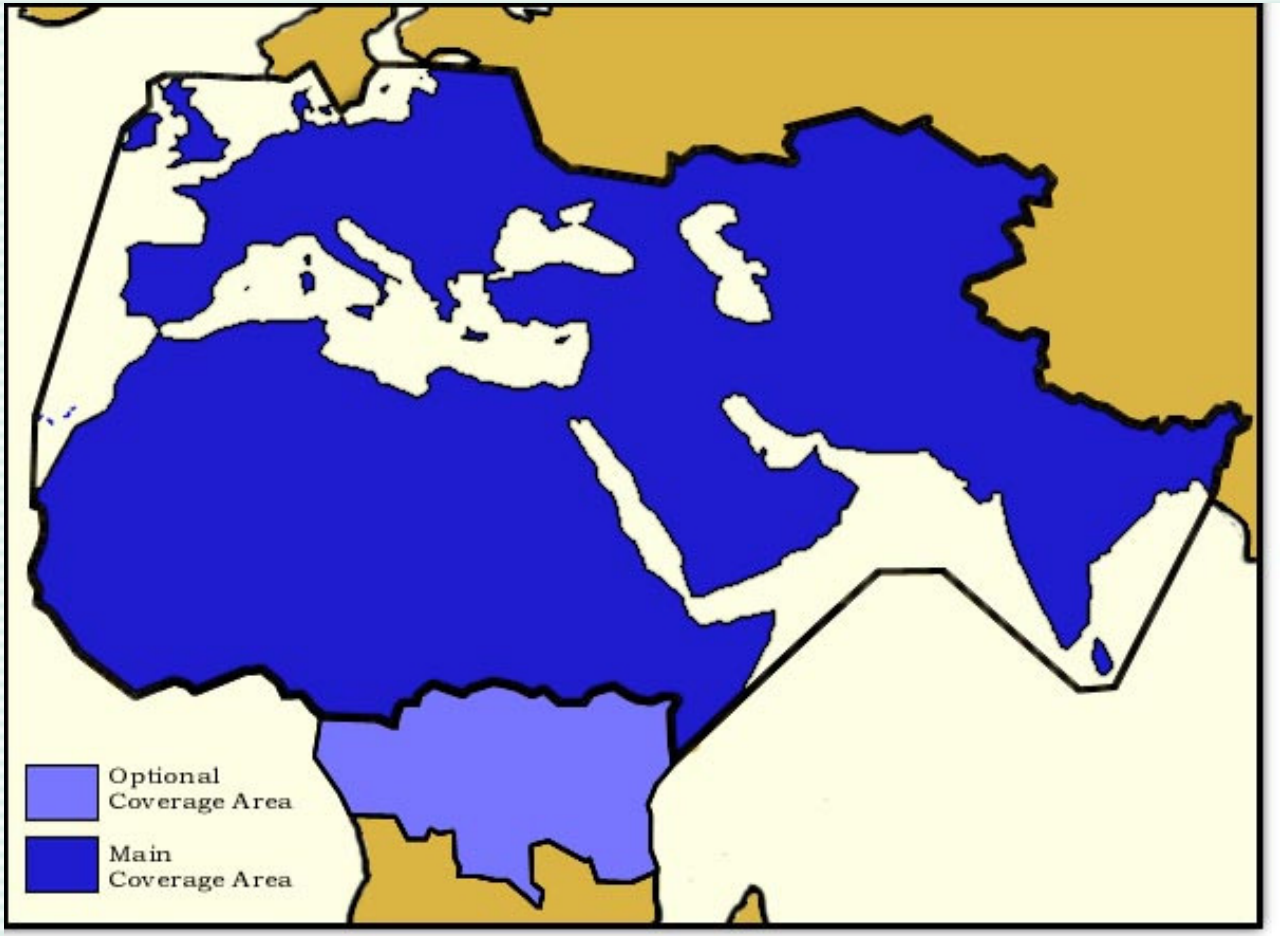
THURAYA SATPHONE

- GSM-compatible
- Can be used as terrestrial phone in reach of GSM network
- In remote areas communications via satellite
- 9.6 kbit/s data services
- In combination with DVB multicast system, high-speed downloads possible

THURAYA TERMINAL

Source: THURAYA

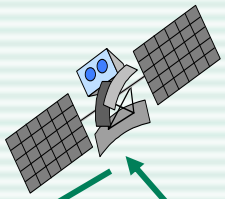
THURAYA COVERAGE



Source: THURAYA

HYBRID SYSTEM

- DVB-S high-speed forward link
- Satellite phone data return link
- With proper protocols fairly high-speed download possible



DVB Transmitter

Satphone

„TVRO“ dish

Server

Internet

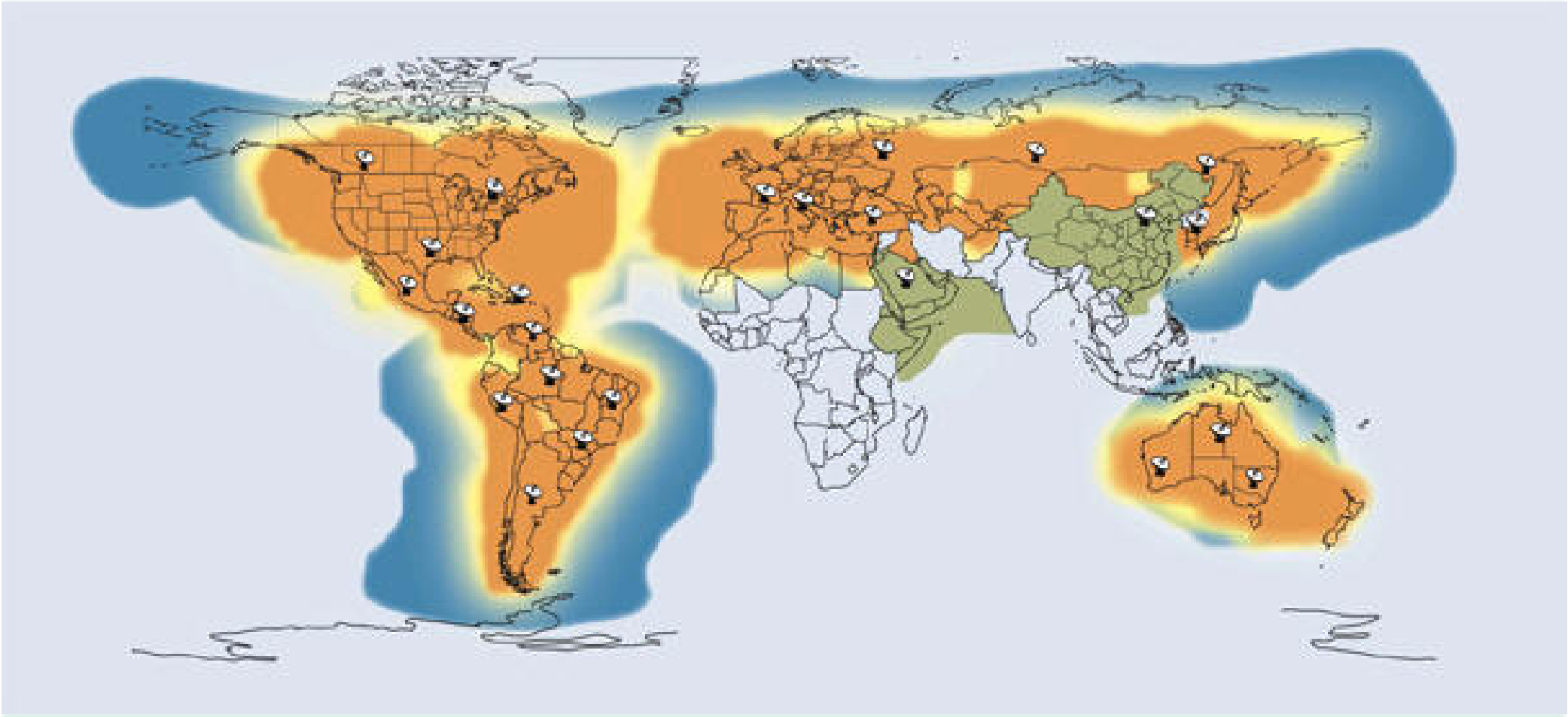
Laptop

GLOBALSTAR

- LEO constellation
- Coverage depending on terrestrial gateways
- Satellite phone with data capability (9.6 kbit/s)

Source: GLOBALSTAR

GLOBALSTAR COVERAGE



Source: GLOBALSTAR

ORBCOMM

- Store-and-forward messaging system
- LEO constellation
- World-wide coverage
- Not real-time
- VHF band (137/148 MHz)
- Serial data interface
- Suitable for data collection

Source: ORBCOMM

SUMMARY

- **Satellite communications provides means for**
  - → Data collection from sensors and sensor networks
  - → Data dissemination
- **Symmetrical and asymmetrical solutions**
- **Provision of services in remote areas**
- **Rapid deployment**
- **Reliable systems**
- **Affordable solutions available using DVB technology**