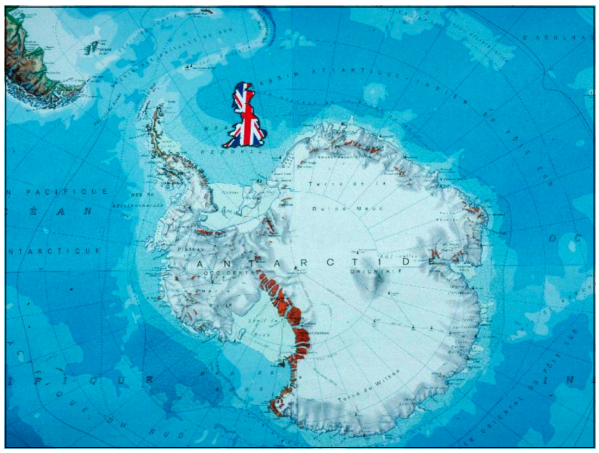
POLAR SCIENCE
FOR PLANET EARTH

## NETWORKS IN THE POLAR REGIONS

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL


British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
POLAR SCIENCE
FOR PLANET EARTH




## ANTARCTICA

- 58 times the size of Great Britain
- Highest average height
- Highest average wind speeds
- Lowest temperatures
- Contains 90% of the world's ice
- Minimal new precipitation
- Complete days/nights

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL
POLAR SCIENCE
FOR PLANET EARTH

## WHY ANTARCTICA?

- Area South of 60°S latitude
- Operated under Antarctic Treaty since 1961
- 46 countries have acceded to the Treaty
- Territorial claims remain frozen
- A continent for science



## VISITORS TO ANTARCTICA

- No indigenous population
- 50,000 tourists per year
- Max 5000 scientists in summer
- Max 500 scientists in winter



## ANTARCTIC SCIENCE

- Atmosphere – ozone hole, carbon dioxide
- Ice – ice melt, sea level rise, heat transfer to atmosphere
- Oceans – marine life, ocean acidification
- Life – impact on species
- Human impact – sustainable use of the oceans
- Climate change – Antarctica in the earth system



## SCIENCE DELIVERY

Geology – collection of rock

Upper Atmosphere – Radar systems

Ice – Satellites, radars, gps, ice cores

## SCIENCE DELIVERY

Antarctic Research Ship
100 metres long; oceanographic science capability

Antarctic Supply Ship
80 metres long; logistics and support vessel

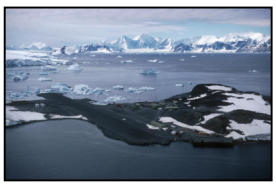
British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

## ANTARCTIC INFRASTRUCTURE



## ROTHERA STATION



900 metre runway
Wharf
Laboratories, workshops, accommodation

Control tower
Communications infrastructure

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

## HALLEY STATION

Halley V
Constructed 1988 to 1991

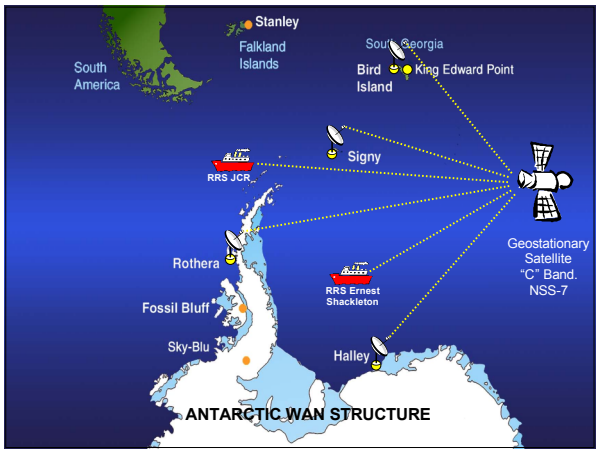
Halley VI
Under construction



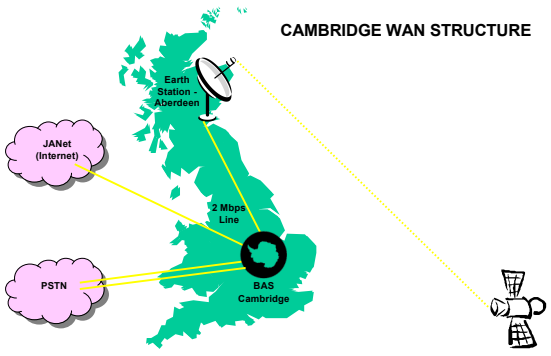
## ICT

- All BAS Stations and Ships have networked IT
- Windows, LINUX, Novell
- All servers are virtualised – energy saving
- Standard client setups
- HF and VHF radio on stations and ships
- Satellite systems include:
  - VSAT
  - Iridium
  - Argos






## CAMBRIDGE WAN STRUCTURE



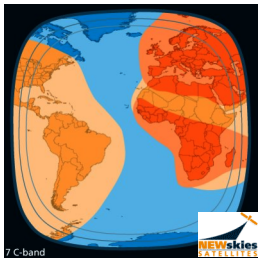
## THE SUPPLIER

- Invsat Ltd – wholly owned subsidiary of Inmarsat Ventures plc
- Supply VSAT solutions
- Based in Aberdeen
- 7.3m C-Band teleport
- 4.6m Ku-Band teleport
- 24 / 7 / 365 SMC



## THE SATELLITE

- New Skies Satellites NSS - 7
- GSO over the AOR at 338° East
- C and Ku Band Services
- Global and Hemi footprints



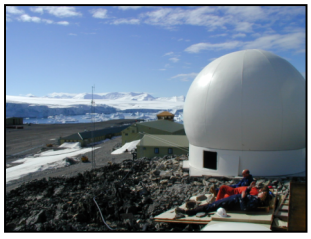



## THE RRS ERNEST SHACKLETON

- 2.4m antenna c/w Orbit tracking system
- Codan RF equipment
- 128 kbps duplex bandwidth
- VoIP, e-mail, Internet and data transfer services



## ROTHERA BASE



- 3.7m fixed antenna
- Fully redundant Codan RF equipment
- 384 kbps duplex bandwidth
- VoIP, e-mail, Internet and data transfer services

## SATELLITES IN POLAR REGIONS

- Low angle of elevation
- Tracking on ships and at Halley
- Satellite power-down at poles
- Multiple satellites at poles
- Bandwidth availability/cost



## USE OF VSAT

- Telephone calls – business and personal
- Science data
- Systems support and engineering
- Email
- Business systems
- Internet access



## USE OF VSAT

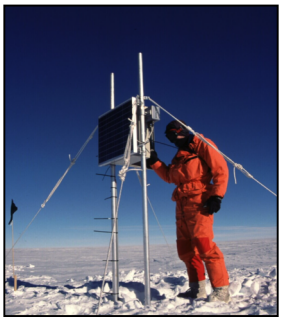
- Telephones priority – VoIP
- Web cache
- Caching Post Office
- Single email address
- Packeteer bandwidth prioritisation
- Internet access on JCR restricted to nominated machine
- £275K per year



## REMOTE COMMUNICATIONS

- Ships
  - Fleet 77 on JCR for North of 70º
- Field and Aircraft
  - Iridium
  - HF
  - VHF
- Instrumentation
  - Iridium
  - Argos

## AUTONOMOUS INSTRUMENTS



British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

## IRIDIUM OPEN PORT

## SATELLITE

| System | Monthly cost for… | Cost |
|---|---|---|
| Iridium SBD (Short burst data) | 1 message/day (340 bytes) | $15 |
| ARGOS | 1 message/day (32 bytes) | $124 |
| Iridium dialup | 1 megabyte/month | $72 |
| Iridium OpenPort | 1 megabyte/month | $52 |

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

POLAR SCIENCE FOR PLANET EARTH

## DATA TRANSFER COSTS

| Instrument | Annual data | Cost per year |
|---|---|---|
| AWS | 3MB | $300 (Iridium dialup) |
| Magnetometer | 300MB | $18,000 (Iridium dialup)<br>$10,000 (aircraft, 6 hours flying time)<br>$3,500 (Iridium OpenPort, 32kbit/s) |
| Isostatic rebound GPS | 5GB | $29,000 (Iridium OpenPort)<br>$10,000 (aircraft, 6 hours flying time) |

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

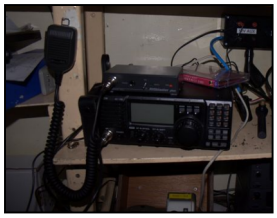
POLAR SCIENCE FOR PLANET EARTH

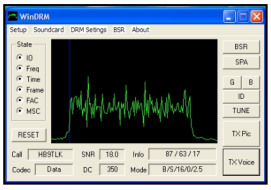
## ALTERNATIVE COMMUNICATIONS

- Video optimised satcomms
- Redundant and wobbly satellites
- Cable
- HF Radio
- Digital Radio
- Reduce expectations and activities



## DIGITAL RADIO






HF field radio, WinDRM software
COFDM encoding on QPSK modulation
Error correction
1.5 kbps data rate

British Antarctic Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
POLAR SCIENCE FOR PLANET EARTH

## SUMMARY

- Antarctica connected via satellite
  - Arctic has cable and satellite infrastructure
- Antarctica needs networks for science visitors
  - Arctic needs networks for inhabitants, science visitors and industry
- Antarctic science has access to bandwidth limited networks

British Antarctic Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
POLAR SCIENCE FOR PLANET EARTH