An Overview of Satellite Communications for Polar Research and Operations

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An exciting time!
Smaller and smaller...

Governments
Big Corporates
Specialists
Start-ups
Cowboys!

7 tonnes
900kg / 2000lb
90kg / 200lb
6kg / 13lb
250g / 9oz
## Orbits

<table>
<thead>
<tr>
<th>Geostationary</th>
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<tbody>
<tr>
<td>Appears fixed in the sky</td>
</tr>
<tr>
<td>Can use fixed high gain antenna on land</td>
</tr>
<tr>
<td>Lots of bandwidth available</td>
</tr>
<tr>
<td>High altitude, so high latency: &gt;240ms</td>
</tr>
<tr>
<td>No high latitude coverage (&gt;~80 degrees)</td>
</tr>
</tbody>
</table>

[https://stuffin.space/](https://stuffin.space/) is a great way to look at orbits!
Iridium
Geostationary options

• Inmarsat
• Telecom satellites ("VSAT")
  – C-band (4-8 GHz) – big antennas, robust
  – Ku-band (11-15GHz) – satellite TV
  – Ka-band (26-40GHz) – high-speed internet
• DCS
Polar orbit options

- ARGOS/Kineis
- Gonets
- Iridium
- Kepler
Coming soon?

Not in orbit
Amazon/Kuiper
KLEO
Skylo
HEOSAT

In orbit – demonstration/testing
Astrocast
Beijing Commsat
Fleet
Hiber
Myriota
Sky and Space
Starlink
Swarm
Telesat LEO

Customer trials
OneWeb

Be skeptical of service launch dates!
Buyer’s guide

• What is important to you?
  – Coverage all the way to the pole?
  – Usable on a moving vehicle or ship?
  – Volume of data
  – Power consumption
  – Physical size of the terminal
  – Terminal cost
  – Airtime cost

You can’t have the moon on a stick!
Message or stream?

<table>
<thead>
<tr>
<th>Message</th>
<th>Stream</th>
</tr>
</thead>
<tbody>
<tr>
<td>Like text messaging – individual messages carrying small amounts of data</td>
<td>Like a phone call or broadband connection – a continuous stream of data</td>
</tr>
<tr>
<td>Can be simplex or duplex</td>
<td>Always duplex</td>
</tr>
<tr>
<td>Can have long delivery latency</td>
<td>“Real time” service</td>
</tr>
<tr>
<td>Can be low power and compact</td>
<td>Power-hungry and often bulky</td>
</tr>
<tr>
<td>Examples:</td>
<td>Examples:</td>
</tr>
<tr>
<td>• Argos</td>
<td>• Iridium Pilot</td>
</tr>
<tr>
<td>• Iridium SBD</td>
<td>• Inmarsat BGAN and GlobalXpress</td>
</tr>
<tr>
<td>• Inmarsat ISatDataPro</td>
<td></td>
</tr>
</tbody>
</table>
Installation issues

• The terminal must see the sky
• Consider a terrestrial radio link
• Beware snow and rime-ice
• Make sure you have adequate peak and average power available
The price is right?

• Free is sometimes an option!
• ARGOS has a special tariff for scientists
• Talk to your salesperson – the price can often be negotiated, especially if you are operating multiple terminals and can pre-pay for airtime.
New opportunities

• “low hassle” connectivity
• real-time data collection
• enhanced safety through active tracking
• enhanced logistics: where’s my stuff?
• beware the social changes that arise!
Satcom Forum

https://wiswiki.wmo.int/Satcom
Satcom Handbook

- https://wiswiki.wmo.int/Satcom-Guide
- PDF: search for “WMO Satcom Handbook”