GPSDTN: Velocity-Enabled DTN networks for Arctic Research?

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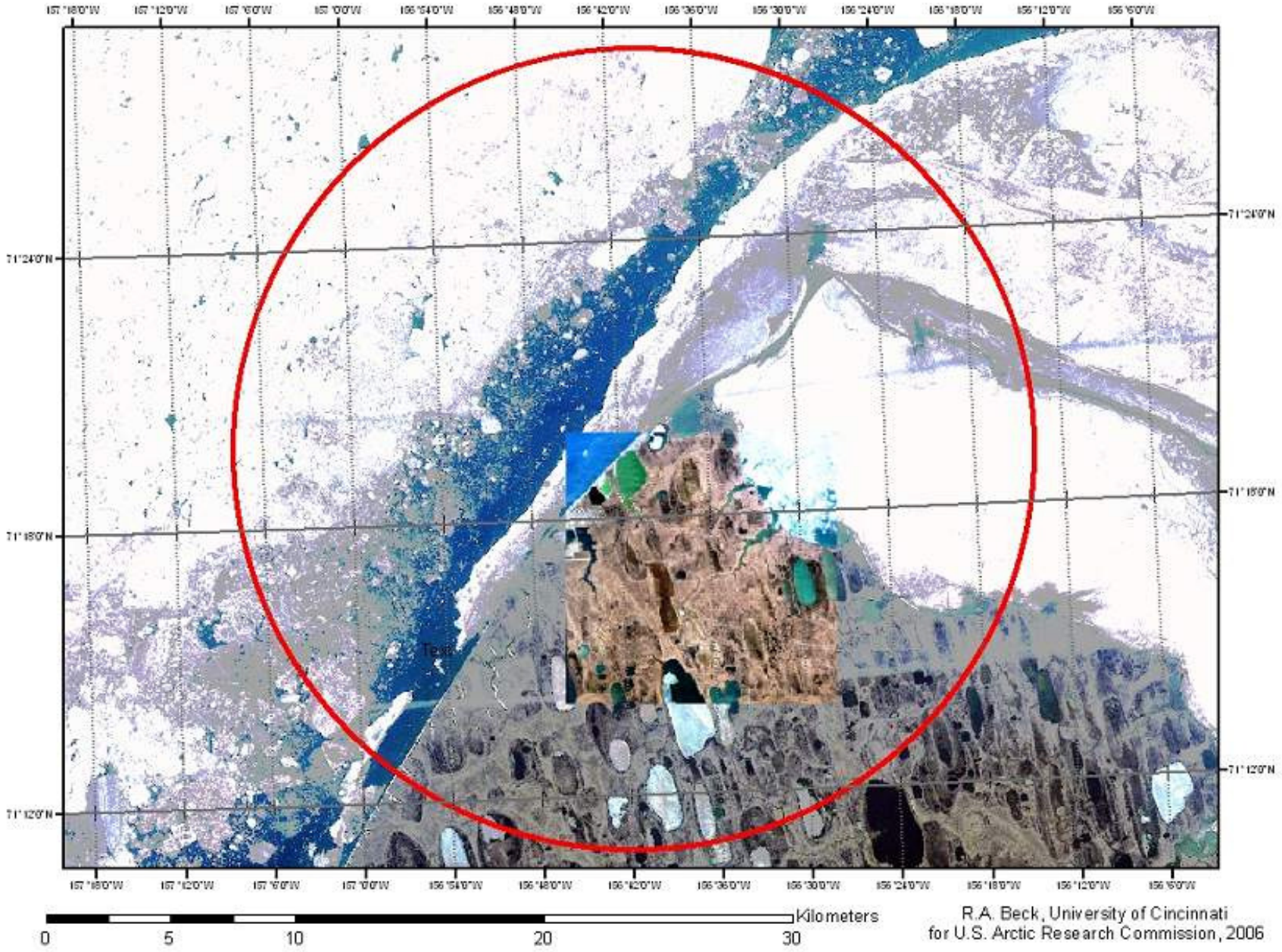
We need DTN for Arctic Research!

Kevin Fall's DTN icebreakers need a coordinated hand-off to and from the new Barrow Global Climate Change Research Facility high bandwidth cloud.

Why would Arctic researchers want a velocity-aware version of DTN ("GPSDTN")?

Velocity-enabled routing (latitude, longitude, elevation, time-of-position-fix, TX radius) would let DTN icebreakers know when they are within range of the BGCCRF's high-bandwidth WiMaxE cloud.

Barrow High Bandwidth WipLL / WiMAXe 15km Cloud



BGCCRF, August 26, 2006

BGCCRF Server Room

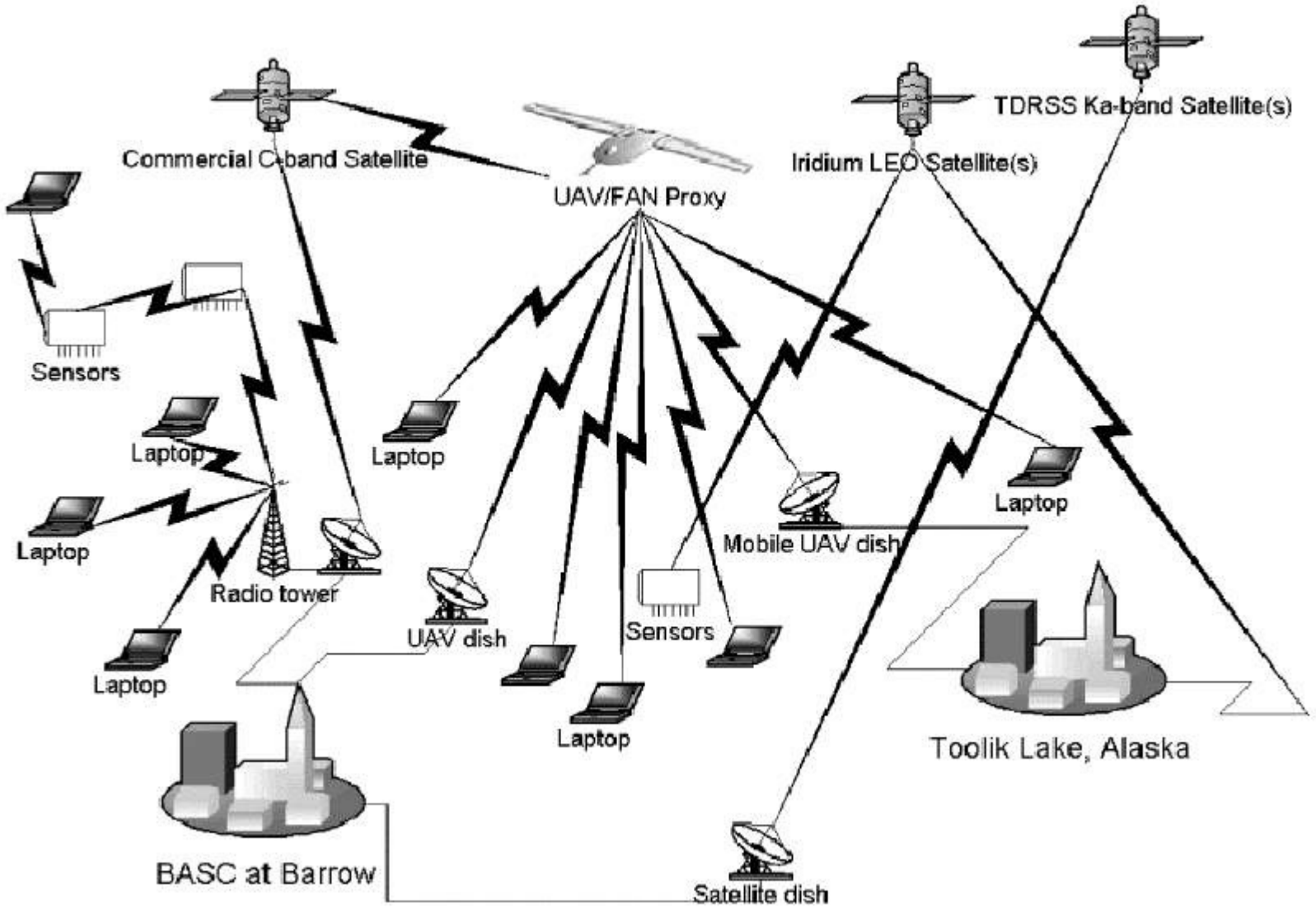
The BGCCRF has 8 parallel physical networks.

One of those networks is reserved for DTN research (if you are interested).

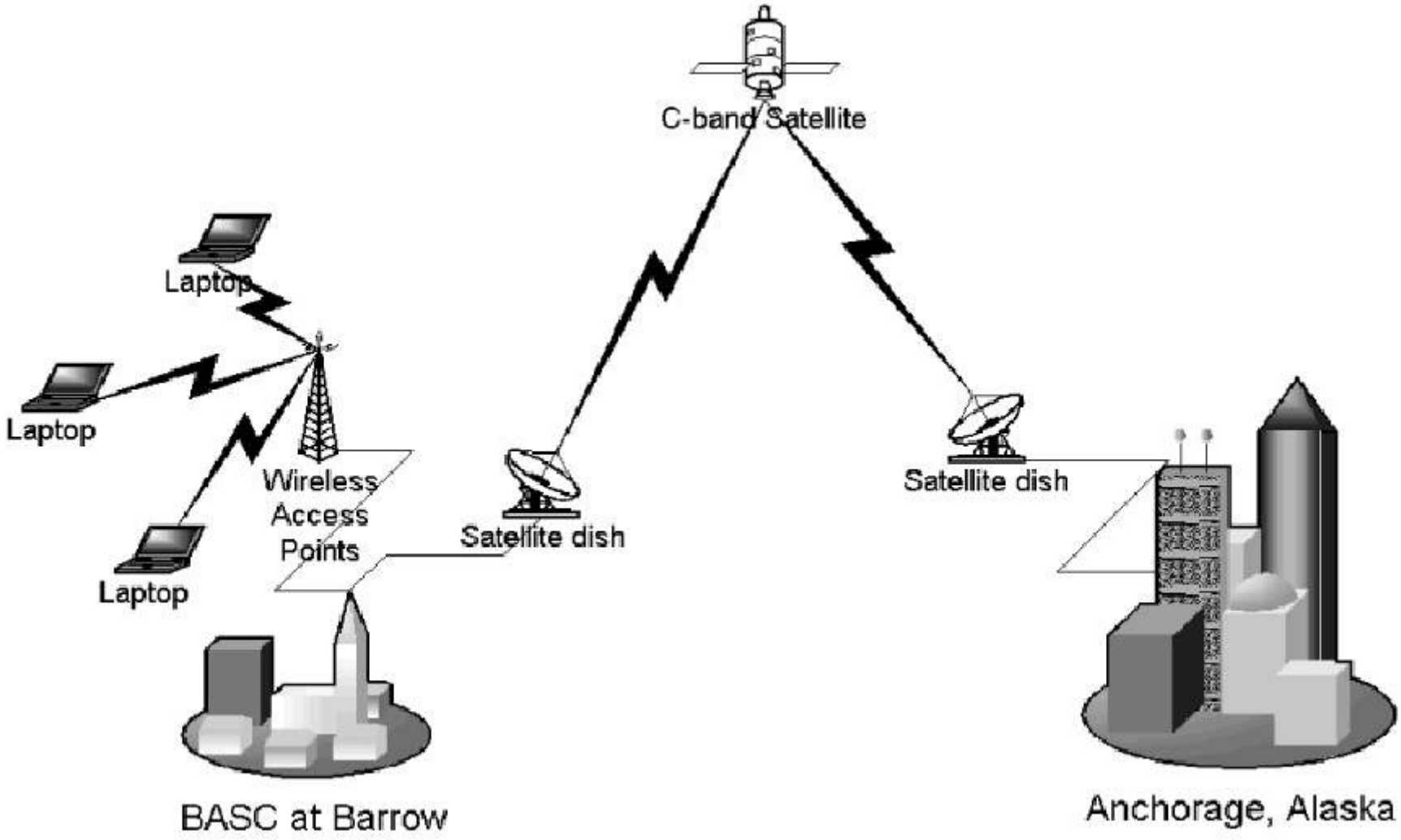
GPSDTN nodes for Arctic Research are likely to be sparse, ephemeral, mobile and power-limited.

Example of Need for Arctic DTN: Remotely Deployed Sensors: CALM Sensor Array (70 sensors deployed across North Slope of Alaska).

What we want: Coordinated High and Low Bandwidth DTN for Arctic Research



What we have: 1 X T-1 GEO Link



BGCCRF has 1 X T-1 Outbound GEO Satellite Connectivity between Barrow and the rest of the Internet (thin waist problem of Cerf et al., 2004).

We need some terabyte scale DTN data mules between Barrow and Fairbanks for at least the next several years.

Flying Aircraft Network* as Barrow to Fairbanks (GPS) DTN Data Mules?

*Concept courtesy of Mead Treadwell, US Arctic Research Commissioner

Do we need DTN for Arctic Research? Yes!

Do we need GPSDTN for Arctic Research? Maybe.

Why would Arctic researchers want a velocity-aware version of DTN ("GPSDTN")?

1. Researchers need to know

a. where their data were generated

b. when their data were generated

c. when their data were transmitted

d. where and when node #36 died so that it can be recovered and repaired.

Why would Arctic researchers want a velocity-aware version of DTN ("GPSDTN")?

2. DTN routing efficiency would improve if DTN nodes knew where each other are *probably* going to be (i.e.MoVe-Lookahead Algorithm of LeBrun et al, 2005).

Location-based Routing

- Aided by GPS via narrow-band control channel.
- Every node has location information
- Universal time is provided by the aid of GPS
- Use geographical forwarding to send packets

From Yang Peng, Scaleable Routing in MANET, 2003

Why would Arctic researchers want a velocity-aware version of DTN ("GPSDTN")?

3. More efficient velocity-enabled predictive DTN routing would conserve *extremely limited power and expensive and limited connectivity*, especially in winter (EASE, Jianliang Xu et al., 2005).

Next Generation Arctic GPSDTN Data Mule?

Possible GPSDTN scenario

1. Use NMEA 0183 v3.1
GGA, ZDA, WPL, AAM, RAD*
(Radio type, radius(m),
Residual energy, and link quality)
*new.
2. Update GPSDTN local oracles and nodes via narrow band Iridium control channel.
3. Use 3-D, power-aware version of MOVE-Lookahead for primary routing algorithm.

Iridium already updates velocity oracles for the Arctic

- **U.S. Dept. of Interior**
  - Automatic position reporting for aircraft in Alaska
- **FAA Capstone Project**
  - Safety communications with aircraft out of terrestrial communications range
- **Iridium LLC is willing to cooperate on GPSDTN**

Iridium - July 2006 Alaska Voice and Data

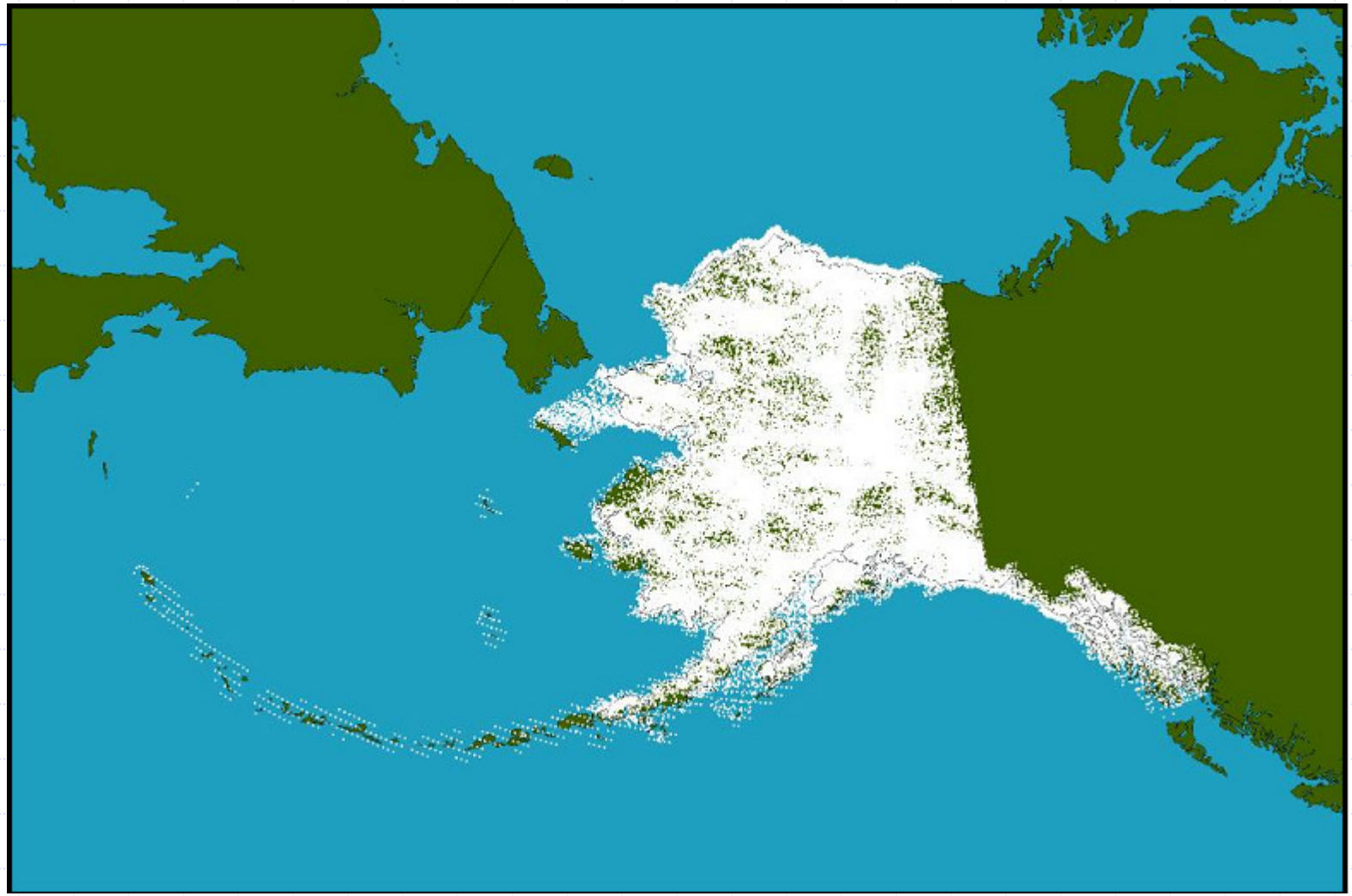


Image courtesy of Iridium LLC.

Iridium and partners are developing small portable data units for mobile computers and "motes" with data rates up to 128kbs.

Example:
Iridium/NAL A3LA-DGS L-band Transceiver with GPS (speaks NMEA 0183), about $1,400.

Local Arctic
GPSDTN Oracles

Summary

DTN + GPS + NMEA + Iridium + WiMaxE? + HLBR? + DTNRG = GPSDTN?

Thank you IETF DTNRG!