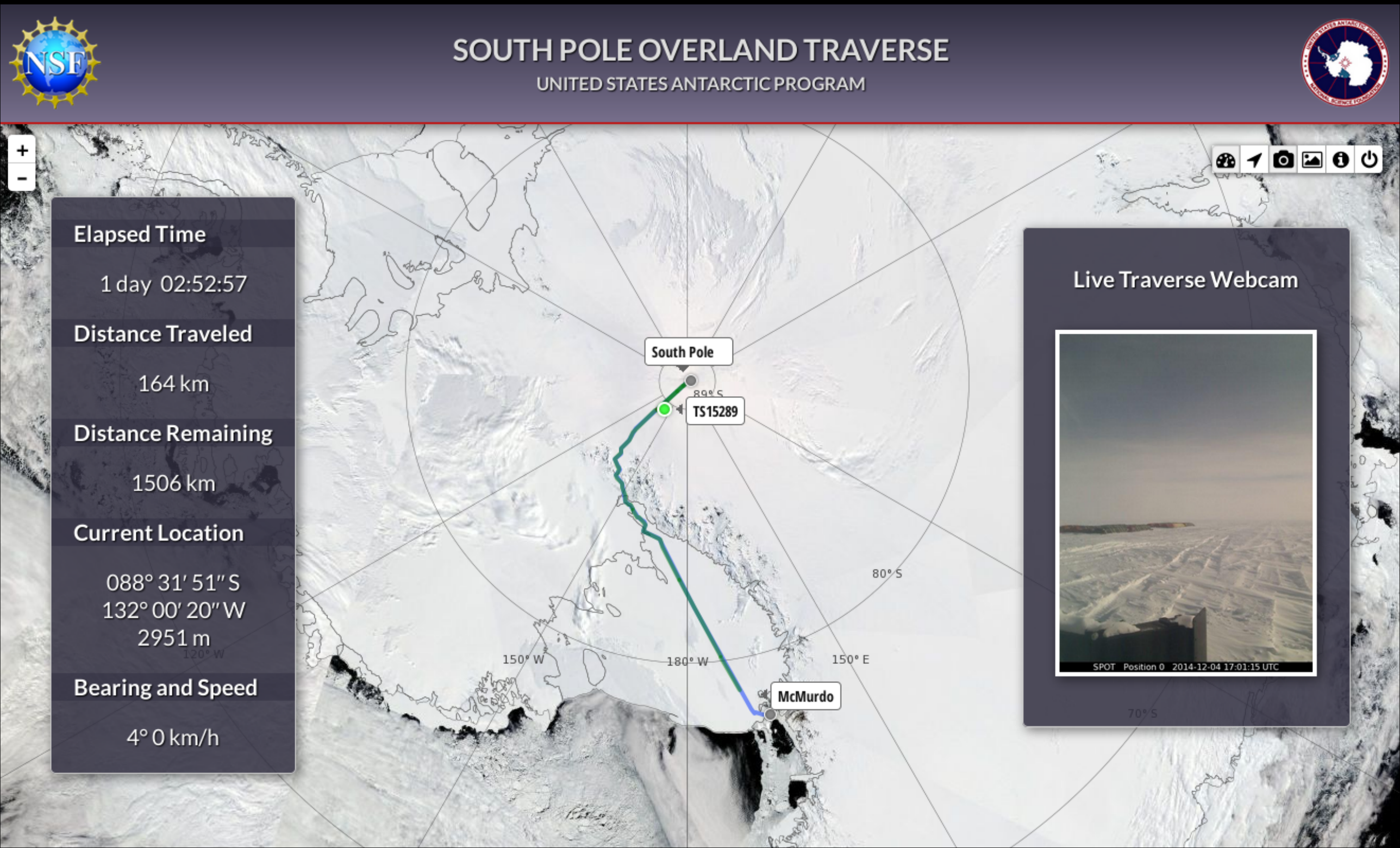
POLAR TECHNOLOGY CONFERENCE

HOW IT WORKS: THE TECHNOLOGIES BEHIND THE REAL-TIME SOUTH POLE TRAVERSE TRACKING

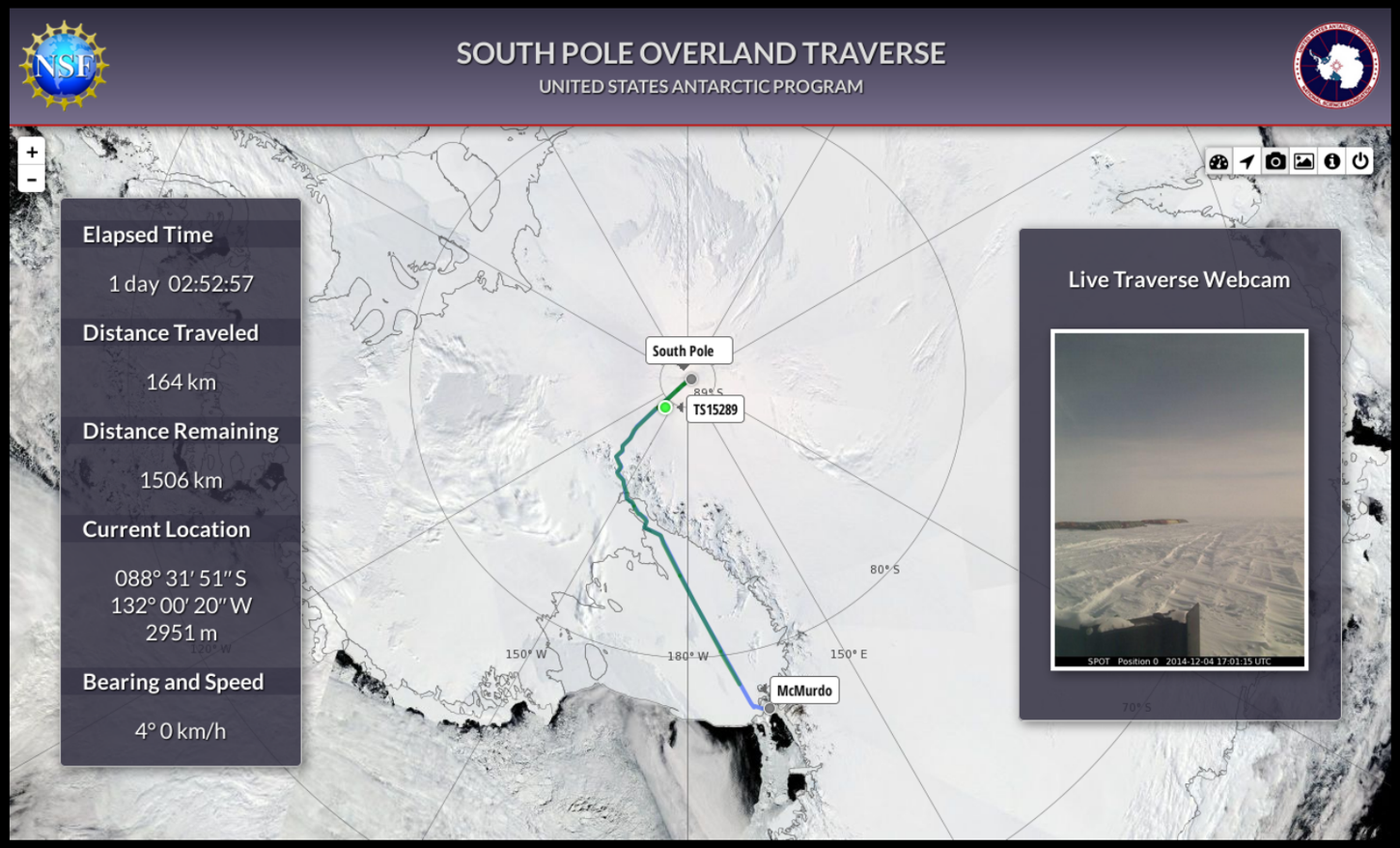
TODD VALENTIC
SRI INTERNATIONAL
MARCH 24, 2015

THE GOAL


SOUTH POLE OVERLAND TRAVERSE
UNITED STATES ANTARCTIC PROGRAM
Elapsed Time
1 day 02:52:57
Distance Traveled
164 km
Distance Remaining
1506 km
Current Location
088° 31′ 51″ S
132° 00′ 20″ W
2951 m
Bearing and Speed
4° 0 km/h
Live Traverse Webcam
SPOT Position 0 2014-12-04 17:01:15 UTC
South Pole
TS15289
McMurdo
89° S
80° S
70° S
150° W
180° W
150° E
120° W

FEATURES

- Dashboard
- Vehicle markers
- Tracks and route
- Photos and gallery
- Polar projection
- 50,000 points
- 3,000 images



Aesthetically appealing

Fast loading and smooth

Responsive (kiosk, desktop, mobile)

THE HARDWARE

BREADCRUMB TRACKERS

Based on the NAL 9602-LP

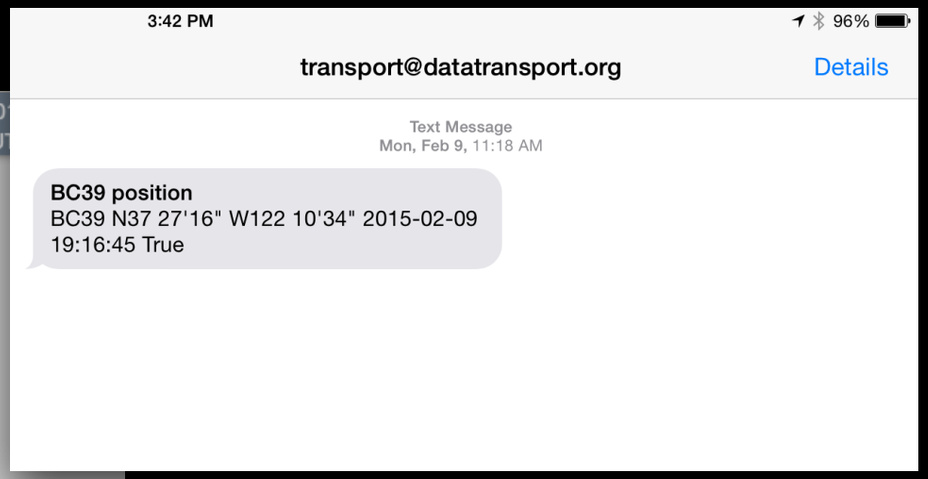
- 1-minute GPS updater
- Iridium SBD messages

- Dual frequency antenna
- Integrated heater, rated to -40C
- Polycarbonate case
- Proprietary data format (beware!)

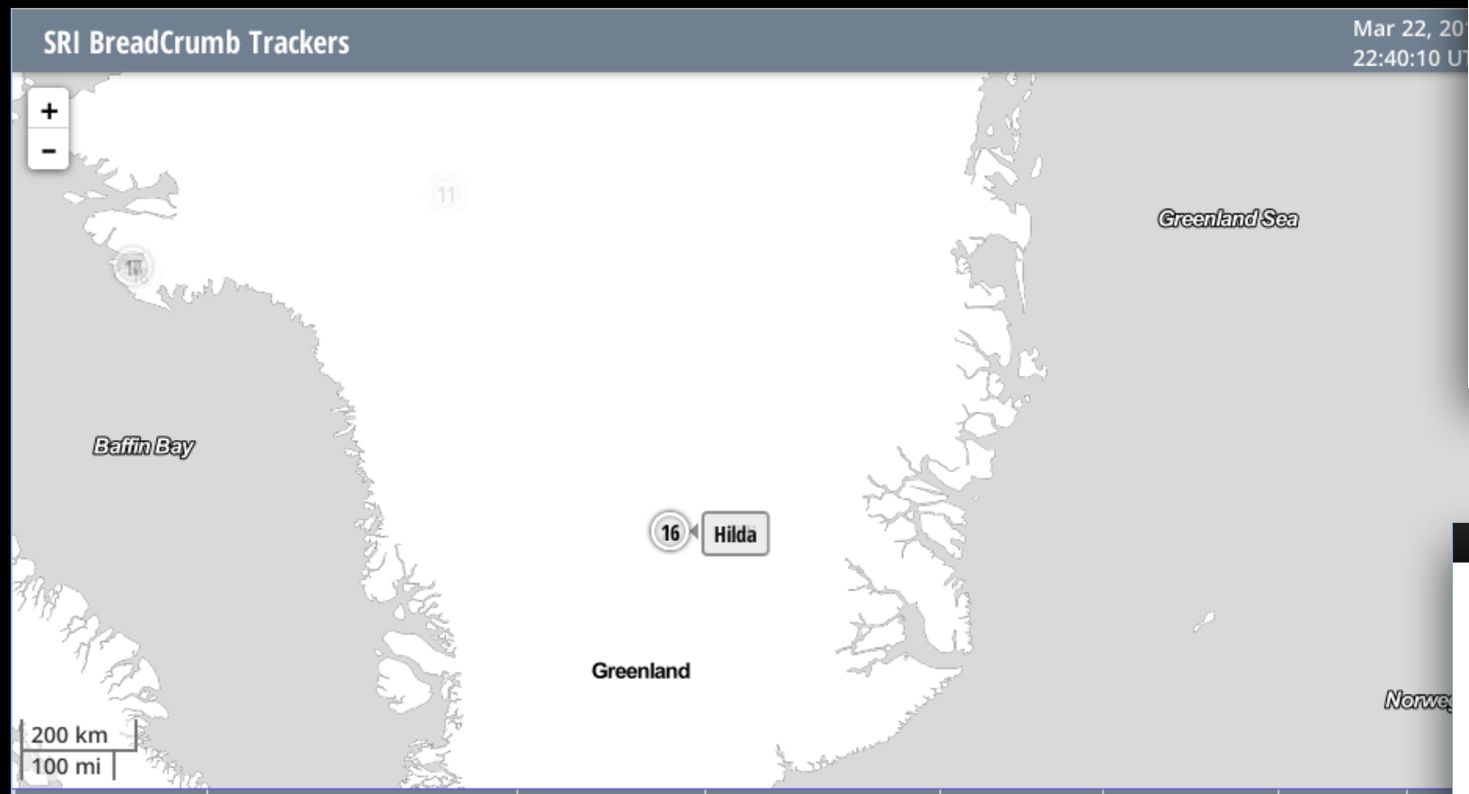
http://polar.sri.com/polarpower.org/PTC/2012_pdf/PTC_2012_Stehle.pdf

BREADCRUMB TRACKERS

REAL-TIME MONITORING

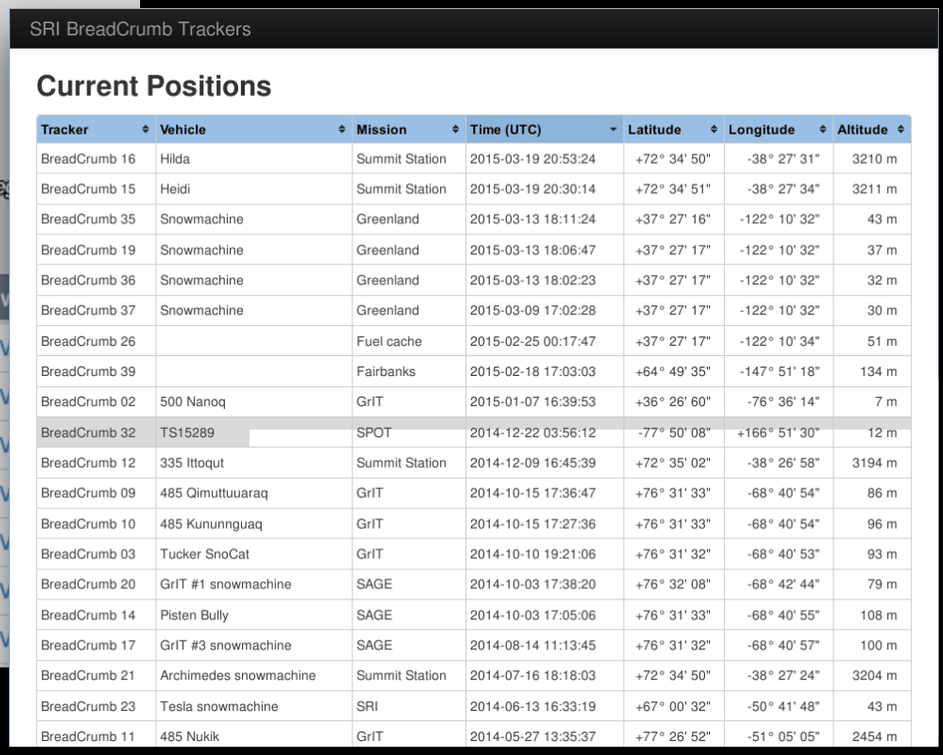


TEXT MESSAGES



Tracker	Vehicle	Group	Time (UTC)	Latitude	Longitude	Altitude	Dov
BreadCrumb 16	Hilda	Summit Station	2015-03-19 20:53:24	+72° 34' 50"	-38° 27' 31"	3210 m	CSV
BreadCrumb 15	Heidi	Summit Station	2015-03-19 20:30:14	+72° 34' 51"	-38° 27' 34"	3211 m	CSV
BreadCrumb 35	Snowmachine	Greenland	2015-03-13 18:11:24	+37° 27' 16"	-122° 10' 32"	43 m	CSV
BreadCrumb 19	Snowmachine	Greenland	2015-03-13 18:06:47	+37° 27' 17"	-122° 10' 32"	37 m	CSV
BreadCrumb 36	Snowmachine	Greenland	2015-03-13 18:02:23	+37° 27' 17"	-122° 10' 32"	32 m	CSV
BreadCrumb 37	Snowmachine	Greenland	2015-03-09 17:02:28	+37° 27' 17"	-122° 10' 32"	30 m	CSV
BreadCrumb 26		Fuel cache	2015-02-25 00:17:47	+37° 27' 17"	-122° 10' 34"	51 m	CSV

MAPPING



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BreadCrumb 26		Fuel cache	2015-02-25 00:17:47	+37° 27' 17"	-122° 10' 34"	51 m
BreadCrumb 39		Fairbanks	2015-02-18 17:03:03	+64° 49' 35"	-147° 51' 18"	134 m
BreadCrumb 02	500 Nanoq	GrIT	2015-01-07 16:39:53	+36° 26' 60"	-76° 36' 14"	7 m
BreadCrumb 32	TS15289	SPOT	2014-12-22 03:56:12	-77° 50' 08"	+166° 51' 30"	12 m
BreadCrumb 12	335 Ittoqut	Summit Station	2014-12-09 16:45:39	+72° 35' 02"	-38° 26' 58"	3194 m
BreadCrumb 09	485 Qimuttuuaraq	GrIT	2014-10-15 17:36:47	+76° 31' 33"	-68° 40' 54"	86 m
BreadCrumb 10	485 Kununnguaq	GrIT	2014-10-15 17:27:36	+76° 31' 33"	-68° 40' 54"	96 m
BreadCrumb 03	Tucker SnoCat	GrIT	2014-10-10 19:21:06	+76° 31' 32"	-68° 40' 53"	93 m
BreadCrumb 20	GrIT #1 snowmachine	SAGE	2014-10-03 17:38:20	+76° 32' 08"	-68° 42' 44"	79 m
BreadCrumb 14	Pisten Bully	SAGE	2014-10-03 17:05:06	+76° 31' 33"	-68° 40' 55"	108 m
BreadCrumb 17	GrIT #3 snowmachine	SAGE	2014-08-14 11:13:45	+76° 31' 32"	-68° 40' 57"	100 m
BreadCrumb 21	Archimedes snowmachine	Summit Station	2014-07-16 18:18:03	+72° 34' 50"	-38° 27' 24"	3204 m
BreadCrumb 23	Tesla snowmachine	SRI	2014-06-13 16:33:19	+67° 00' 32"	-50° 41' 48"	43 m
BreadCrumb 11	485 Nukik	GrIT	2014-05-27 13:35:37	+77° 26' 52"	-51° 05' 05"	2454 m

MOBILE

TINCAN SBC

CAMERA SYSTEM

O-BUOY 5 AND THE CCGS LOUIS S. ST.-LAURENT

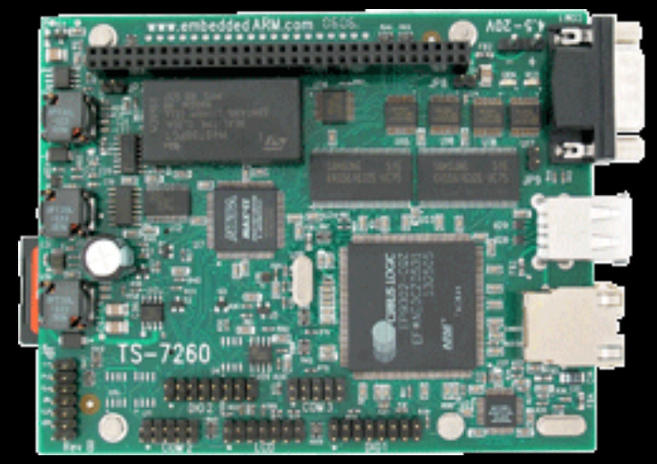
TINCAN SBC

CAMERA SYSTEM

http://polarpower.org/static/docs/PTC_2010/2010PTC_Valentic.pdf

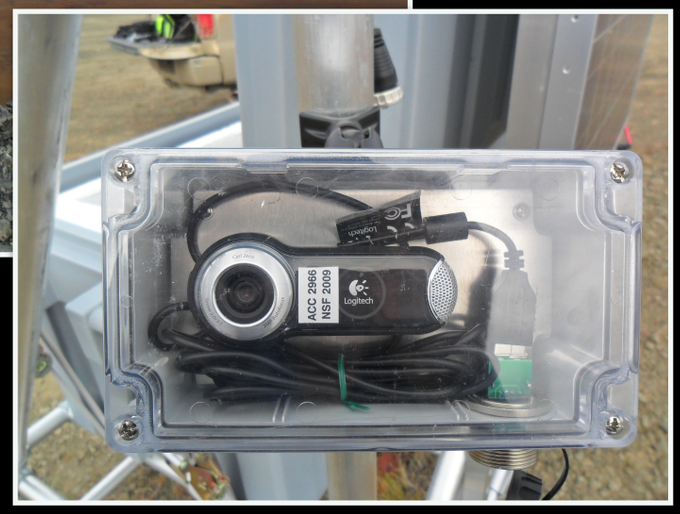
SINGLE BOARD COMPUTER

TINCAN SBC



Based on a TS-7260

- 200MHz ARM9 CPU
- 128MB RAM / 128MB Flash
- Ethernet, USB, Serial
- DIO, ADC, SPI, Watchdog
- Low power (1W)
- Runs Linux, Python
- Data Transport applications



http://polarpower.org/static/docs/PTC_2009/2009PTC_Valentic.pdf

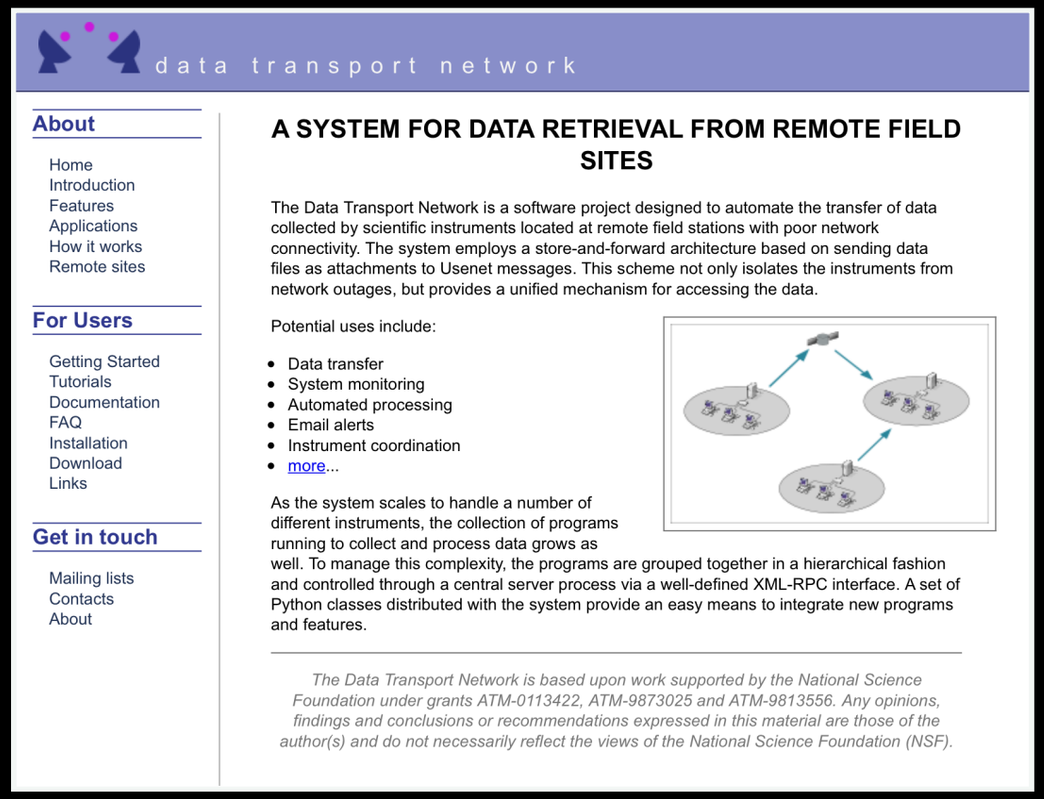
http://polar.sri.com/polarpower.org/PTC/2012_pdf/PTC_2012_Valentic.pdf

THE SOFTWARE

THE DATA TRANSPORT NETWORK

SOFTWARE FRAMEWORK FOR DATA STREAMS

- Data acquisition
- Transfer of data
- Data processing
- Health monitoring
- Archiving
- Used on embedded systems and servers

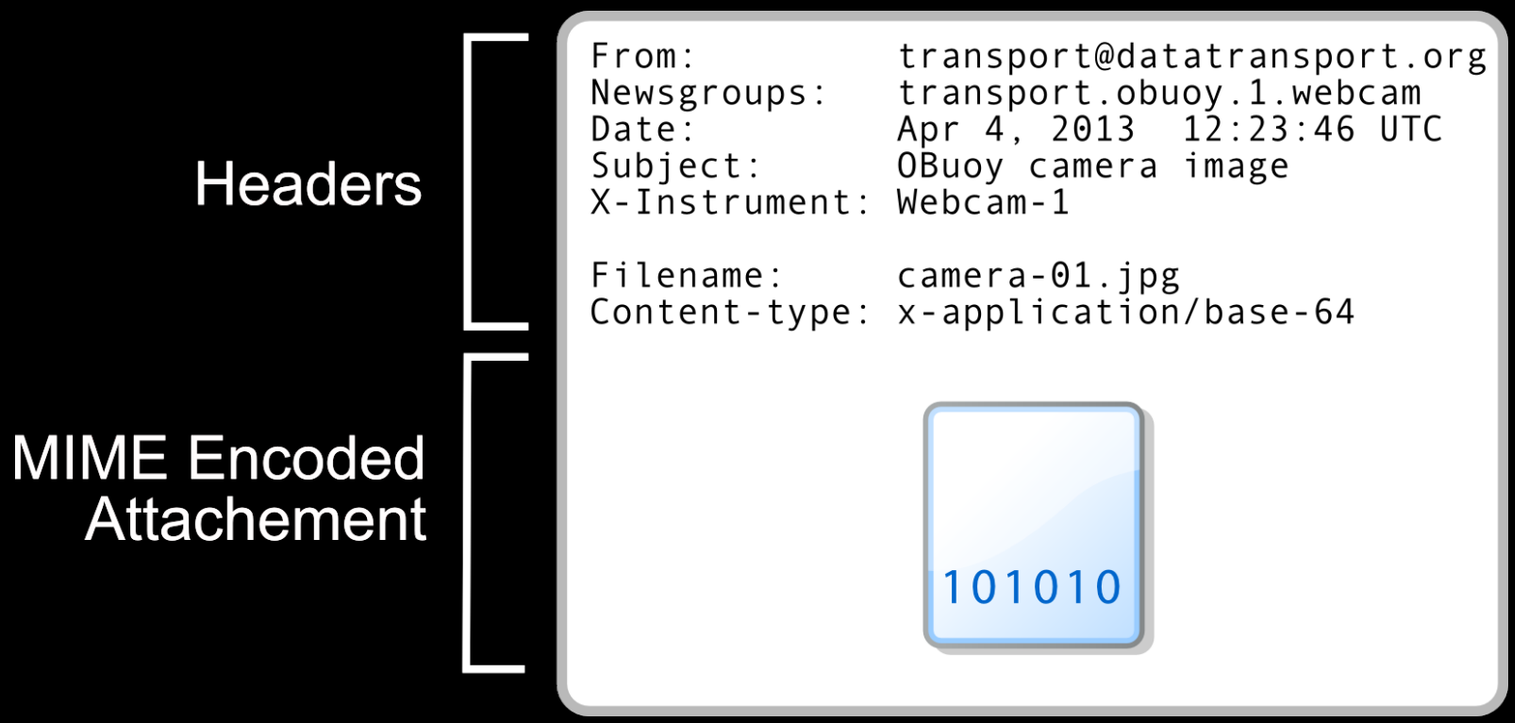


http://datatransport.org

http://polar.sri.com/polarpower.org/PTC/2013_pdf/PTC_2013_Valentic.pdf

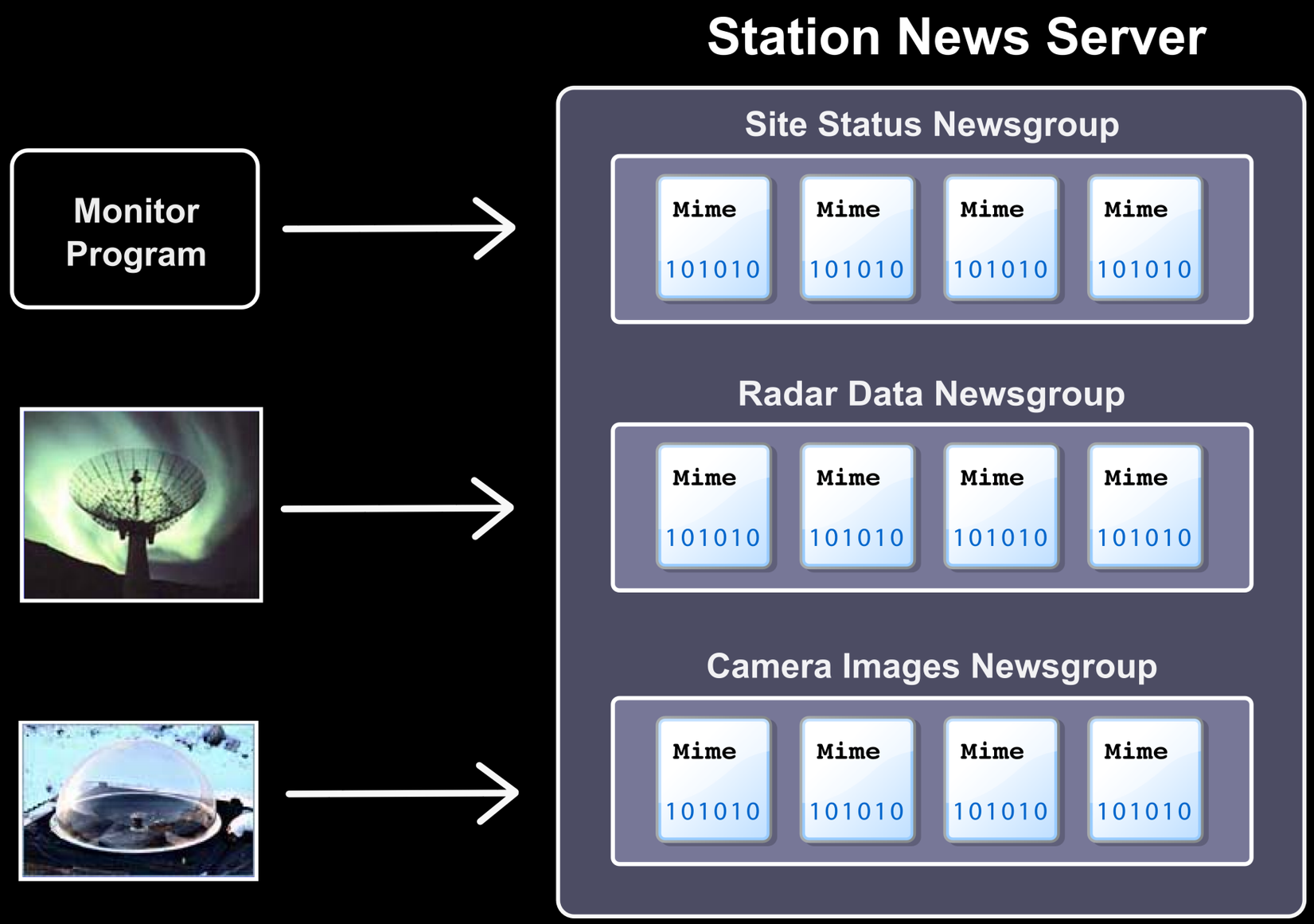
HOW IT WORKS

USENET MESSAGES

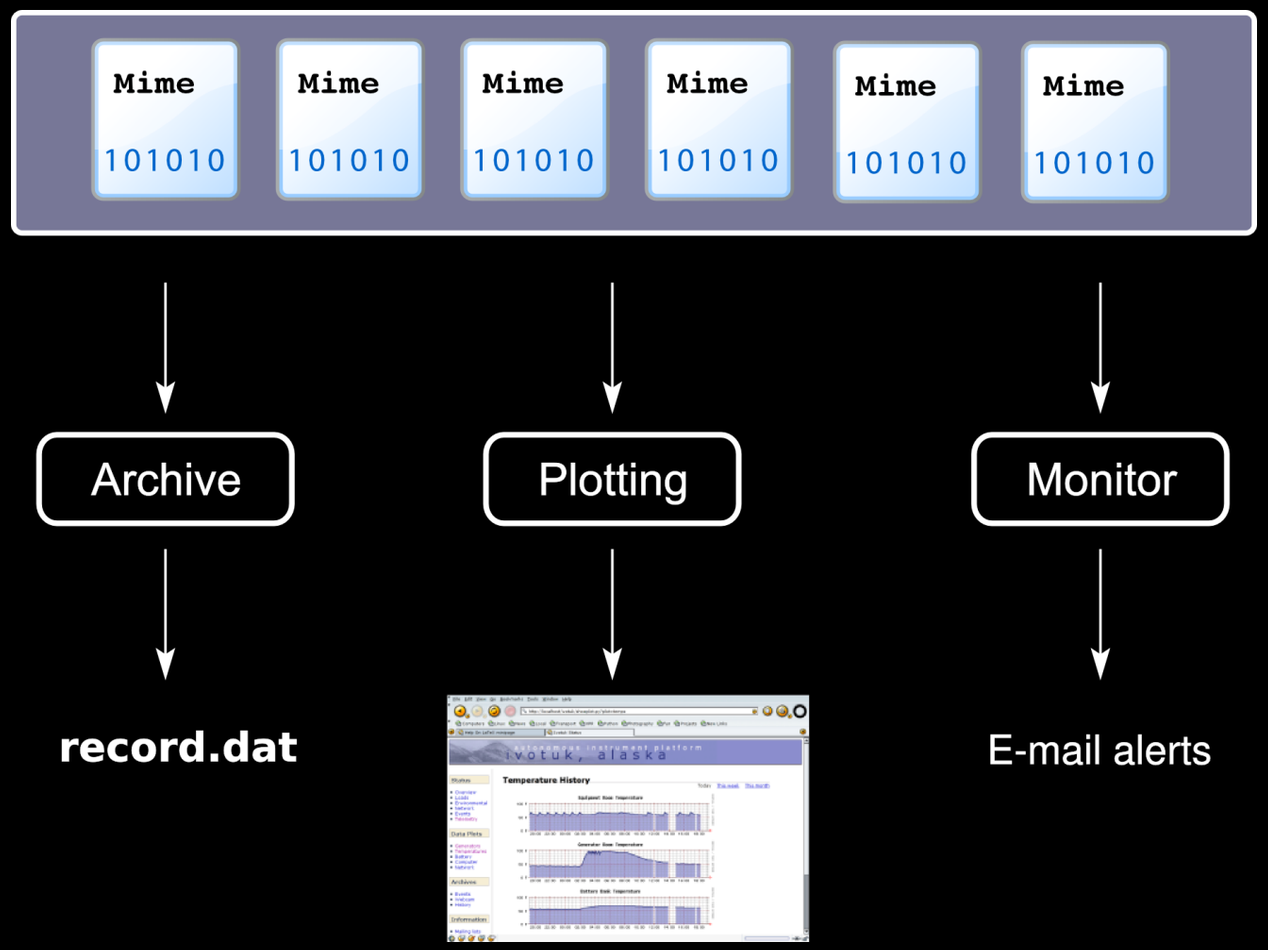


- Data files are sent as attachments
- Headers provide metadata
- Any type day data can be sent (text, images, binaries ,etc)

NEWSGROUPS HOLD MESSAGES



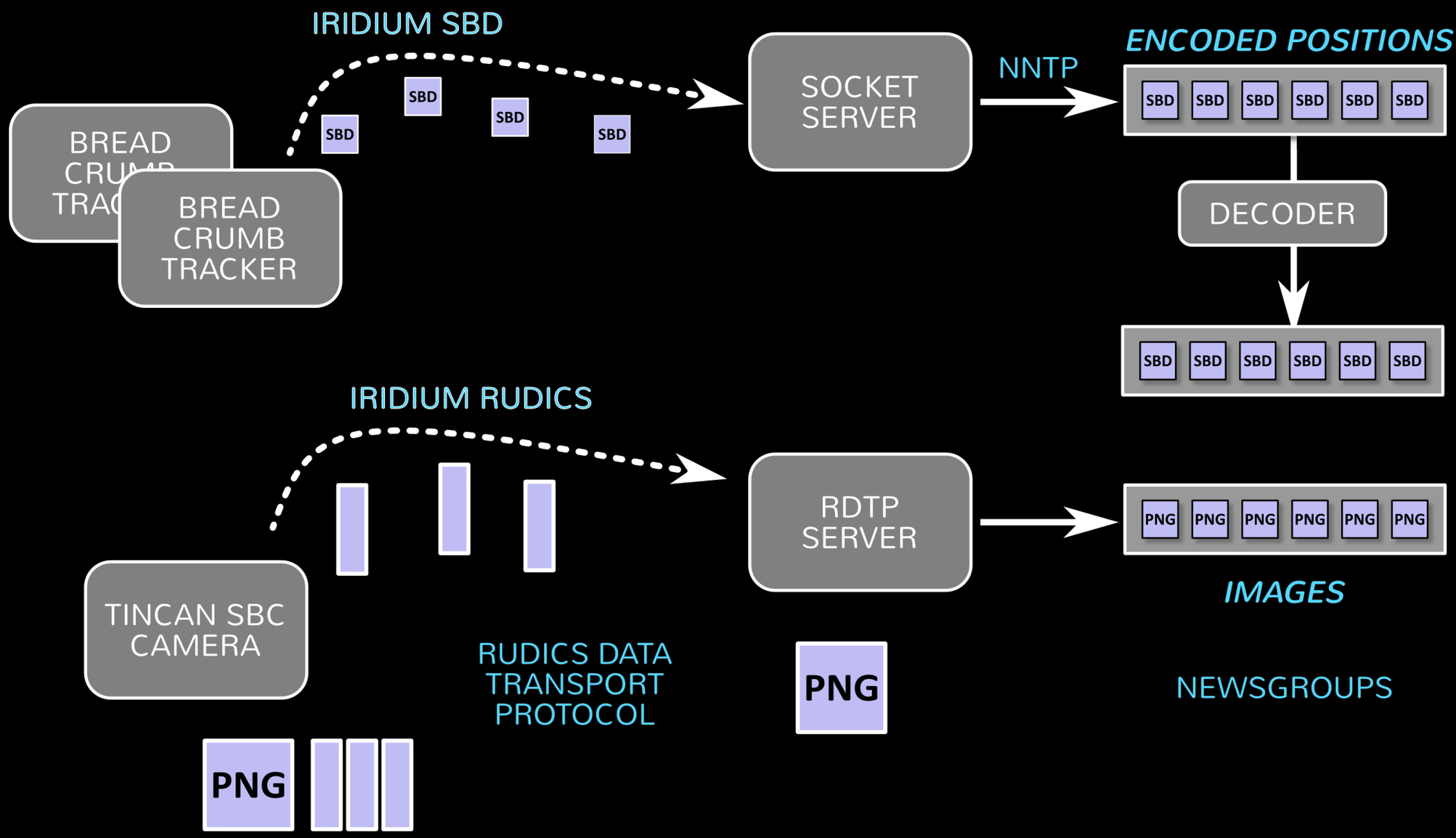
PUBLISH AND SUBSCRIBE



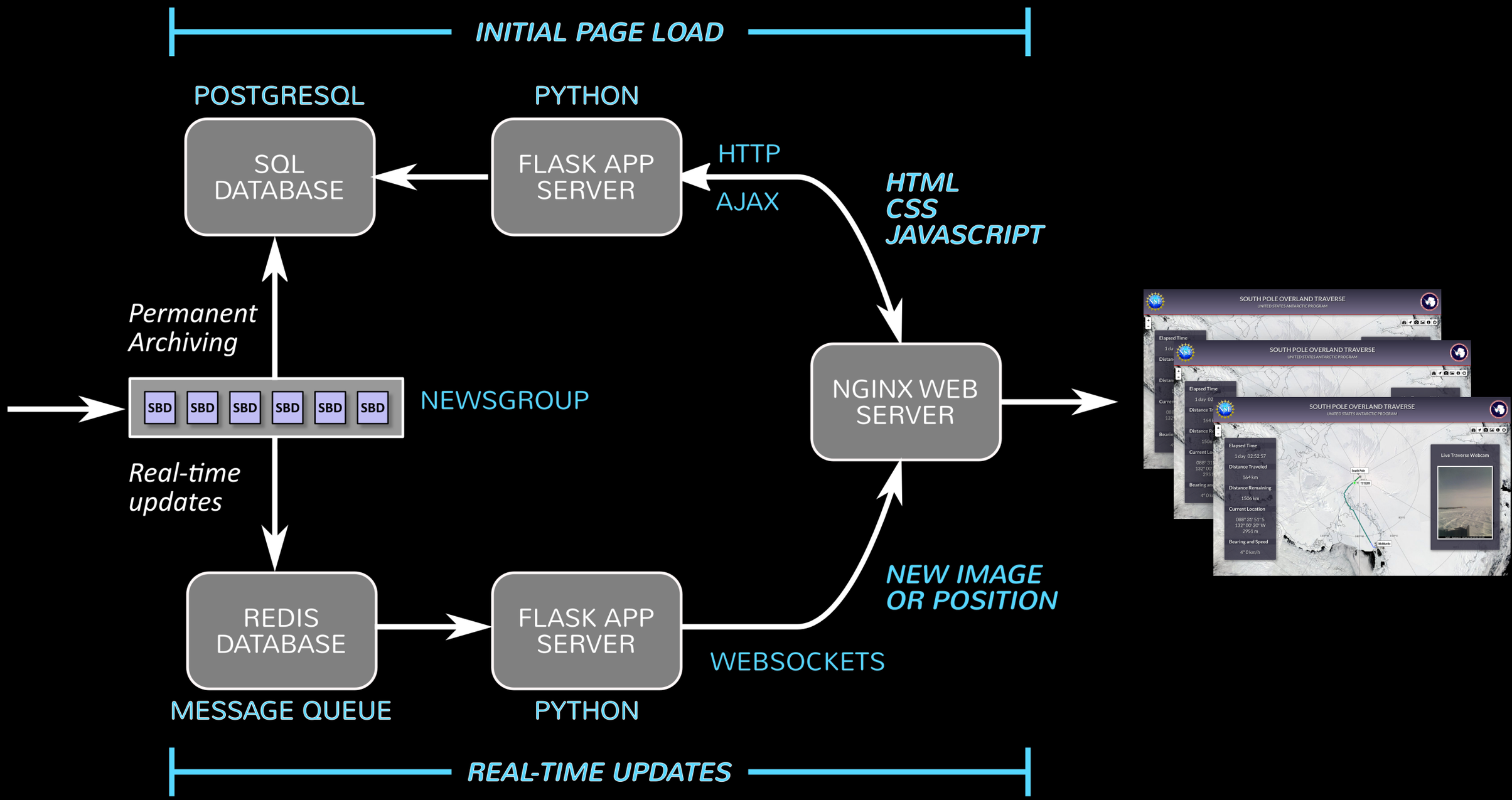
- Single producer and many consumers
- Copies of data are accessed
- Short term history, automatic expiration (2 weeks)
- Market place for data

DATA TRANSPORT

FEILD TO SERVER

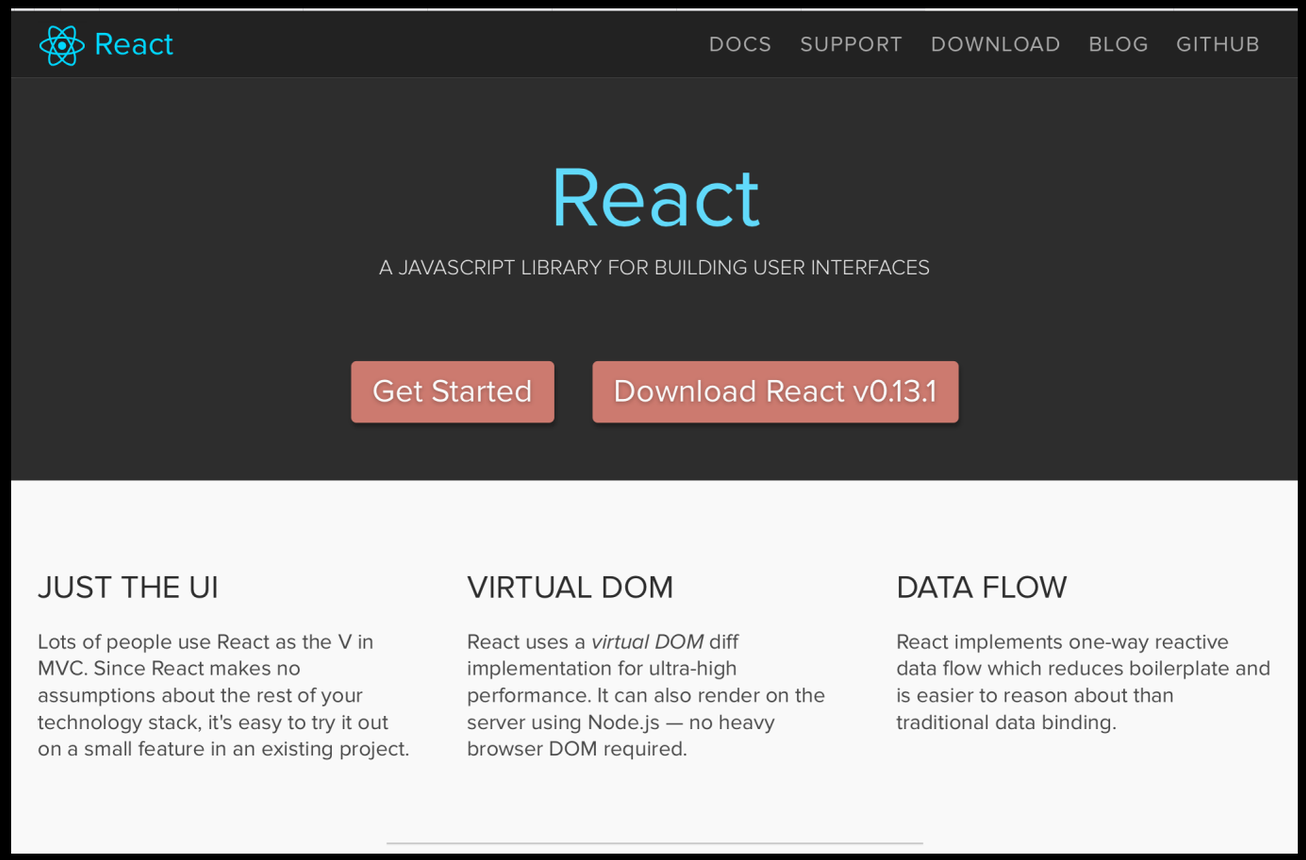


WEB SERVER ARCHITECTURE



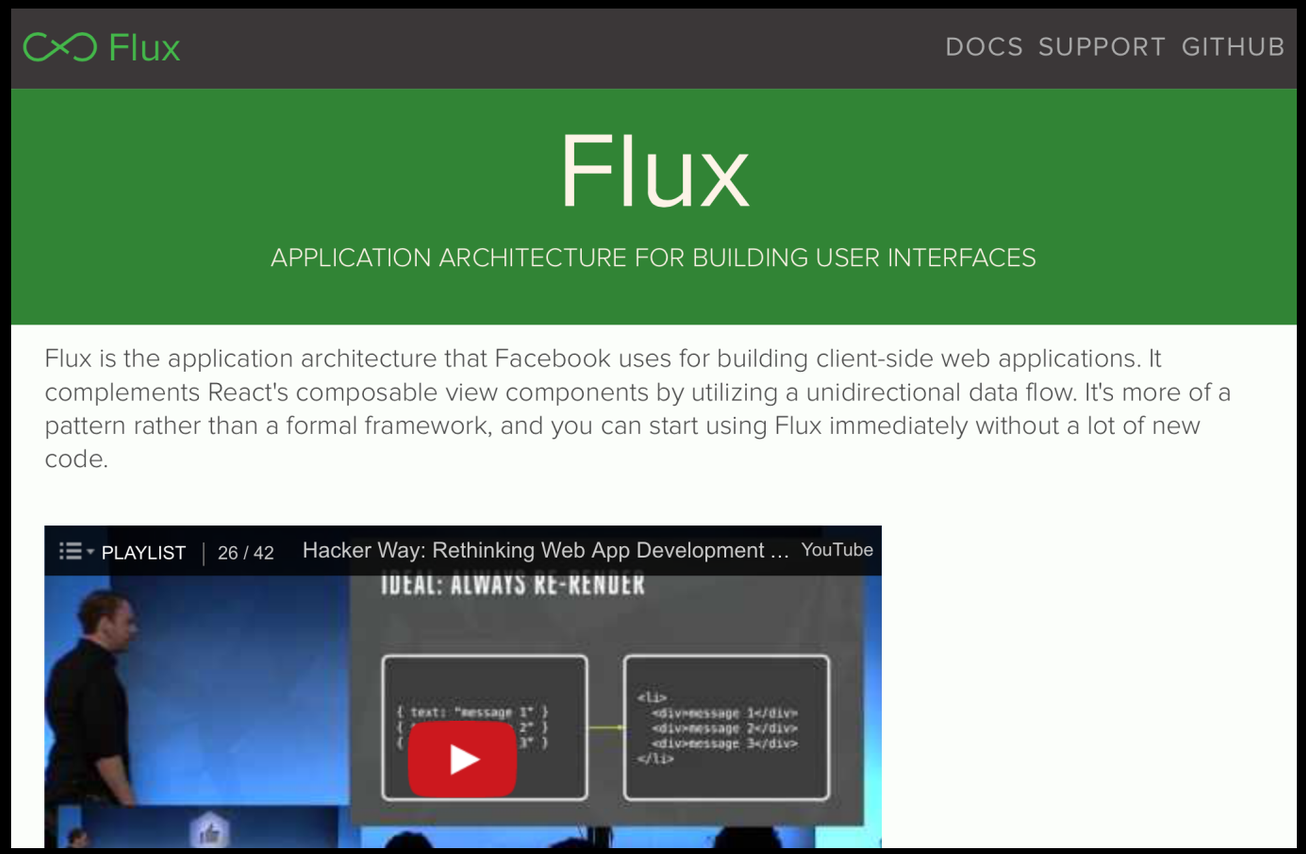
THE WEB PAGE

USER INTERFACE LAYER



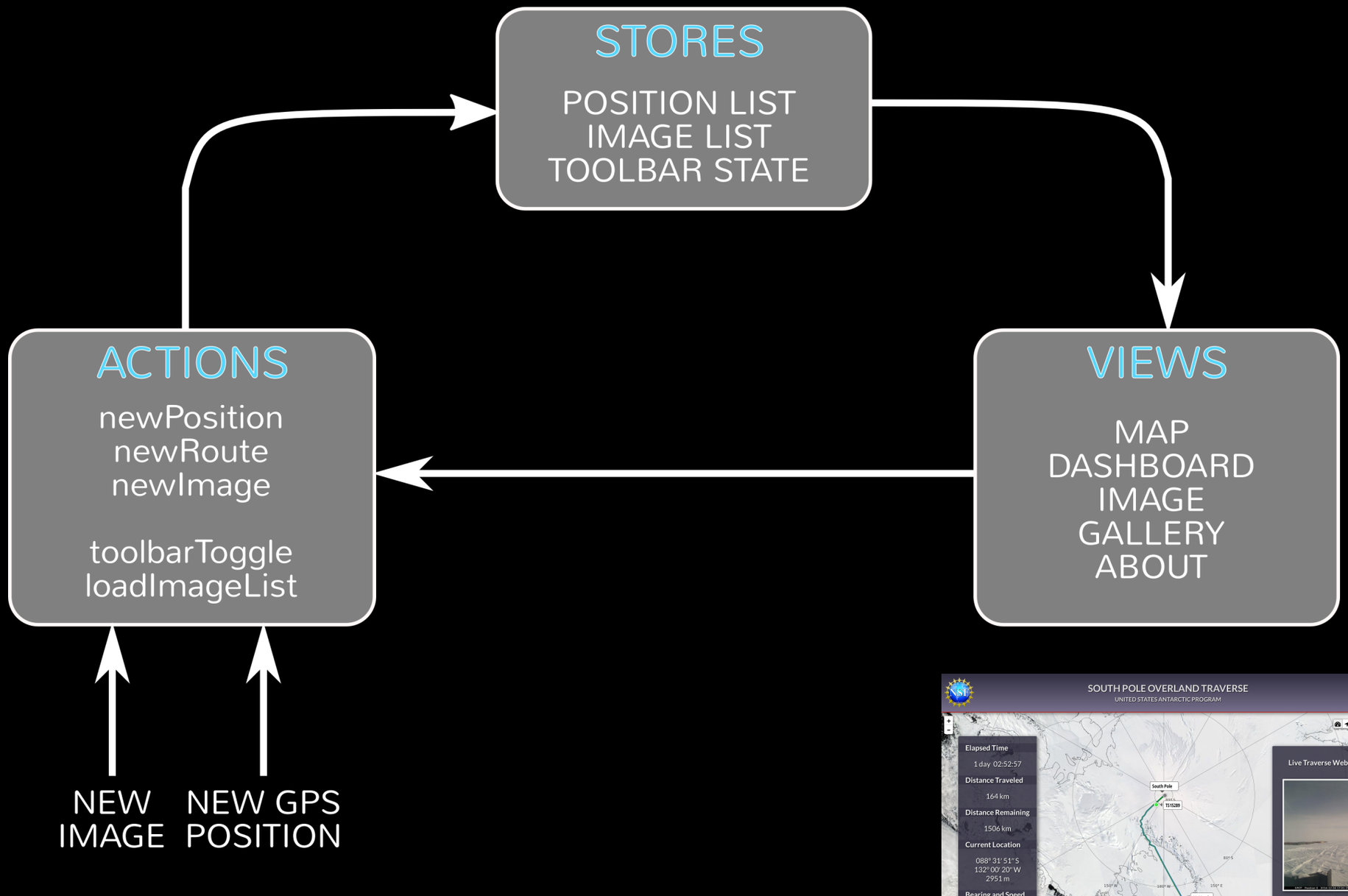
APPLICATION ARCHITECTURE

FACEBOOK.GITHUB.IO/REACT
FACEBOOK.GITHUB.IO/FLUX
GITHUB.COM/SPOIKE/REFLUXJS



WEB CLIENT ARCHITECTURE

ONE WAY DATA FLOW



LEAFLETJS.ORG

CLIENT MAPPING TOOLS

Leaflet

Star 10,049 Tweet Follow 12.5K followers Like 5.4k

An Open-Source JavaScript Library for Mobile-Friendly Interactive Maps

Overview | Features | Tutorials | API | Download | Plugins | Blog | GitHub | Twitter | Forum

Leaflet Features

Leaflet doesn't try to do everything for everyone. Instead it focuses on making *the basic things work perfectly*. It should still satisfy the needs of the vast majority of map apps developers while being easily extended by third-party plugins.

Available Map Layers

- Tile layers
- Markers
- Popups
- Vector layers: polylines, polygons, circles, rectangles, circle markers
- GeoJSON layers
- Image overlays
- WMS layers

Visual Features

- Zoom animation (for all layers, including tile layers, markers and vector layers)
- Panning animation
- Smooth continuous zoom on modern mobile devices
- Tile and popup fade animation
- Very nice default design for markers, popups and other map controls
- Retina resolution support for tile layers and markers

Map Controls

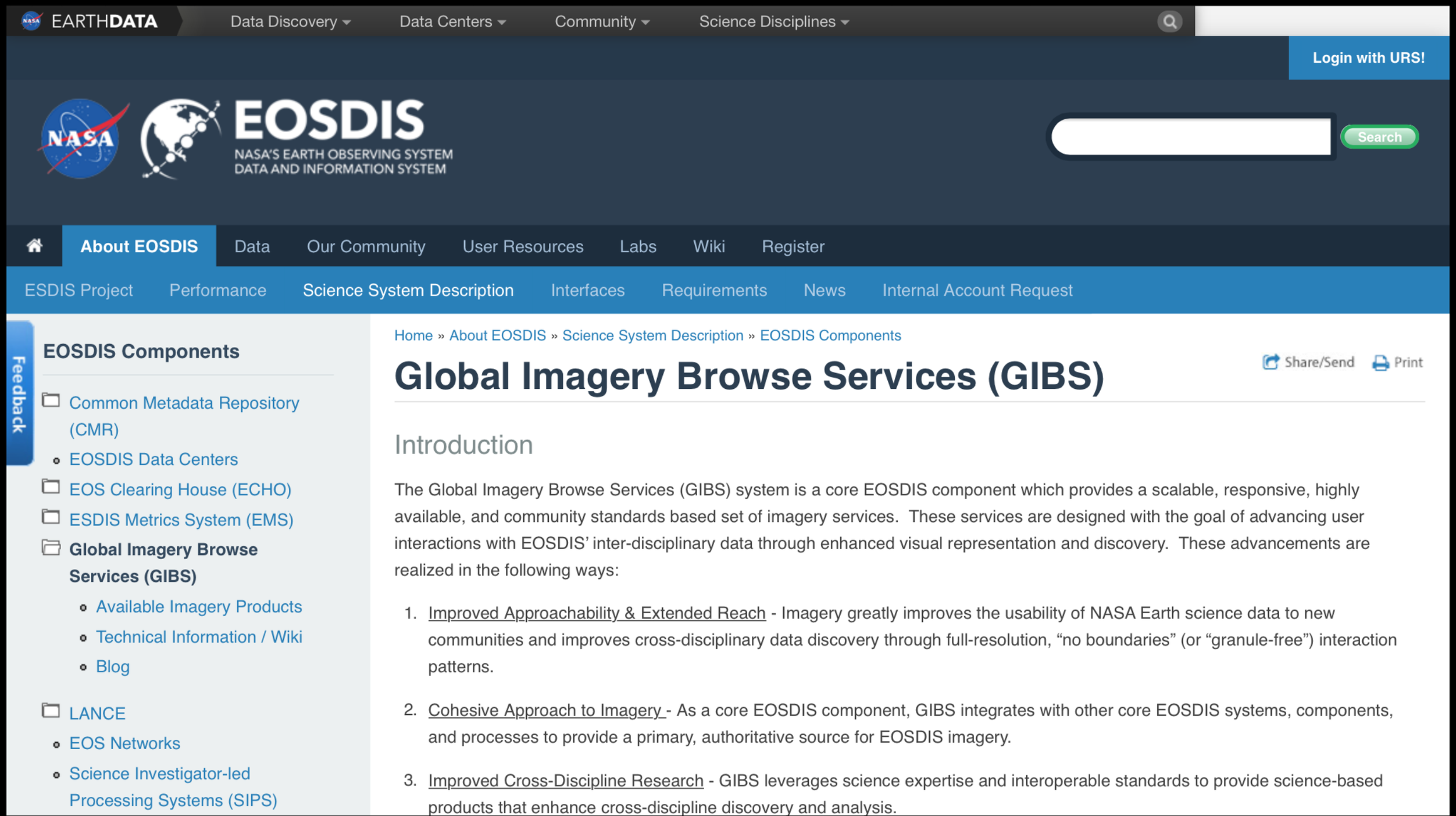
- Zoom buttons
- Attribution
- Layer switcher
- Scale

Browser Support

On Desktop

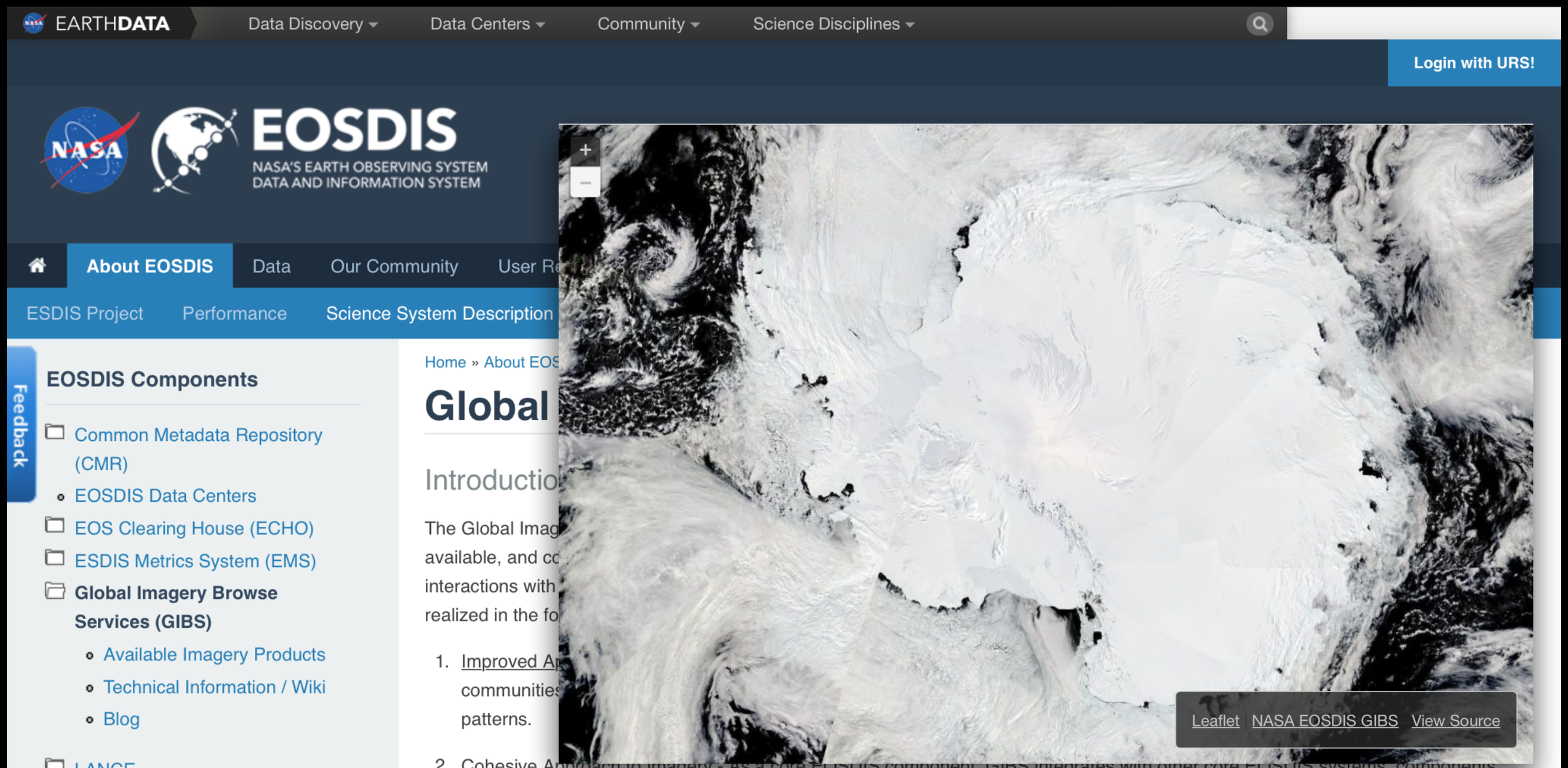
POLAR STEREOGRAPHIC PROJECTION

MAP TILE SERVER

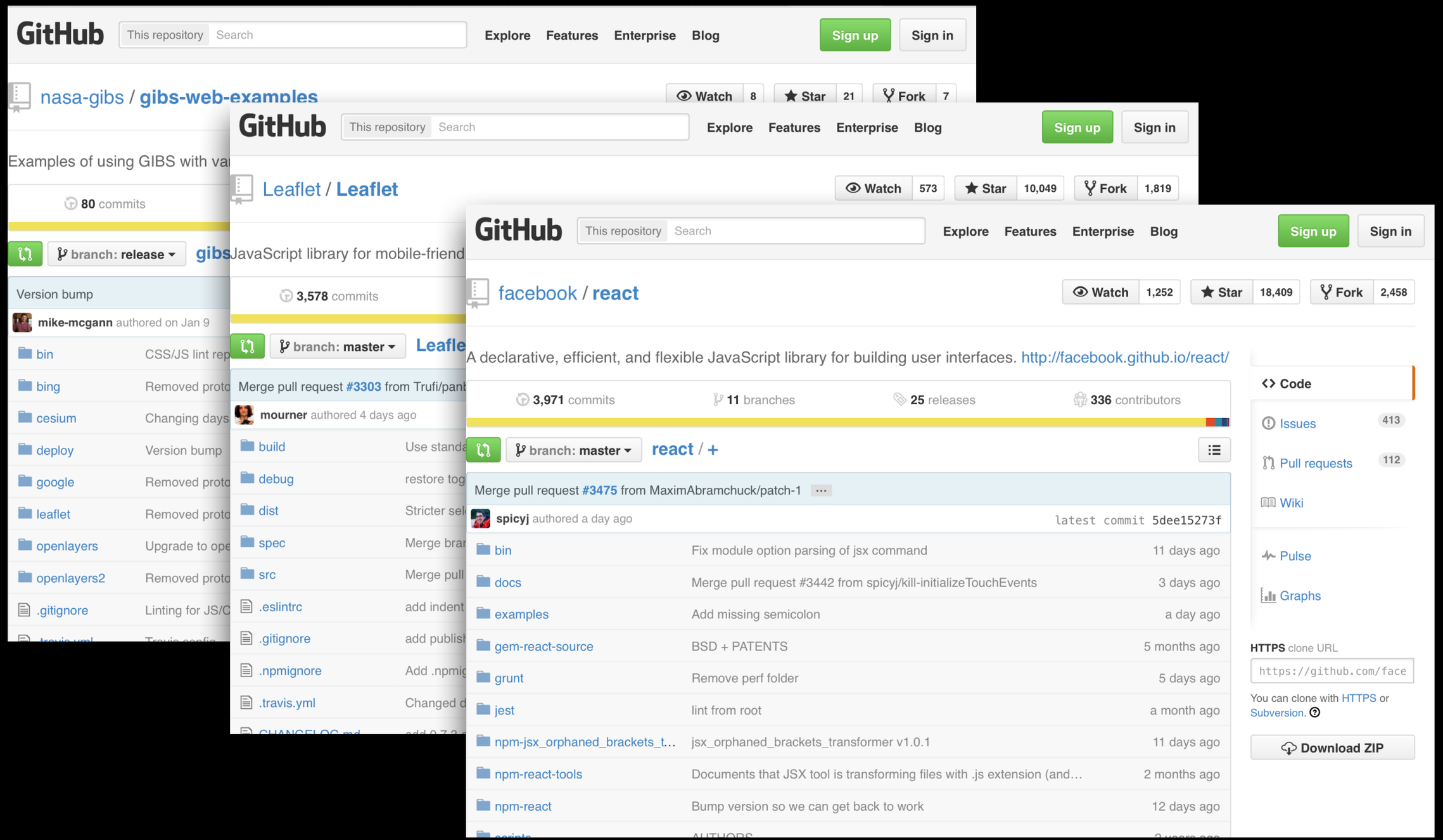


POLAR STEREOGRAPHIC PROJECTION

MAP TILE SERVER



OPEN-SOURCE PROJECTS



TRICKS OF THE TRADE

MAKING THE PAGE FAST

- Minimize number downloads from web server - use modern tooling such as WebPack to create a single bundle

- Snapshot table in database, updated via triggers

- Proper SQL indexing, schema and queries

- Smart caching and DOM management in client

- Line smoothing and marker grouping