From the Bench to Orbit

Test-as-you-Fly processing with Das3

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Data Processing by Mission Phase

NASA Phase B (Preliminary design/tech completion)

- Data displayed via O-scope, LabView, etc.
- Data artifacts usually ad-hoc

NASA Phase C (Final design and Fabrication)

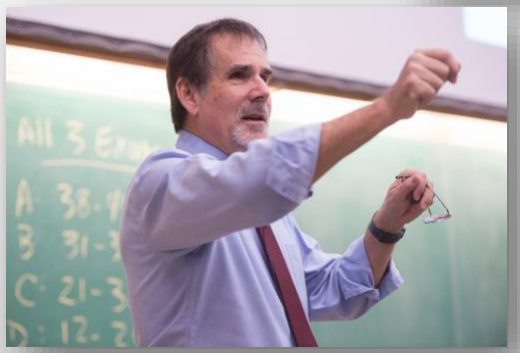
- Embedded CPUs are working
- Packetized data available
- Engineers need NeRT (Near Real Time) display
- Packet formats often in flux

NASA Phase D (Assembly, Integration and Test)

- Scientists using flight-like science products
- NeRT display still essential

NASA Phase E (Operations)

- Archive quality science product files
- NeRT display rarely applicable



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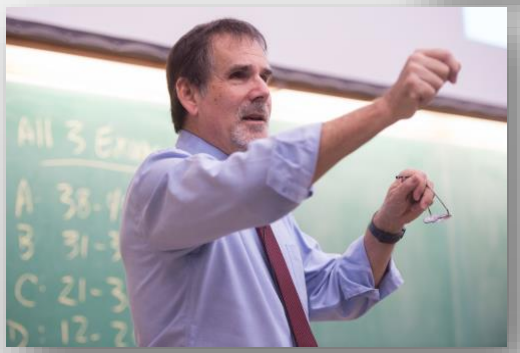
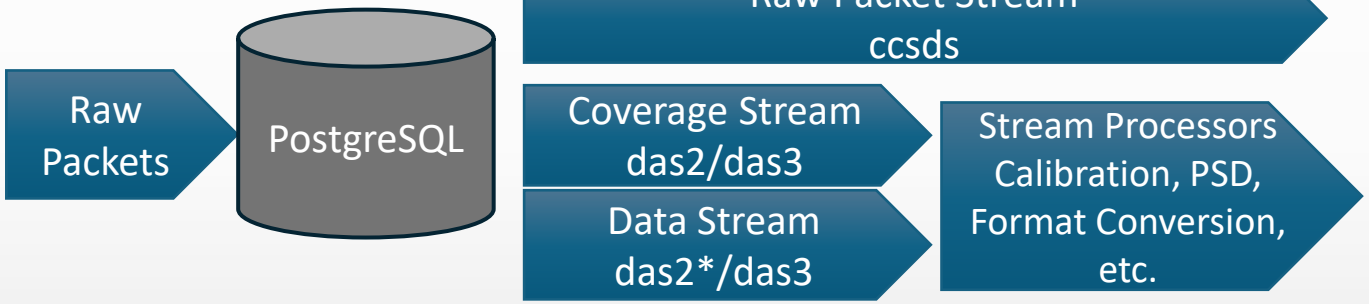
Supported phases

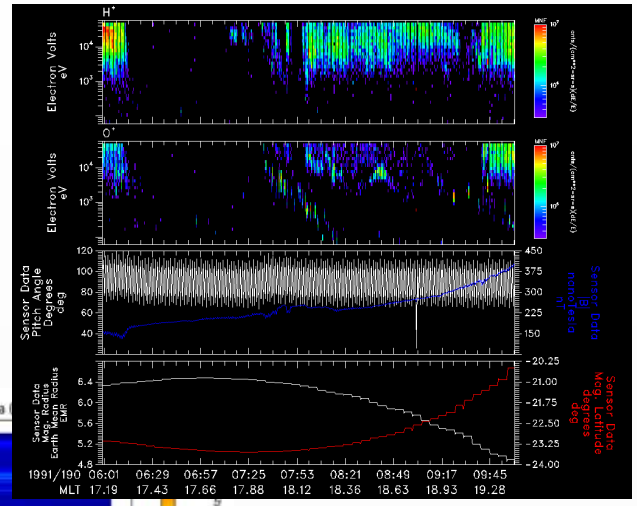


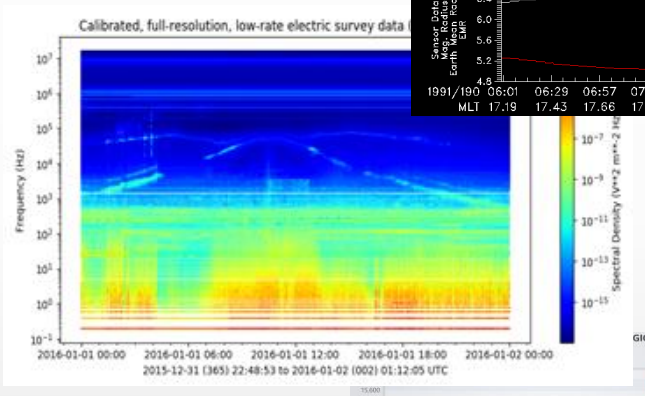
Architecture as Implemented

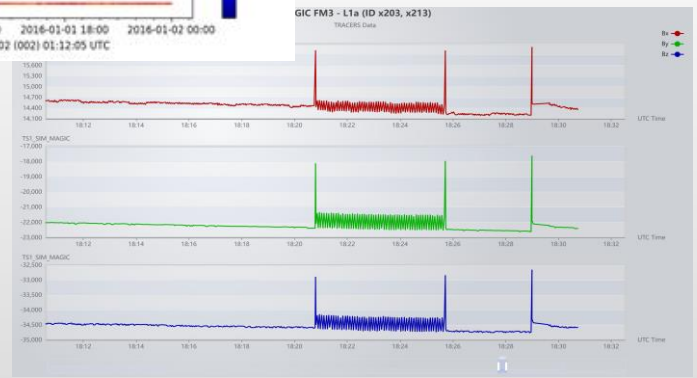


if dataset is rank-2 or less

HTTP SERVER INTERFACE - MULTI-API







SERVERS

CLIENTS

New Protocol: dasStream v3.0

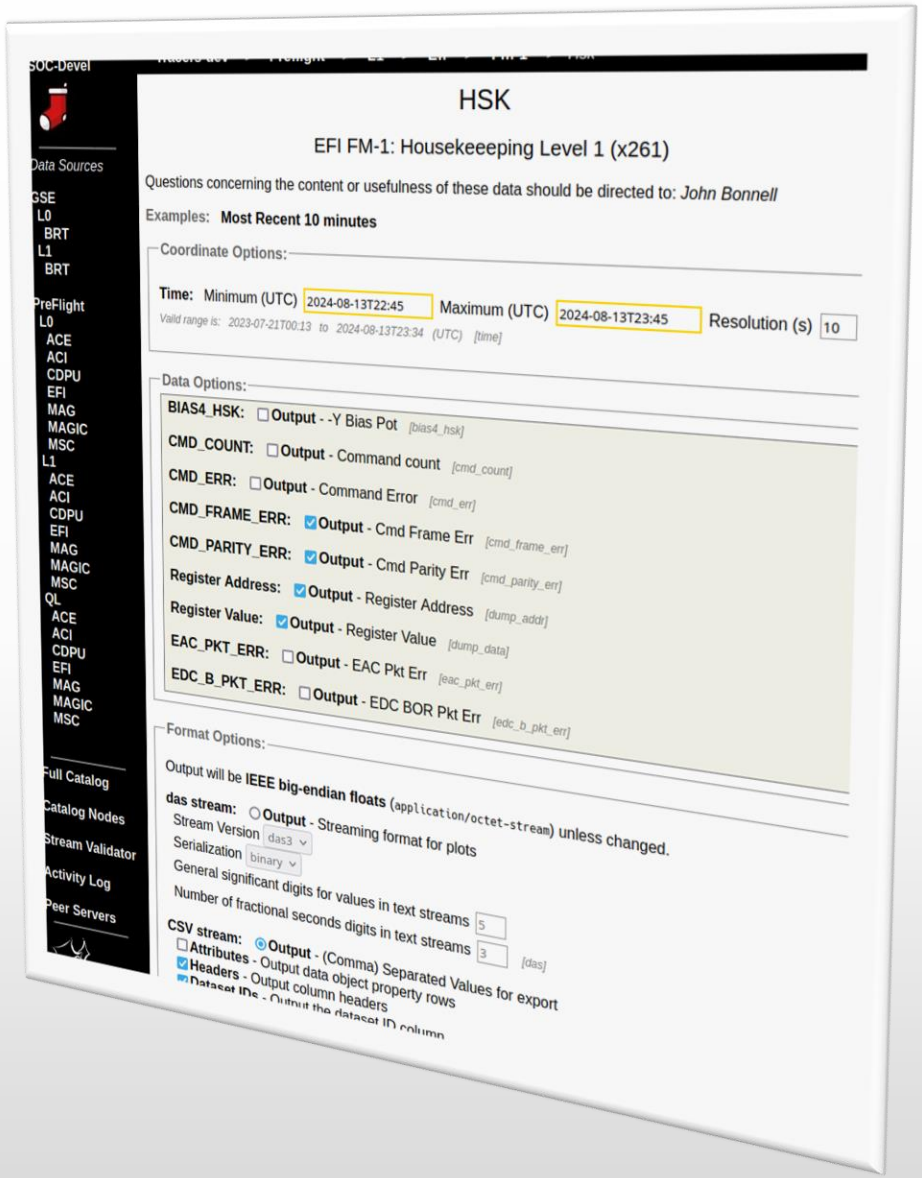
- Used for inter-process communication.
- Cleanly separates physical dimensions from array dimensions
- Handles high-rank data, up to 7 independent coordinates.
- Does not assume rectangular arrays
- Handles text data and variable length items
- Header validation via XSD schemas.

```
|Sx||50|
<stream type="das-basic-stream" version="3.0">
  <proerties>
    <p name="instrument_host">MEX</p>
    <p name="instrument">MARSIS</p>
  </proerties>
</stream>
|Hx|1|3455|
<dataset name="ais" rank="3" index="*;160;80" plot="cartesian3d" >

  <coord physDim="time" axis="x">
    <properties><p name="label">SCET</p></properties>
    <scalar use="center" semantic="datetime" index="*;-;-" units="UTC">
      <packet numItems="1" itemBytes="24" encoding="utf8" />
    </scalar>
  </coord>

  <coord physDim="altitude" axis="y">
    <properties><p name="label">cΔt/2, Apparent altitude</p></properties>
    <scalar use="reference" semantic="real" storage="float" index="*;-;-" units="km">
      <packet numItems="1" itemBytes="12" encoding="utf8" />
    </scalar>
    <scalar use="offset" semantic="real" storage="float" index="-;-;80" units="km">
      <sequence minval="0.0000e+00" interval="-1.3705e+01" />
    </scalar>
  </coord>

  <coord physDim="frequency" axis="z">
    <properties><p name="label">Frequency (MHz)</p></properties>
    <scalar use="center" semantic="real" storage="float" index="-;160;-" units="MHz">
      <values>
      1.09400e-01 1.20500e-01 1.31200e-01 1.42300e-01 1.53000e-01 1.75200e-01 1.85900e-01
      2.07600e-01 2.18800e-01 2.29900e-01 2.40500e-01 2.51700e-01 2.73400e-01 2.84600e-01
      3.06300e-01 3.17000e-01 3.28100e-01 3.39200e-01 3.49900e-01 3.61000e-01 3.71700e-01
      ...
      </values>
    </scalar>
  </coord>

  <data physDim="E_spec_dens" name="sounder_return">
    <properties>
      <p name="label">Spectral Density (V!a2!nm!a-2!nHz!a-1!n)</p>
    </properties>
    <scalar use="center" semantic="real" index="*;160;80" units="V**2 m**-2 Hz**-1" >
      <packet numItems="12800" itemBytes="12" encoding="utf8" fill="-1.0e+31"/>
    </scalar>
  </data>
</dataset>
|Pd|1|153636|2012-12-21T15:06:40.596  1.5404e+03  1.7882e-14  1.1964e-14  4.3845e-15  1.9897e-15
5.8294e-16  5.5629e-15  3.6921e-16  5.1378e-16  5.3454e-15  2.7233e-15  1.1994e-15  8.0604e-16
4.7716e-15  3.9284e-15  2.8748e-15  2.0690e-14  2.5603e-16  2.7896e-14  4.0383e-14  4.3642e-14
```

A das3 stream, binary and text encodings are supported

New Server: dasFlex

- Is a backwards compatible to [das2py-server]
- Server core is format agnostic, each installed component indicates supported formats
- Reads HTTP GET parameters and solves for a command pipeline, then runs it for data.
- It's supplied with das2 and das3 components, but others can be installed.
- Can convert das2 or das3 pipeline output **CSV** or **CDF**.



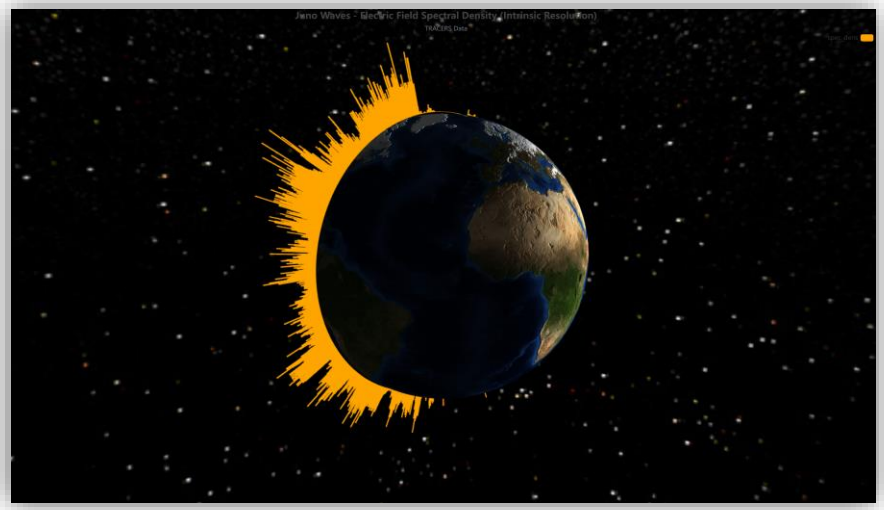
New Reader: dasTelem

- Provides bulk telemetry storage and data readers for dasFlex
- Removes the need to write custom data reader programs for early mission data.
- Written in D and PL/pgSQL. Relies on PostgreSQL for packet storage, parsing configuration and calibration data.
- Real-time events handled via PostgreSQL notifications
- Not yet optimized. Initial performance is 2.3 to 16.2 MB/sec, depending on packet complexity.

A portion of the dasTelem DB schema

New Client: DASOC

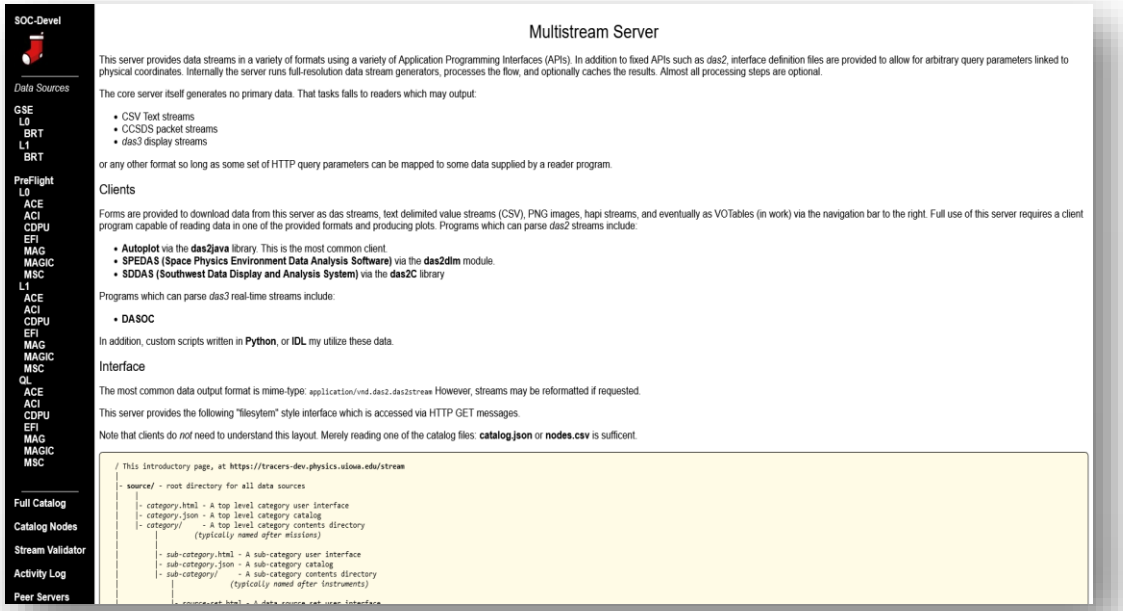
- Web application parsing and utilizing das3 stream data for creating interactive displays
- NodeJS project using JavaScript/TypeScript primarily
- Graphing powered by Apache ECharts
  - Open-source, well documented, data sampling built in, WebGL extension for 3D graphing, and highly customizable
- Ongoing incorporation of Web-Assembly for performance
  - For smaller tasks JS is more than capable, but WASM scales better with data size



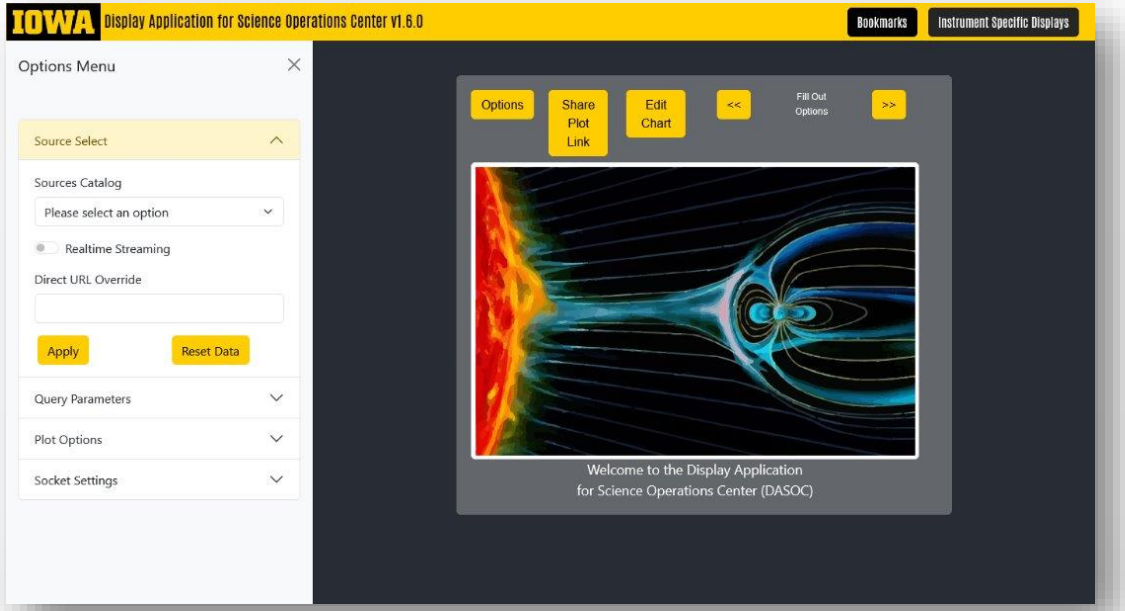
DASOC Internals

- ViteJS used for building
  - Like create-react-app but without the webpack headaches
- React as frontend framework
- Redux helps with data state management
- Gitlab-CI Pipeline to run tests, check build, and generate Docker image automatically
- Currently running nginx Docker container for hosting
- Vitest to run unit testing

Suite Demo



DasFlex



DASOC

Summary and Q&A

Open projects by late Spring 2025 to coincide with TRACERS launch

- Das Suite: https://github.com/das-developers
- Kevin Steele: kevin-steele@uiowa.edu
- Chris Piker: chris-piker@uiowa.edu
- Larry Ganroth: larry-granroth@uiowa.edu
- Carrie Gonzalez @ SwRI
- Special thanks to David Miles @ U of I
- Special appreciation to Prof. Craig Kletzing