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.
- $\circ~$ Data artifacts usually ad-hoc
- NASA Phase C (Final design and Fabrication)
 - $\circ~$ 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)

- $\circ~$ Scientists using flight-like science products
- NeRT display still essential

NASA Phase E (Operations)

- \circ Archive quality science product files
- $\circ~$ NeRT display rarely applicable







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Supported phases





Architecture as Implemented



<u>____</u>_

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das3

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 <u>XSD schemas</u>.

```
<stream type="das-basic-stream" version="3.0">
 <proerties>
   MEX
   MARSIS
 </proerties>
|Hx|1|3455|
<dataset name="ais" rank="3" index="*:160:80" plot="cartesian3d" >
 <coord physDim="time" axis="x">
   <properties>SCET</properties>
     <packet numItems="1" itemBytes="24" encoding="utf8" />
   </scalar>
  <coord physDim="altitude" axis="y">
   <properties>cAt/2, Apparent altitude</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 physDim="frequency" axis="z">
   <properties>Frequency (MHz)</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>
 <data physDim="E_spec_dens" name="sounder_return">
   <properties>
     Spectral Density (V!a2!nm!a-2!nHz!a-1!n)
   </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 <u>das2py-server</u>
- 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.

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A portion of the dasTelem DB schema





das3

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

OC-Devel	Multistream Server	IOWA 🛛
,	This server provides data streams in a variety of formats using a variety of Application Programming Interfaces (APIs). In addition to fixed APIs such as das2, interface definition files are provided to allow for arbitrary query parameters linked to physical coordinates. Internatly the server runs full-resolution data stream generators, processes the flow, and optionally caches the results. Almost all processing steps are optional.	Options Menu
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eer Servers	(typically need of the survey)	











Summary and Q&A

Open projects by late Spring 2025 to coincide with TRACERS launch

- Das Suite: https://github.com/das-developers
- Kevin Steele: <u>kevin-steele@uiowa.edu</u>
- Chris Piker: chris-piker@uiowa.edu
- Larry Ganroth: larry-granroth@uiowa.edu
- Carrie Gonzalez @ SwRI
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