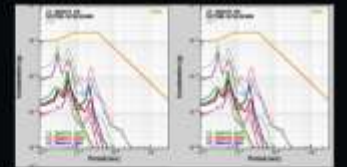
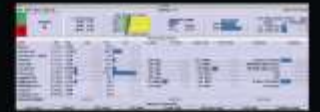
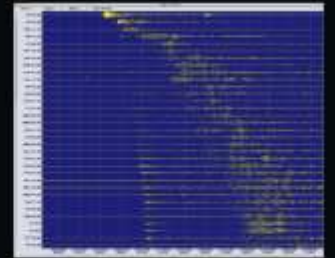


# Antelope



**BRTT**



# Antelope

Dr. Kent Lindquist  
Boulder Real Time Technologies, Inc.



# Antelope Presence

- Antelope running on All 7 Continents
- Countries
- Cities
- Critical Facilities
- Structures



# *Antelope Applications*

- Seismic data center operations
  - Several-station networks
  - Hundreds of station networks – USArray, Italy/DPC, Chile
- Seismic network and inter-network operations
  - weak motion processing
  - strong motion processing
- Data exchange
  - Real-time “virtual” seismic networks
  - Non real-time (e.g. SEED, autoDRM, web-based)
  - Access to other tools, such as SAC and MATLAB
- CTBT/NDC operations
- Infrasound
- Hydroacoustics
- Portable telemetry deployments (USArray)
- Offline processing of “standalone” portable deployments (IRIS/PASSCAL)
- Research in seismology (University Community)
- Induced Seismicity Applications
- Structural health monitoring
- Generic “sensor webs” and multi-hazard monitoring



# Antelope Key Points

- Enterprise-grade core infrastructure
- Dual support for data-driven mission and operations-support mission



# Antelope Key Points

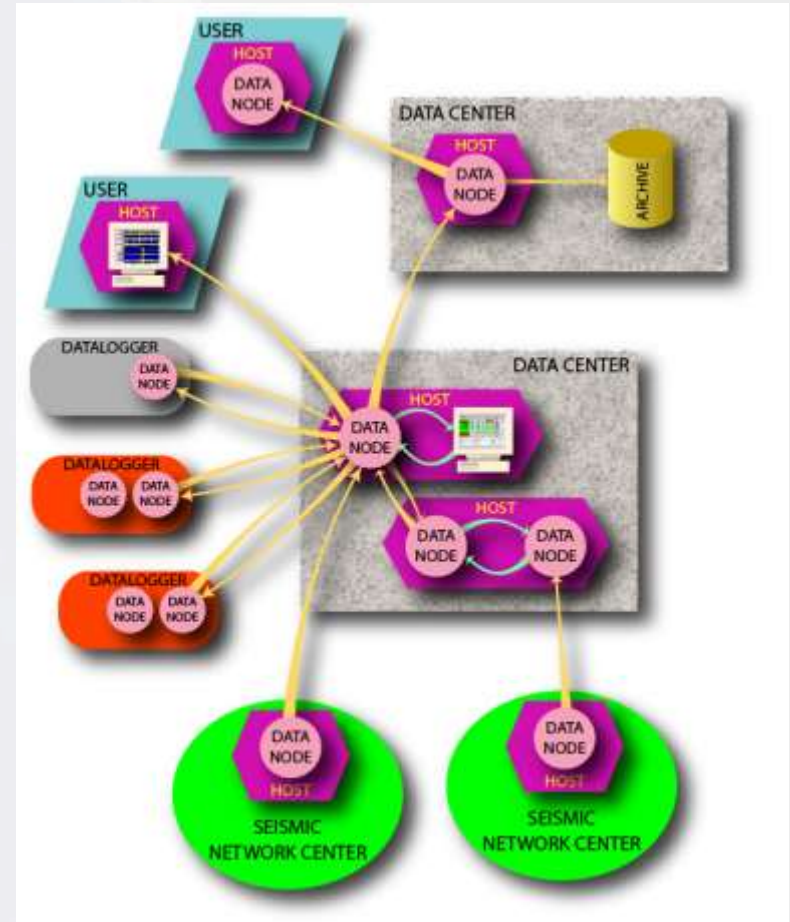
- Complete software package for traditional seismic network operations
- ***Extensible Middleware Framework*** for interconnecting data sources with data processing to create custom earth monitoring systems
- Store-and-forward packet system enables reliable transport, processing, dissemination
- Embedded relational database system
- Core utilities available for both streaming and batch-mode processing
- Has been applied to numerous environmental monitoring domains
  - seismic, tsunami, volcano, strong-motion, sensor-web, structural health
- ***Open architecture***, with both closed and open-source components
- High performance and reliability
- High scalability
- High interoperability
- Minimum processing and communications latencies (early warning)
- Productive development environment for new/extended functionality
- ***Coherent engineering throughout creates highly robust, highly functional, low cost-of-ownership system – only available from commercial code***



# Data Transport Backbone

## *orbserver*

- *orbserver* / *orb* protocol
- Network transparent
- Data-neutral
- Data-driven
- Extremely reliable
- Short-haul Inter-process communication
- Long-haul, low latency data transport
- Extension to standard networking stack:
  - IP = packet transport
  - TCP = reliable transport of bytes
  - Orb = reliable transport of monitoring-data packets





# Data Acquisition

- Antelope provides the worldwide premier software utilities to acquire data from, monitor the health of, and control Kinometrics dataloggers
- Three-tiered model for acquisition
  - Data
  - State-Of-Health
  - Command-and-control





# Data Acquisition Strategy

- One orb client executable for each datalogger model
- All data, state-of-health, commands exchanged through orb packets
- Programs are generally threaded: many dataloggers served by each program instance
- ***Huge amount of time and effort invested in these programs to foresee and circumvent every reasonable and many unreasonable acquisition problems***



# Data Acquisition: altus2orb

## *altus2orb*

- Supports entire Kinometrics Altus product line
- Works with legacy Altus dataloggers
- Works with Rock dataloggers running in Altus emulation mode
- Provides TCP server communication mode for modem threads
- Provides POC reception capability: keep streaming data alive when remote IP address changes
- Large-network field-proven





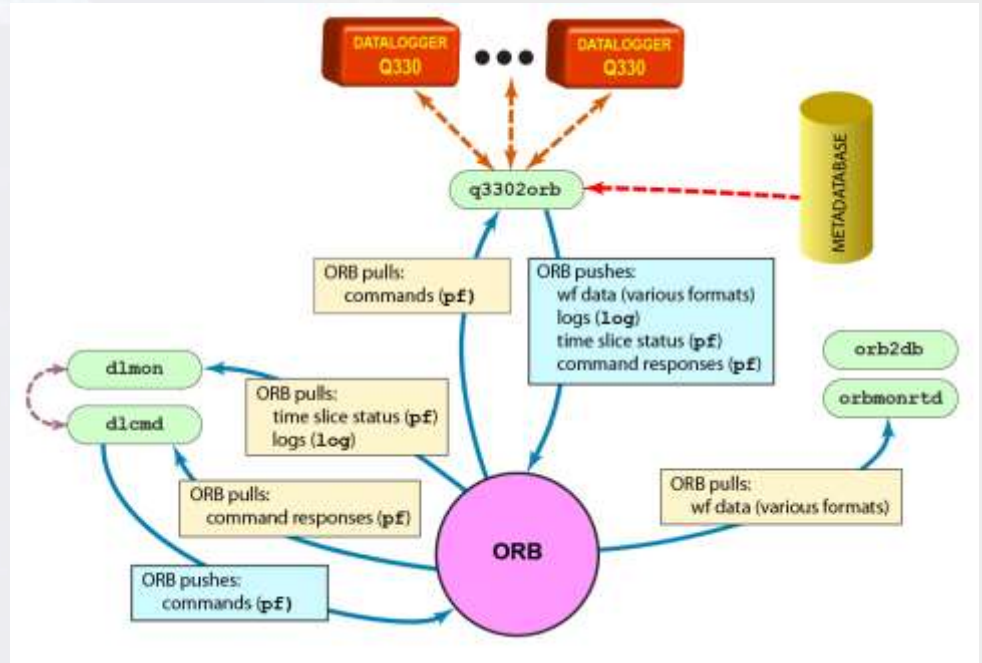
# Data Acquisition: q3302orb

q3302orb

Over 2 years at USArray:



- 1166 dataloggers
- 10,292 physical data channels at multiple sample rates
- ~40,000 channels of SOH waveform data
- 8760 instance-days of software running
- 16 Terasamples of end user data collected (not including SOH)



- *0 downtime, 0 lost data* due to acquisition software failures
- 1 FTE to manage data center O&M
- *99.5% data completeness*

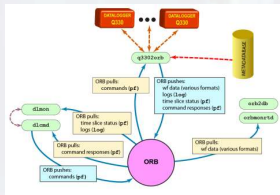




# Dataflow SOH Monitoring

dlmon

The screenshot displays the dlmon software interface. At the top, there is a grid of TA windows, each representing a different traffic analysis point. Below this grid, a large window shows a detailed log of network events. The log entries include timestamps, source and destination IP addresses, and descriptions of network activities such as data stream opening, packet sending, and connection establishment. For example, the log shows a data stream opening at 2007:174 18:59:40.8201 and a connection establishment at 2007:174 18:59:40.8201. The log also shows various error messages and status updates.



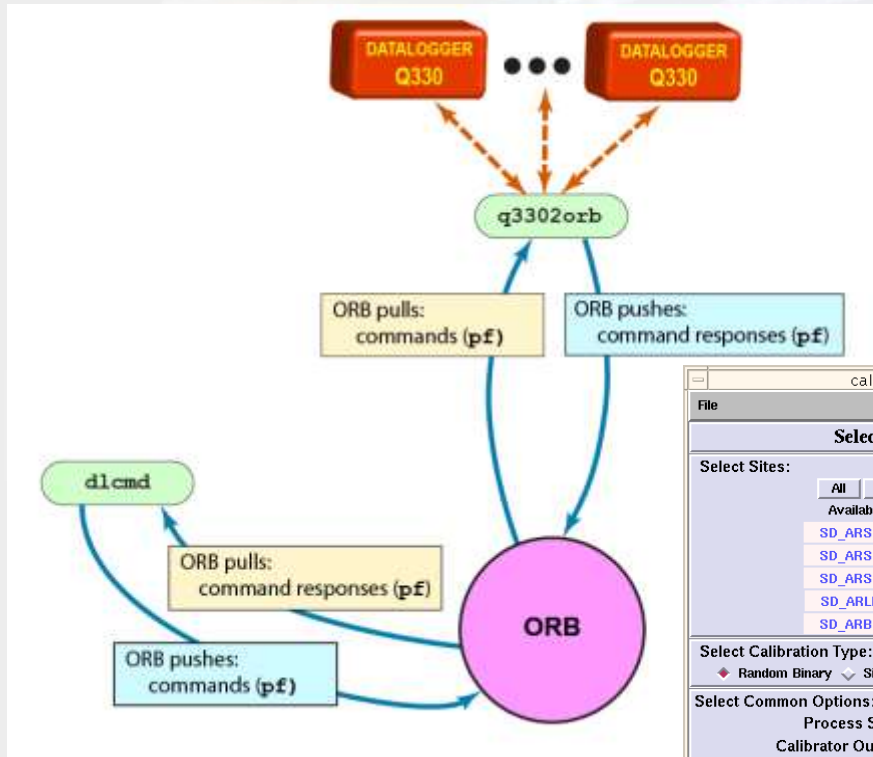
High Success rate of Antelope acquisition:

- Robust Software
- Sophisticated SOH Monitoring

# BRTT



# Datalogger Command and Control



*dlcmd*

calconfig: calibration configuration window

File

### Select Calibration Configuration Parameters

Select Sites:

All	None	23900	GS-21	KS54000	GS-13
Available					Select
SD_ARSP01					SD_ARSP01
SD_ARSP02					
SD_ARSP03					
SD_ARLP31					
SD_ARBB32					

Select Calibration Type:

◆ Random Binary ▾ Single Sine Wave ▾ Sine Wave Sweep ▾ Free Period

Select Common Options:

Process Sites: ◆ Serially ▾ Concurrently  
Calibrator Output: ◆ Sensor ▾ Loopback  
Loopback Options:  Preamp in  Loopback loaded  
Calibration Start Time:   
Calibration Settle Time:   
Settle Time Without Autozero:   
Recover Time:

Select rbc Calibration Parameters for Site SD\_ARSP03

Channel: SHZ

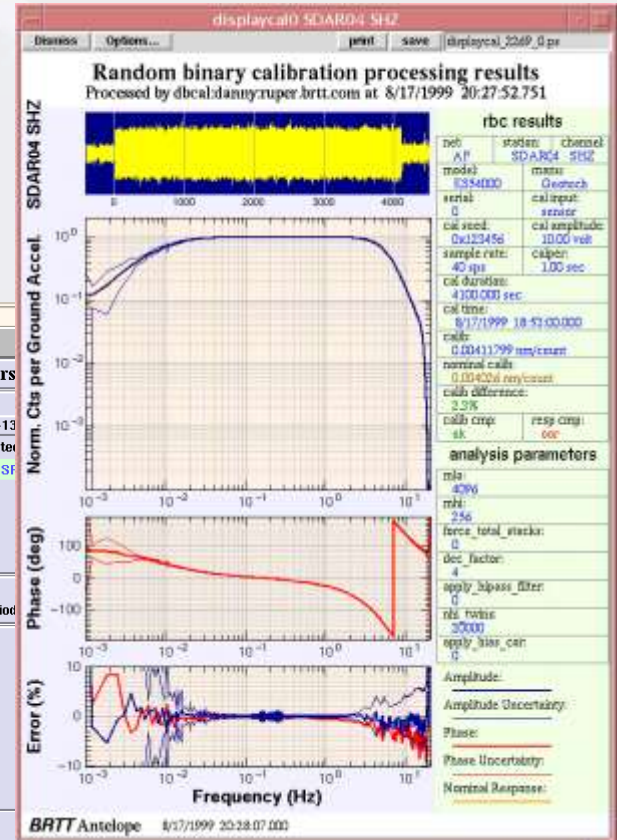
Select Amplitude in Volts:  actual volts=5.00000 dac=0x6666,0  
Select Duration Time in Minutes:   
Select Random Seed Value:

Select RBC Analysis Parameters:

Select Low Frequency in Hz:   
Select Mid Frequency in Hz:

EXECUTE THE CALIBRATION SEQUENCE

Status:





# Station Metadata Management

## *dbbuild*

- Program for building the “metadata” part of a Datascope database (*site*, *sitechan*, *sensor*, *instrument*, *calibration*, *stage* tables plus external instrument response files)
- Can operate in either interactive or batch mode.
- Can run from a master configuration file
- Based on well-documented ASCII files
- User-configurable single-stage response files
- set of parameter files that describe standard dataloggers, pre-amplifiers and sensors

**Master Database Construction**

**Database Configuration** Help

Configuration time: 4/1/2004      Comment:

**Network**

net network name  
XT SECARIB - Passcal Broadband Experiment

**Station**

sta	latitude	longitude	elevation	station name
ZUPC	8.3597	-65.1951	0.0960	Zuata

**Datalogger**

Reftek 130 Datalogger

rt130

serial number: 123      dista:

**Sensor**

Episensor 200 Hz 10 Volt FS 2g Clear

1 episensor\_2g\_10vfs

serial number	edepth	band	rsptype	loc code
456	0.0	s	R	<input type="checkbox"/>

axis	hang	wang	sensor gain	lead	preamp gain	preamp stage
Z	0	0	5.1e-10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
N	0	90	5.1e-10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
E	90	90	5.1e-10	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

samprate	on	chan	loc	dichan	on	chan	loc	dichan	on	chan	loc	dichan
250sps	<input checked="" type="checkbox"/>	HGZ	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HGN	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	HGE	<input type="checkbox"/>	<input type="checkbox"/>

Add



# Embedded Relational Database

## *Datascope*

- Schema-independent relational database system
- Flat-file, no “black box” into which your data disappear
- Written directly from core ideas of relational databases
  - Create *sets* of things
  - Establish *relationships* amongst them
  - Intuitive database operations
- Optimized for real-time monitoring
- Coherently engineered with Real-time Tools
- Many specialized tools and features for seismic tasks



# Real-time System

- Unix building-block design
  - Hundreds of small, well-designed programs, each with a clear job
  - Shared-object libraries of generic and specialized tools
- Framework to customize solutions
- Scalable
- Network-transparent
  - Allows local deployments
  - Allows distributed processing
- Demonstration system based on GSN
  - Learning and Testing
  - Augment small networks with global processing for context
  - Basis for rapid configuration of larger operations







# Conclusion

## **Antelope is:**

- The Premier, State-of-the-art seismic monitoring software platform in the world
- The industry leader in robustness, flexibility, and design quality
- Open-architecture
- 20 years field-proven
- Commercially maintained, commercially supported

***Software is a critical, first-class element of systems that meet customer business mission***



# Remainder of Meeting

- Anza, CEUSN Network usage
- Dbmoment
- Extending Antelope
- Multi-hazard monitoring
- Afternoon: **Discussion**



*Reminder*

# Antelope User Group

*Meeting*



August 17-19 Fairbanks, Alaska

**UAF** ALASKA  
UNIVERSITY OF ALASKA  
FAIRBANKS EARTHQUAKE  
CENTER



<http://www.brtt.com/events/alaska2016/index.html>

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