Introduction
The Waveform Server, a Python Twisted application integrated and built on the popular Boulder Real Time Technologies (BRTT) Antelope Environmental Monitoring System allows rapid access and interactivity with multi-station, multi-sensor and multi-channel data stored in Center for Seismic Studies (CSS) 3.0 schema relational databases (Lindquist et al., 2008, Newman et al., 2009, Reyes et al., 2010). The application uses web 2.0 technologies (JSMN-based data exchange, AJAX functionality, and HTML5 elements) and standardized libraries (Query and Query-UI) to quickly display large volumes of data in a user-friendly format to either a stand-alone application or remote (iframe) display. The application can be essentially split into two independent components: the server-side Waveform Server Engine, and client-side data rendering component (Waveform Viewer).

Server-side: The Waveform Server Engine
1. Object-oriented programming (OOP) paradigm: flexible environment for other programmers to expand & improve the application
2. Event-driven reactor is a key component of the server
3. Previously used deferred objects (object encapsulates an instruction that will produce a result in the future).
4. Data exchange in compressed JSON format is easily parsable by all popular scripting languages. Reformattting data objects from tuples to simple arrays has improved server performance.

Inside the engine: the reactor loop
1. Client (i.e. web browser) initiates the process with HTTP_GET request.
2. The Reactor loop forwards the request to the appropriate resource.
3. The Reactor acknowledges the query with a response of NOT_DONE_YET
4. The Reactor calls one of the workers from the pool with the function and the request information.
5. The Reactor is ready to accept new connections.
6. The Reactor will complete and the callback function will return the data to the Reactor thread.
7. The Reactor will send the result back over the opened connection to the client.

How the engine works: the query lifecycle
1. Client (i.e. web browser) initiates the process by querying the server with a user provided URI.
2. The Twisted Reactor interprets the URI using cached metadata and produces a meta-query object that contains references to the requested data.
3. The meta-query object is sent to a worker from the pool of workers maintained by the reactor.
4. The worker processes the request, retrieving the requested data from the database.
5. The worker sends the data back to the Reactor thread.
6. The Reactor sends the data back over the opened connection to the client.

Client-side: WaveformViewer
Providing anonymous web-based access to both near real-time and archived time-series data recorded by instruments in a seismic network is an easy and efficient way for network operators and scientists to determine network-wide data return rates and quality, scan seismic events, assess calibrations, etc.

The Waveform Viewer interface is easily customizable for any network using simple Antelope configuration files (gf) and templates on the server side, and cascading style sheets (CSS) on the client-side interface. These can be easily modified to re-architect the client-side interface for any particular purpose.

The application has been thoroughly tested using broadband (1 & 40Hz) seismic data from both particular purpose.

Download
You can download the code used in this presentation from the online Git repository hosted by Github.

http://github.com/antelopeusersgroup/antelope_contrib

Future development
1. Real time live interface to streaming waveforms from a Object Ring Buffer (ORB).
2. Optimize performance of data extraction and better handling of long running queries.
3. Promote the development of new clients that can use the server as a gateway to the databases.

References
Reyes, J.C. <reyes@ucsd.edu>1, Newman, R.L.1, Davis, G.A.1, Vernon, E.L. and Steidl, J.H.2
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Waveform Server Uses
1. Seismic network data return rates and quality
2. Gap analysis: station specific or network wide
3. Rapid assessment of earthquake waveform data
4. Analysis of state-of-health channel data to assist station engineers in diagnostics