

## CT/Open MCT: Modular Streaming Data Display

### Introduction

A prototype interface has been developed between two complementary software packages: CloudTurbine and Open MCT. CloudTurbine, or CT, (<https://www.cloudturbine.com/>) is being developed under a Phase II SBIR project for NASA Armstrong by Cycronix. CT is “stream sharing” middleware which uses incremental files to distribute data from any source through popular file sharing systems such as Google Drive, Dropbox, OneDrive and more. Open Mission Control Technologies, or Open MCT, (<https://nasa.github.io/openmct/>) is a framework being developed by the NASA Ames Research Center and the Jet Propulsion Laboratory for mission planning and operations and browser-based viewing of streaming data. Both CT and Open MCT are free and open source (Apache 2.0 licenses) available on GitHub.

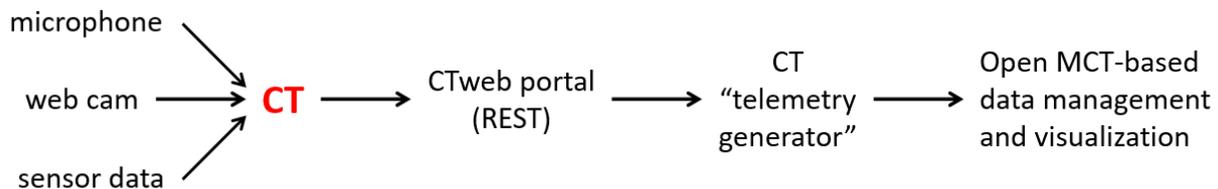
Combining CT and Open MCT technologies provides an opportunity to facilitate:

- connecting new data sources to Open MCT
- as a data streaming backbone for distributed Open MCT deployments
- as a replay/archiving repository for Open MCT data
- provide a powerful third-party data viewer for CT data streams

### Implementation

A prototype CT-based “telemetry generator” layer for integration with Open MCT has been developed. Figure 1 provides an overview of the data flow for this synergistic deployment. Starting from the left hand-side in this figure, we see examples of data that can be stored in CloudTurbine; in fact, any type of data can be stored in CT format – image, text, audio, sensor data, etc. CT data is made available to the Open MCT integration using the CTweb portal, which supports a REST-type interface (stateless data requests made via HTTP/HTTPS).

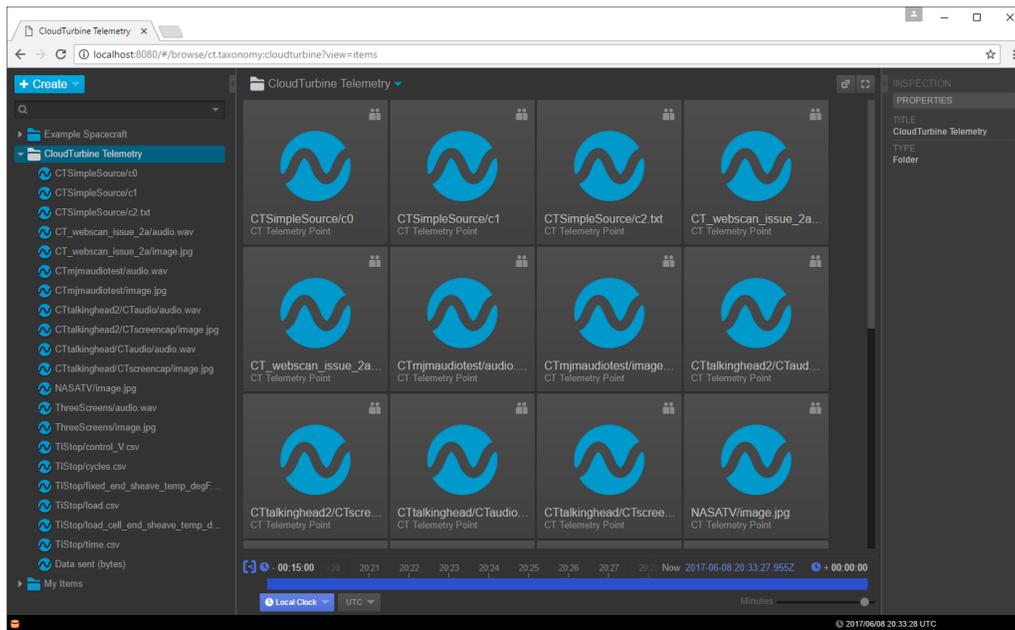
Based on Open MCT’s “spacecraft” tutorial, we developed a CT-based “telemetry generator” layer between the CTweb portal and Open MCT visualization layers. This prototype implementation is available on GitHub at <https://github.com/jpw-erigo/openmct-tutorial>. At startup, the CT telemetry generator queries the CTweb portal for its channel list. The CT telemetry generator then queries the CTweb portal for data updates on all channels. This CT data is available via browser by connecting to the Open MCT local server.



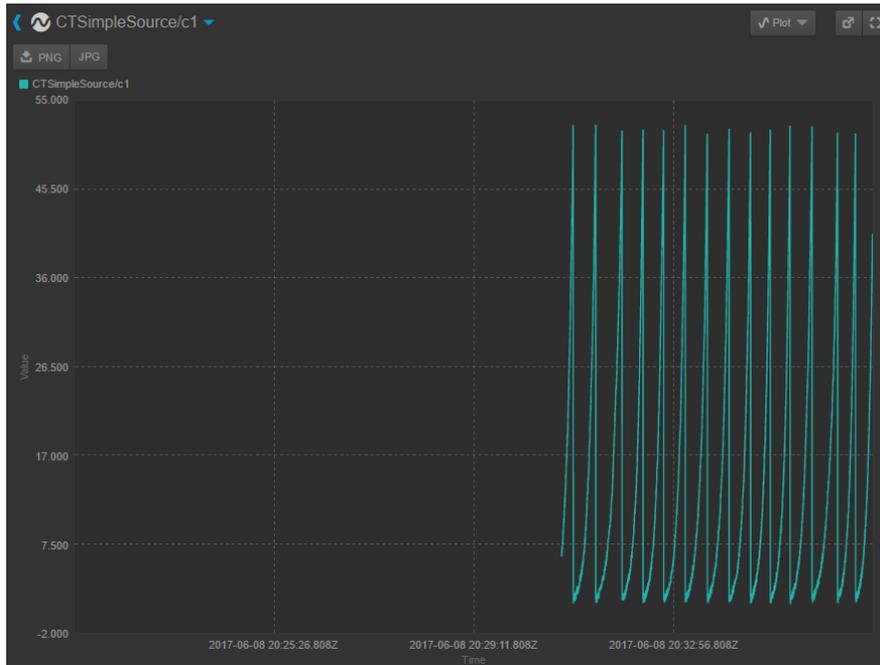
**Figure 1. CT/Open MCT integration overview**

HTTP is the primary protocol used between these layers (although the CT telemetry generator uses WebSockets to push real-time data updates to Open MCT for active plots). Data shared from the CT telemetry generator to Open MCT is in JSON format.

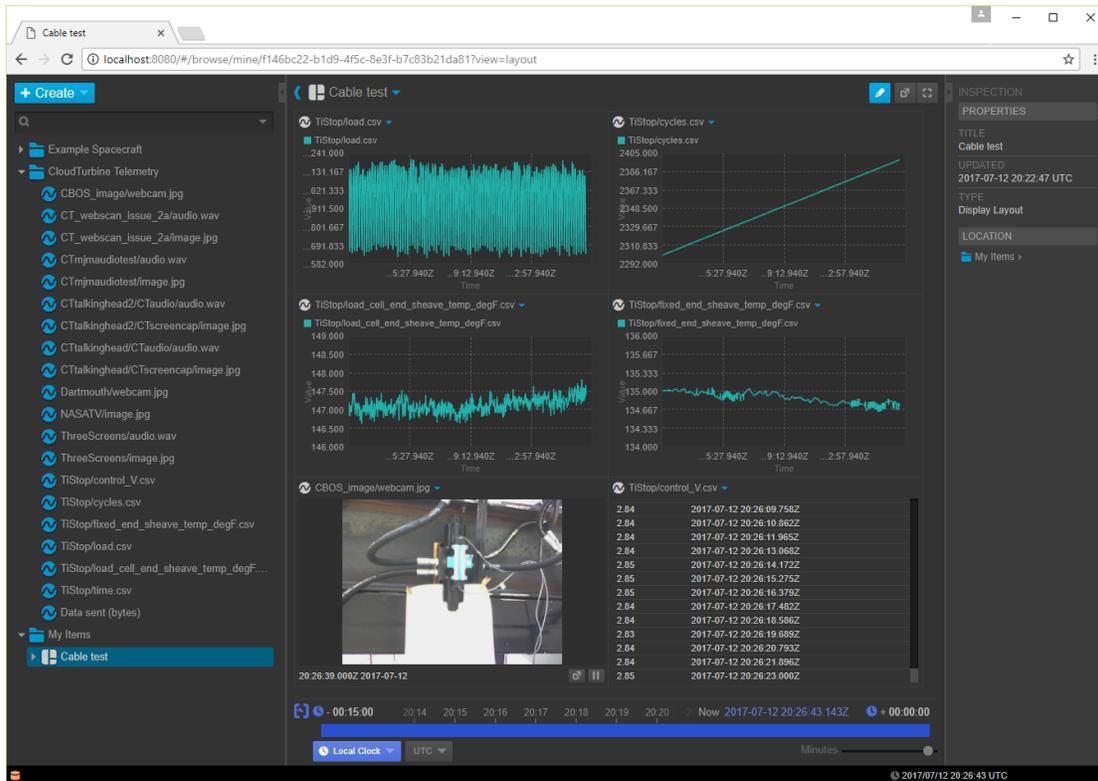
Figures 2 – 5 provide examples of the CT/Open MCT integration. Figure 2 shows the list of CT channels displayed in the Open MCT tree listing. Figure 3 is an example of Open MCT displaying data for a single CT channel. Figure 4 shows live CT data from a test conducted at Erigo Technologies displayed in Open MCT (plots, tabular, and image data). Finally, Figure 5 shows Open MCT displaying audio/video data (8kHz audio and 5Hz image data).



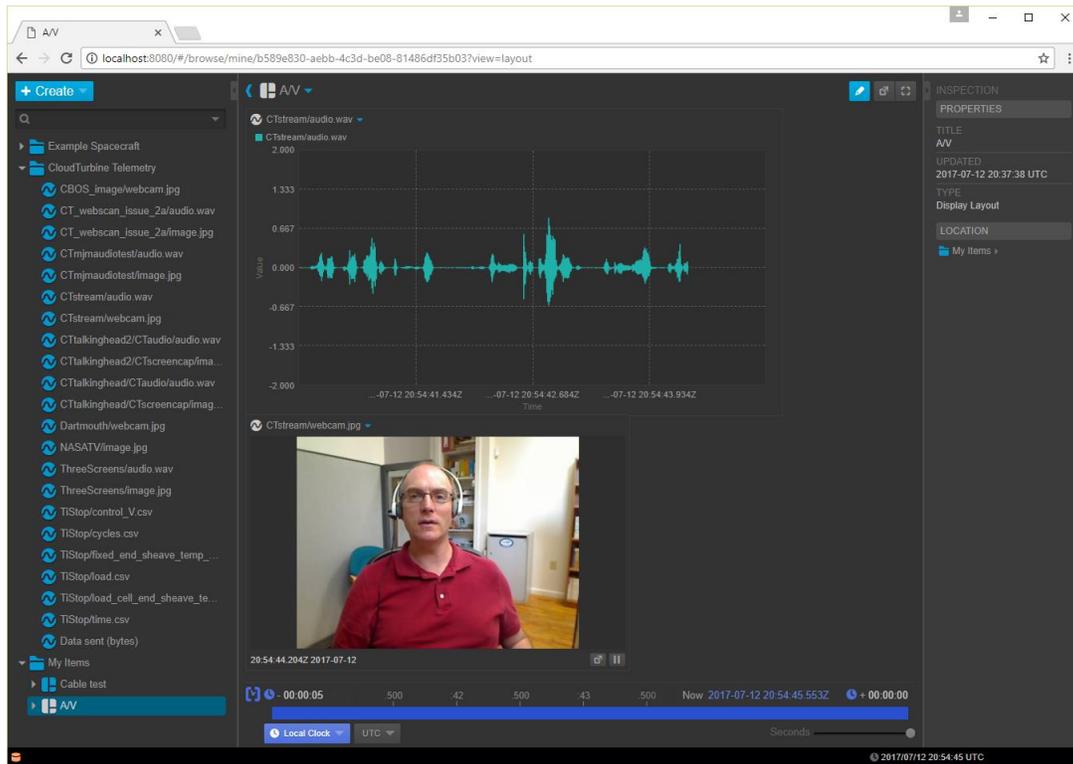
**Figure 2. CloudTurbine channel list in Open MCT browser interface.**



**Figure 3. CloudTurbine data displayed in Open MCT browser interface.**



**Figure 4. Cable test data for a Navy-sponsored project conducted at Erigo Technologies displayed in Open MCT browser interface.**



**Figure 5. CloudTurbine audio/video data displayed in Open MCT browser interface.**

### Future Work

The CT/Open MCT integration can be utilized and expanded in a number of ways, including:

- Send CT data to a distributed network of Open MCT viewers.
- Explore using CT as an Open MCT data store/archive.
- Investigate the limits of the CT-to-Open MCT data transfer. Throughput may be enhanced via an option to distribute packed data to the client-side real-time telemetry provider; this provider must then unpack the data and send it point-by-point to the Open MCT listeners (e.g. plots).
- Although the Open MCT composition provider cannot currently be called in real-time to update the object tree (i.e., Open MCT channel list), this is a feature that that Open MCT team may add in the future. When it is, updates to the CT source list could be reflected in the Open MCT tree in real time.

To investigate these (and other) issues, an “app-kit” dedicated to the CT/Open MCT interface has been setup at the CloudTurbine web portal ([http://www.cloudturbine.com/app\\_kit/ct-openmct/](http://www.cloudturbine.com/app_kit/ct-openmct/)). The developer community is invited to join this team to enhance the CT/Open MCT integration!