

## AWIPS II Technical Interchange Meeting

Primary audience: GOES-R Proving Ground

Time: 2:45 PM to 3:45 PM EDT

Date: May 17, 2011

An audio recording of the call is available.

Notes taken and prepared by Jordan Gerth, last revised on May 22, 2011.

Bill Campbell took attendance. Doug Lawson and Frank Griffith joined the call from Raytheon in Omaha. Ed Mandel was present from the NWS OST. CIMSS and CIRA had representatives in person.

- **Action: Work to collect, and then distribute information on the McIDAS AREA plugins currently developed by Raytheon, NCEP, and SPoRT so that a unified decoder can be delivered operationally to support the experimental product ingest.**
  - **OPR: Raytheon, NCEP and SPoRT to provide code or pseudo-code so that the group can decide if this is worth pursuing. (Nov 12)**

We just received the viz plug-in for the National Centers perspective in OB11.5. It may be necessary that Raytheon develop a plug-in for the d2d perspective.

- **Action: Raytheon needs to further describe how the legends are created and displayed. Information on the shader language and process is also important. The maximum and minimum values are parameterized when the data selection occurs, and that controls what you see on the screen as far as color.**
  - **OPR: Raytheon to provide comments on how their code works for the display legends. (Nov 12)**

Raytheon did not have any update. The software has not changed too much. What is in the notes from previous TIMs is probably right. Raytheon is aware of a request for a netCDF3 decoder for the software. They have been discussing how to make it general purpose so you did not have to write a specific plug-in for each type of data. They have not been officially tasked with writing that, unless it has been captured in a Discrepancy Report (DR).

Ed can check the status if a DR has been generated for this. The OCONUS sites have experimental satellite imagery and they could not use McIDAS AREA as an intermediate format because they do not have McIDAS.

Raytheon looked into the development tracking database and found requests for a plug-in to handle hydro-related data in netCDF. There is nothing with regards to satellite data.

Deb said that everything is already in netCDF. We are looking at going from netCDF3. If the National Weather Service is looking for an additional justification, the development of a netCDF3 plug-in would lessen the workload for the CIs and PG providers.

*Ed has the action to look into that. We may need to generate a TTR.*

- **Tell us at what point in the ingest and display process is the conversion between bit space and value space performed. Does/could the interpolation done on the graphics card lead to a false return value?**
  - **OPR: Raytheon to provide this information at the next TIM at Raytheon's Omaha facility.**

Basically, on the ingest side, data should be stored in the HDF5 bit-by-bit the way it came in, other than tiling and decimation for the different display levels. The conversion to value space happens at the CAVE level. Raytheon is in the process of trying to document this in a little more detail.

We were looking at image subtraction. The subtractions are performed byte-wise and the units in the xml file are ignored for satellite. Since satellite only has a few derived parameters, it does not take advantage of the full framework. The satellite display resource has been changed so that the difference parameters are in signed bytes instead of unsigned bytes. It comes down to that the raw bytes are subtracted and the difference is returned as a signed byte.

*Doug and Frank and going to follow up and make sure the information about this is correct.*

- **How do we ensure the transaction of ingesting products into the data repository is complete every time? More broadly, we need to identify fail points in the software. Memory management and execution time should be closely watched to not impact the rest of the system.**
  - **OPR: Raytheon at next TIM.**

To clarify, we are still a little unsure where the strength of the software resides. Should it occur on the edex side or the graphics card, and should we be trying to manipulate what we are sending to the graphics card? Where is the ideal place for a lot of our image manipulations to occur? Raytheon has evolved over the life of the project from doing it on the visualization (cave side) instead of edex. The use of the shader language usually results in a performance boost. It is a more consistent performance base as the load increases. In addition, we do not have all kinds of transformations occurring on edex. The load is basically transferred to the workstation. With radar mosaicking, it was taking a couple minutes a frame, but once it was in the shader language, it was nearly instantaneous. The shader language support has improved a lot. You can have different mosaicking algorithms. These are the perfect type of algorithms because of the vector processors with simultaneous execution channels is perfect for this kind of stuff.

We should be working on the shader language. If you wanted to use the microengine, it could be done without a baseline change. For long-term operational use, it is better to use the graphics card.

**More investigation is needed to determine if the JAI libraries could be problematic with really large datasets.**

- **OPR: Raytheon at next TIM**

Anything Raytheon has done has not hit the limitation. With the data sets that they have been working with, they have not seen any limitations. They had one of their developers look into it. It is possible to

have a layer of tiling. It would be kind of a workaround. So far we have been able to deal with MODIS without reducing the size of the input data set. If there is something significantly bigger than that, then the problems may arise.

Where in memory is loaded data stored? How does that whole process work for panning? Basically, there is a data cube that is between the edex and the display software in cave. It caches the retrievals from edex and holds onto them for a period of time. Basically, your retrievals are tile sets that travel a little bit larger area than the display area. When you start panning a tile or two in width, then it will have to request more data. This is easy to see if you are on a low-end machine and turn on the tile boundaries. Once retrieved, they are cached in that data cube for a period of time.

The data cube is on the local workstation. If there are two CAVEs, there are two data cubes. It was originally designed to handle derived parameters and gridded data. It is also used by satellite data.

*Raytheon is going to diagram that out in more detail.* Basically, if you look at the code, look at the data cube, you can get a feel for how that works. The data cube has a utility class which does the retrieval and that is multi-threaded and it is an eclipse job which does the retrieval. It is a thrift service kind of thing which retrieves the data over HTTP with a thrift serialization. It just loads what needs to be rendered on the screen.

The data cube takes heap. You are restricted to the Java Virtual Machine (JVM) size footprint of the 32-bit OS. There was a phase when Raytheon experimented with special caches. For us, it ended up a performance drag on the system. But when they move to 64-bit, the JVM will have more heap space. There is an evolution beyond 64-bit with better memory management.

The 64-bit CAVE has better performance. Basically, Raytheon has run on a 64-bit OS but not all of the changes have been made internally. It is on the SREC list as far as infrastructure improvements. Raytheon has not been asked to do that. It requires picking up the right libraries, rebuilding, testing, and make sure nothing broke.

There is a company called AZURE which builds very advanced JVM for highly scalable enterprises which can go to much higher memory usage with advanced garbage collection. That is a path for very large machines.

There was no status from SPoRT on testing the limitations of the latest release with 250 m MODIS visible imagery. We will be the first to know once the testing is performed.

- **Beyond the current capabilities, discussing with Raytheon the exact process in linking colors to value mappings and defining a maximum and minimum for the displayed range. Can more of this be defined in the configurable xml?**
  - **OPR: Raytheon at next TIM.**

There is a description in their previous response on this action item. There is nothing more to add.

There are a series of files in the baseline, with the ADE. They are in the static data part of the baseline. They are called glsl files and they are in the plug-in, like the ones for color map control. The ones that satellite would use are in `com.raytheon.viz.core.gl`

What you can do is change them before cave loads up. The color map is a page of code. It gets a minimum and maximum value, and from information passed into it, there are a couple different methods: linear advance and log advance.

- **Determine what from the metadata is actually used for discovery and display.**
  - **OPR: Raytheon at next TIM.**

When it came to configuring new data sets in AWIPS I, all we needed to do was modify flat-text files. The approximate analog to that is xml with this software. A TTR could be written on what we wanted to have under xml configuration control. The satellite stuff was the very first data path through the system and that was written three or four years ago. It probably did not pick up all the configurability. We do not have any TTRs. We need to try to change it.

*Jordan sent a whitepaper to Alaska Region with some recommended changes. We need to hear from them if they want to proceed.*

Raytheon says that the legend stuff is actually built from the metadata. There could be more control to human-readable mapping done in the xml file.

- **Based on our future expectations from NPP and GOES-R, identify what needs to be handled in the metadata and what needs to be stored in the HDF5.**
  - **OPR: GOES-R PG Partners need to answer. (Nov 30)**

They have been going over the metadata and almost all of it is used. There is some pretty obscure metadata, such as the satellite subpoint. There are some algorithms in the fog processor that use that. *Raytheon has to diagram it out.* Looking at the code for the fog processor, there was a lot of requested metadata. That is because the fog processor is computing some sort categorical fog map.

- **Sample project: Using the display side to combine polar and geostationary data dynamically to create a maximum coverage, maximum resolution product as part of the display. Raytheon says this is probably within the range of what we can do by relaxing the time matching, or using a threshold in the time matching.**
  - **OPR: SPoRT, NCEP, CIRA, CIMSS develop a sample AWIPS II development project that can be executed during the TIM at Raytheon's Omaha facility.**
- **Developers should talk about what is done now with image blending. Subsequent TIMs should address capabilities of the graphics card.**
  - **OPR: Raytheon at next TIM.**

For image blending in AWIPS II, it has to do with how the Air Force has done it. They have a relational database for the entire world. There is a tile for every spot on the globe. The different passes fill in the different tiles as they go by and get converted to map space, and then all the calculations are done in

map space. In a sense, you could get tiles from several different passes and you could see that physically, but that is how they have sought to deal with it.

The database deals with multiple satellite types and channels. Raytheon has a satellite expert in house who designed it. He wanted to deal with multiple passes of data. What it means is that on a display, you could retrieve tiles but you do not care where they came from. The ingest software takes care of it. That may not be the best approach for the future though.

If we could do some of this on the graphics card, you could mix and match satellites without all of the processing on the server side. If you could do that dynamically, that would be a more modern approach but it would take a bit of engineering to figure out. *This is something we could look at in a face-to-face TIM. Raytheon's expert may be involved in the discussion.*

- **How does the satellite decoder work? What are the specific class-level interactions within the plug-in. Developer involvement is required on how to implement a new or generalized decoder, and identify any interference with other classes which may result.**
  - OPR: **Raytheon at next TIM.**

We are trying to have an end-to-end document about how we go from first principles about how we go from an image. Raytheon is producing a software design document. There are a few high-level principles that are not obvious. Once you understand it, you see something like a satellite decoder and you wonder how that gets invoked because it is controlled by the wiring in the Enterprise Service Bus (ESB). There are parts of the system controlled by the ESB and others by the code hierarchy. That will help you find where the input comes from and where the outputs go. That is the core concept of the system. The code is generic and wired together in xml and all of the decoders work that way. The decoders are getting their information from the pipeline. All of the plug-ins operate in the same sort of way. Once that is understood then the questions fall into place.

As far as the multi-threading and how things are done with listeners and references, it is very heavy duty object-oriented (OO). It requires deep OO understanding. Raytheon wrote the code for very specific performance reasons pertaining to data retrieval, tiling and loading onto the display. Parts of that are generic and require knowledge of how the listeners work with the hierarchy. Once that is understood, it crystallizes it for people, but Raytheon needs to make it easier to make that jump with a specific document (likely for August delivery).

A date has been suggested of 17 and 18 August for the face-to-face TIM at the Omaha facility where we are envisioning 10 to 12 folks. We are going to sit down and go through code development to deal with ingest and display in the AWIPS II environment.

*We will need to lay out a very clear agenda. Any suggestions that Raytheon has would be critical to creating the agenda.* There are some written responses that have been sent out on the latest set of questions. We want to have folks working with Raytheon. SPoRT wants a hand-held walkthrough of working through ingest and display of an ASCII (or related commonly formatted) file and that would answer a lot of questions for them.