

GSAW 2017
March 13-16, 2017
Renaissance Los Angeles Airport Hotel
Session 4: Data Analytics

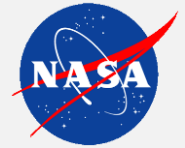
Creative Analytics of Mission Ops Event Messages

Dan Smith

GMSEC Project Manager
NASA Goddard Space Flight Center
Software Engineering Division
Dan.Smith@nasa.gov



Events/Log Analysis - Theory



- 2016/101:13:34:05.34 ORB Entering Eclipse. Duration = 12:34.000
- Historically, we have put tremendous effort into processing and displaying housekeeping telemetry.
 - We convert it, combine it, limit-check it, plot it, and trend it. We even draw dials and thermometers.
- Events/Log messages have received much less attention
 - Once a message scrolls off the screen, we often never see it again
 - Limited use for automation and for notifying team of issues via email or texting
 - Logs are often in each local system and not viewed together
 - Perl scripts sometimes developed to help analyze the logs
 - It is the logs that know when commands were resent, when there were data drop outs or system failures, when people log on and off, and much much more.
- What could we do better?
 - Bring together the logs of multiple systems to increase situational awareness
 - Express many of our non-telemetry items as event/log messages
 - Create new display and analysis tools to provide powerful new situational awareness and operations support capabilities

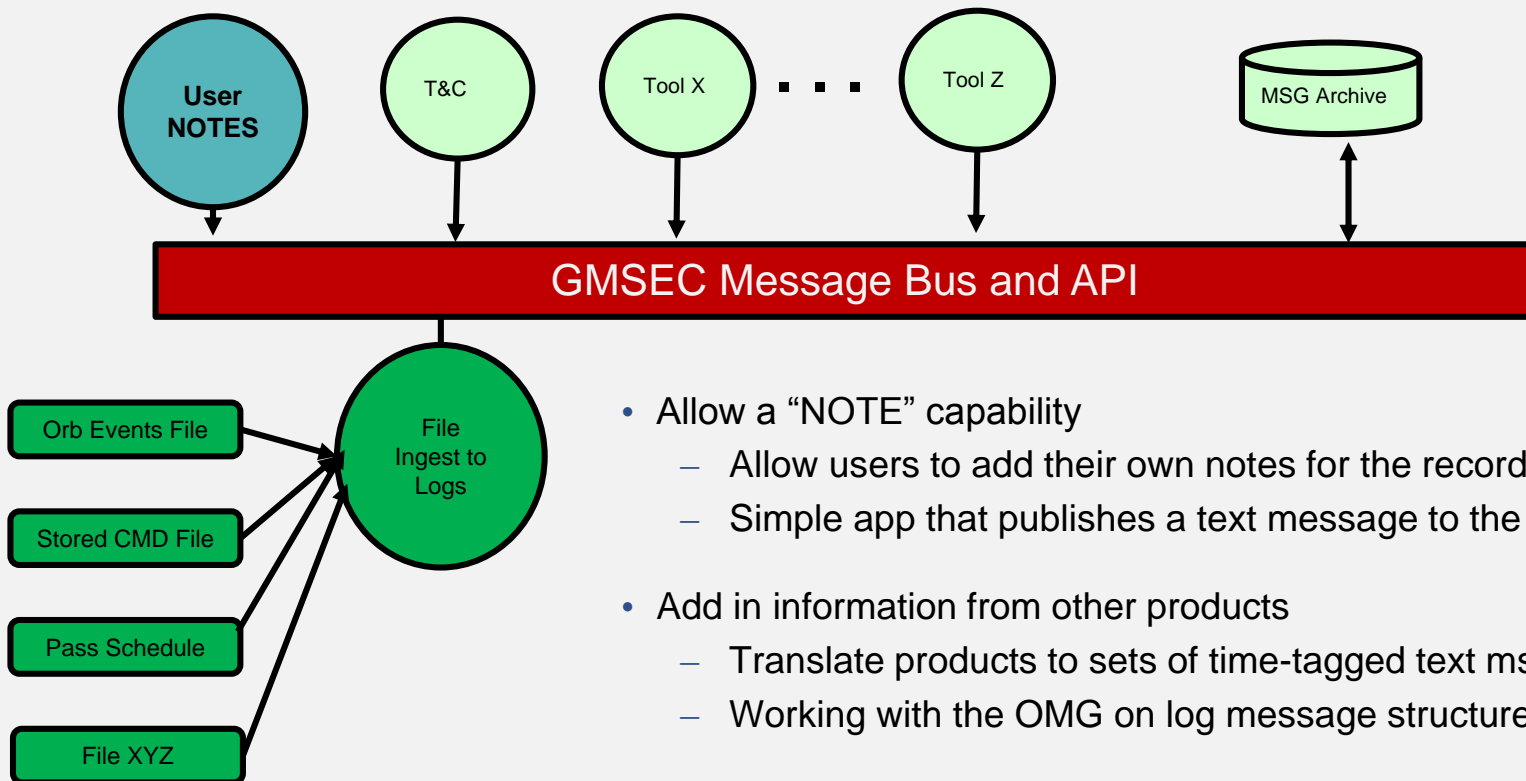


First, let's collect the information



- Combine existing logs

- With GMSEC open pub/sub architecture, components each publish their event messages and a single archive can be created



- Allow a “NOTE” capability
 - Allow users to add their own notes for the record
 - Simple app that publishes a text message to the bus
- Add in information from other products
 - Translate products to sets of time-tagged text msgs
 - Working with the OMG on log message structure standard

Great News: Now we have lots and lots of time-tagged text data to work with!



Now we have a problem!

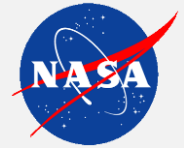


- Some missions may have 50,000 or more messages per day!
- With new levels of automation, there may not even be any operators on-console to watch displays
- As we move towards constellations and enterprise systems, we will be mixing satellites in the same logs
- **Out of sight → Out of mind**

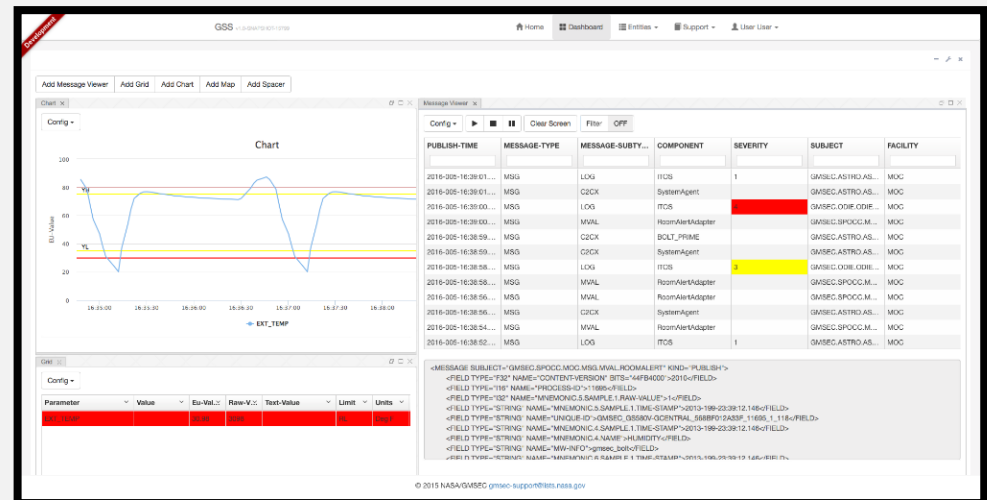
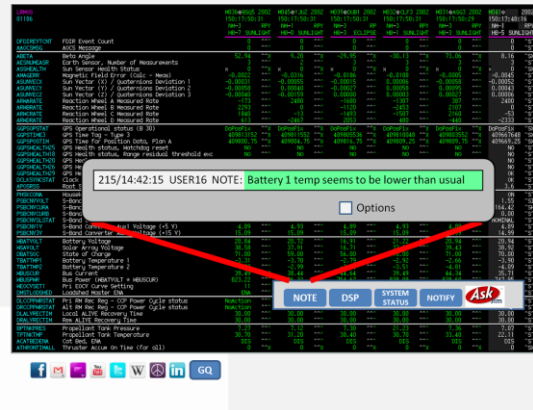
**If we have a huge message log, but nobody can use it,
do we even have a message log?**



How can we display 1,000's of messages?



- Enhanced message log display – similar to today's capabilities
 - Simplify the dynamic filters for the users
 - Enable color coding of message fields, not just of entire line

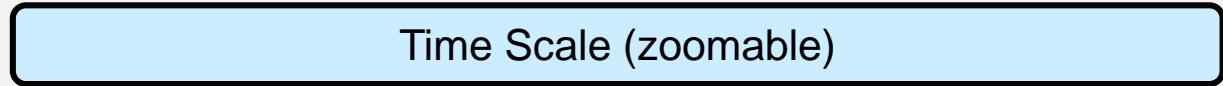


“Ticks and Bars” Display

- User defines the lines of the display
 - TICK, Title = “COMMANDS SENT”, Find = “/CMD”
 - Display will show a small mark on a time scale for each command sent
 - BAR, Title = “ECLIPSE”, Start = “Eclipse Entry”, End = “Eclipse exit”
 - Display will show a bar on a time scale depicting eclipse period
- Zoomable time scale; event message viewer at bottom of display



Ticks and Bars Display Capability



CMDS Sent



Alarms



Sched. Passes



Actual Passes



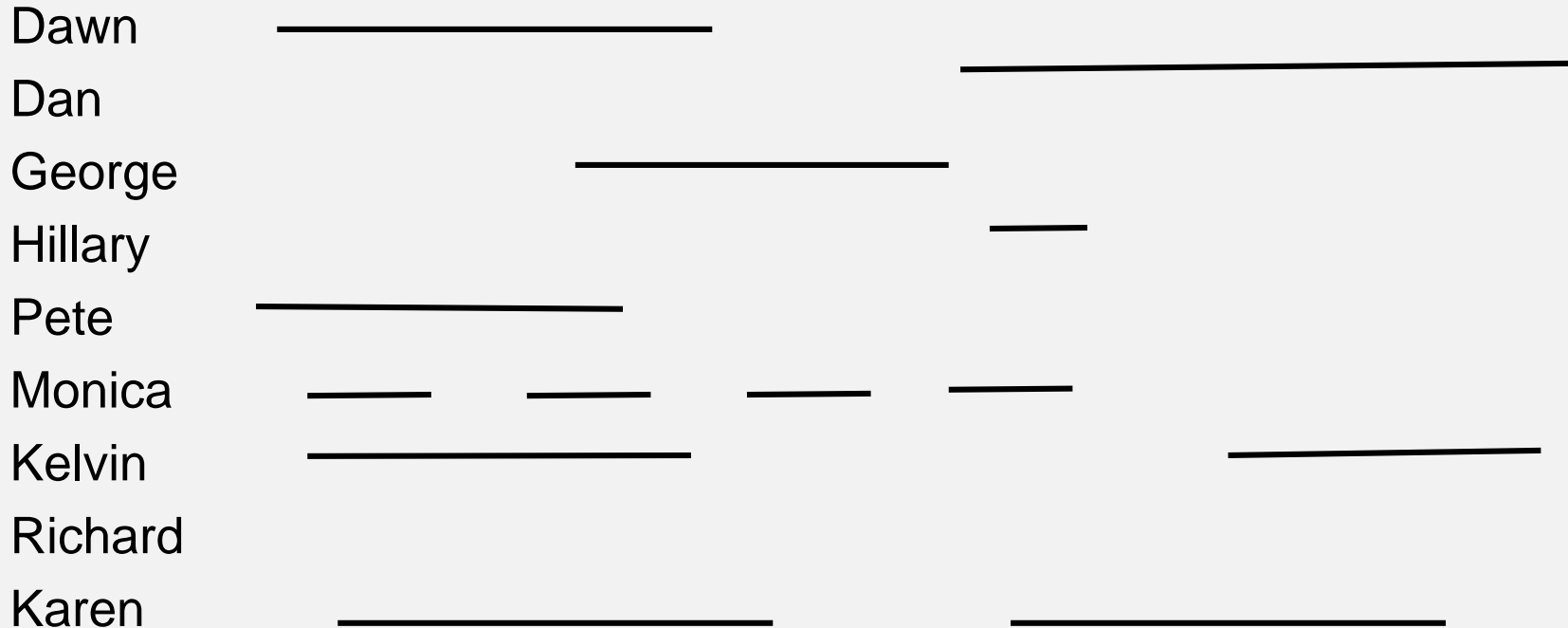
Event/Log Messages (time tags, flags, source, text) Scrollable within above time range



Ticks and Bars Display – Team Staffing



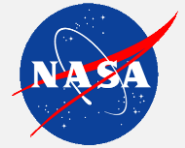
Time Scale (zoomable)



Event/Log Messages (time tags, flags, source, text) Scrollable within above time range



What can we learn from 1,000's of messages?



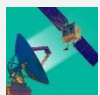
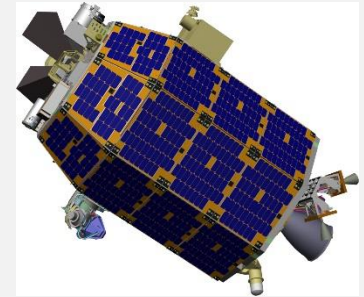
- “Ask Jim” – Query Capabilities
 - Structured language to allow for smart searching of the events logs.
 - Key words or phrases: How many . . . , When did . . . , For how long, ...
 - Key time words: TODAY, YESTERDAY, etc.
 - Response could be an English sentence response or a set of messages.
- User specifies enough information to find the needed messages
 - Time span, text-match information
- Tool can FIND, COUNT and COMPUTE-DURATION
- Could have FAQs and user-defined keywords to simplify user input
- Sample Queries
 - QUESTION: How many commands did we send today?
 - RESPONSE: As of 18:30 today, 237 commands have been sent
 - QUESTION: When did we send command HEATER_1A_ON?
 - RESPONSE: Command HEATER_1A_ON was last sent on Day 63 at 13:42:05



Let's get more advanced



- Event-based automation (already available)
- More sophisticated queries
 - Compound queries
 - Ability to exclude certain messages
- Auto-generation of shift/status reports based on event message analysis
- Text-Based Data Analytics
 - Discover/learn trends or sequence “signatures”
 - Cross-vehicle assessment
- Move to natural language interface
 - Allow broader search ability
 - Support voice recognition
- Create a Ops Assistant
 - Imagine an Amazon Echo for each ops position
 - What would the conversation be?
- Access to telemetry values and event messages could be seamless, allowing queries, reports, and displays to easily intermix the two
 - Time frame on plots could be based on query to event log (ie. Plot parameters x, y, and z for the last orbit, or for when John was logged on yesterday).



Summary



- We think that the set of events/log message enhancements will provide powerful capabilities for the mission user regardless of Agency or type of mission
- Placing an emphasis on non-telemetry analysis opens up a new area of data mining, analytics and tool development – we think the users will help identify even more functions
- This is a great set of applications for mission operations, especially using the GMSEC architecture– the tools will work regardless of what other products are part of the configuration; it works by monitoring traffic on the bus; and is not reliant on any specific vendor products.



Over the Horizon . . .



Could combine event message analysis and analytics with personal “Amazon Echo-style” assistant with virtual reality view of the vehicle showing sun angles/shadows, instrument pointing, temperature readings, etc.



Clipart courtesy of pixabay.com public domain images.

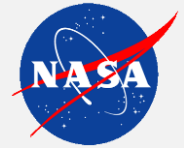




Questions?

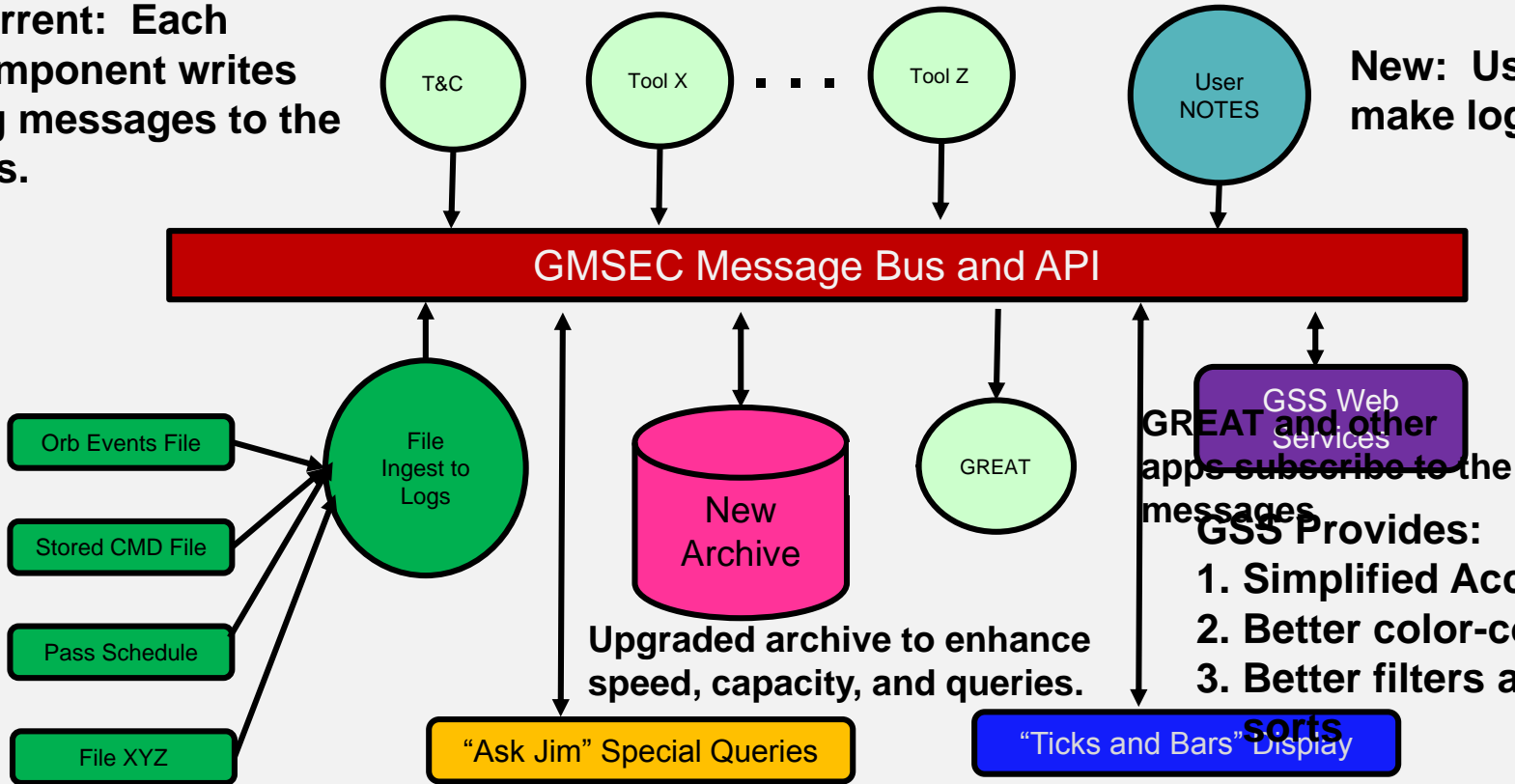


GMSEC Log Msg Approach



Current: Each component writes log messages to the bus.

New: Users can make log entries

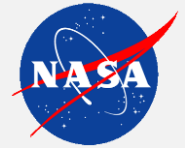


Converting file contents to event messages, creates a single integrated log to help increase situational awareness. Structured English query of the events log file.

User-defined graphical time-based display of selected events.



If I could really change things . . .



- I would make event messages more like e-mail
 - We learned long ago that simply having a time, a source and some flags, and some text [subject] was not enough to convey a message
 - Imagine if we could have optional body text to explain a problem in detail
 - Like the body of email messages
 - Could provide details on a parameter when it goes out of limits
 - Could include the full text of a rule that is violated
 - Imagine if we could have attachments
 - Could capture a screen image when a problem is noted
 - Could include a script that might help get out of a problem

