VOEvent processing pipelines for SVOM Chinese Science Ground Segment

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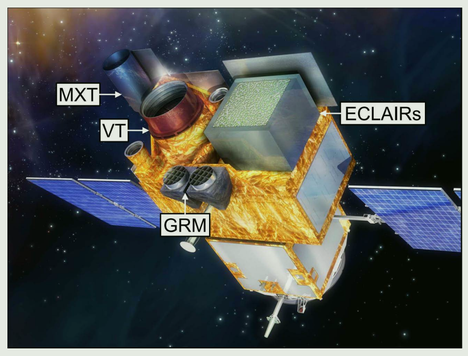
The SVOM mission

The Space-based multi-band astronomical Variable Object Monitor (SVOM) is a collaborative project between China and France dedicated to the detection, localization and study of ~60 Gamma Ray Bursts (GRBs) per year and other high-energy transient phenomena. SVOM is planned to be launched in 2021, with a life of 3-5 years.



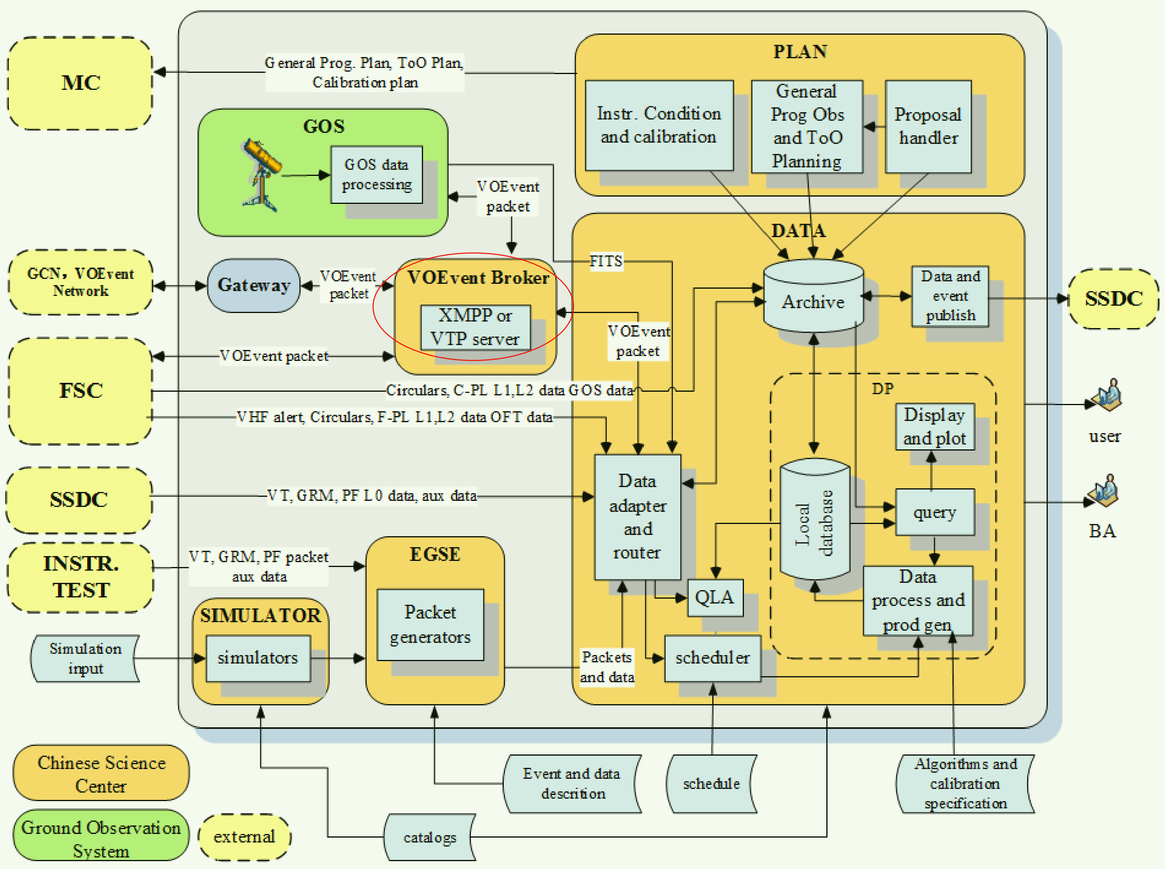
Payloads

- X-/gamma-ray camera(Eclairs)
- Gamma-Ray Monitor(GRM)
- X-ray Imager for Afterglow Observation(MXT)
- Visible Telescope(VT)

Ground facilities

- Chinese ground follow-up telescope (C-GFT)
- French ground follow-up telescope (F-GFT)
- Ground Wide Angle Cameras (GWAC)

SVOM Chinese Science Center architecture

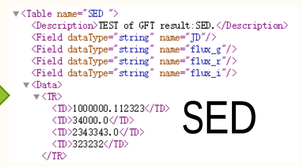


The diagram above shows the technical scheme for the SVOM Chinese science application system. It contains a lot of modules and have complicate logistics, note is the ground alert distribution subsystem showing within the red circle, that is the VOEvent broker, which is an interface between Data reduction subsystem and the global VOEvent network and French Science Center.

Use Voevent for flow control

We design our network to make VOEvent plays various roles. It can carry some key transient information to trigger observation. It can also serve as the payload of observational results, such as SED, light curve, slope. For follow-up observations, VOEvent can be used to notice the raw data upload status from GFT to the CSC.

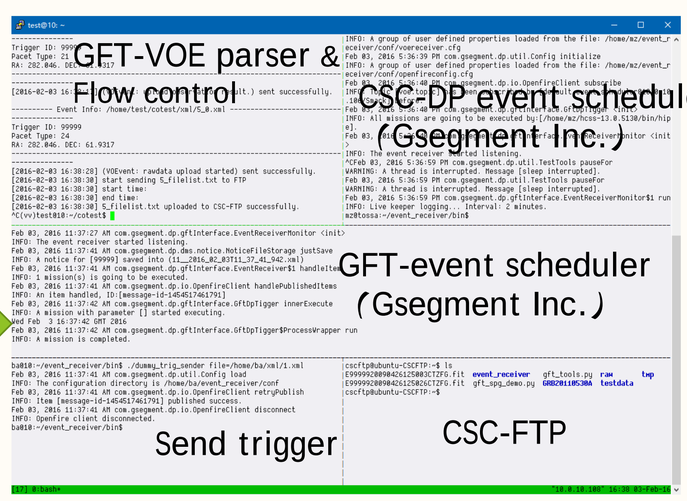
- Triggering observation
- Noticing raw data upload status
- Payload of observational results (SED, light curve, slope…)



SED

GFT-VOE parser & Flow control

CSC-DP event scheduler (Gsegment Inc.)

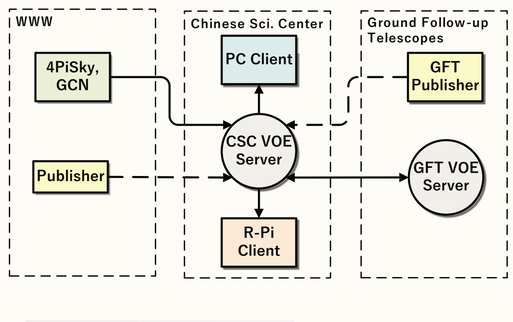


This screenshot during the test shows the test log with all servers in one window. We can see two servers are running a command-line JAVA tool that developed by our development team.

Prototype network based on VTP

Our prototype VOEvent network is based on *Comet*, an open source software implementation of VTP. Comet provides a mechanism for fast and reliable VOEvent distribution. Scalable and flexible due to the tree topology and the software consistence.

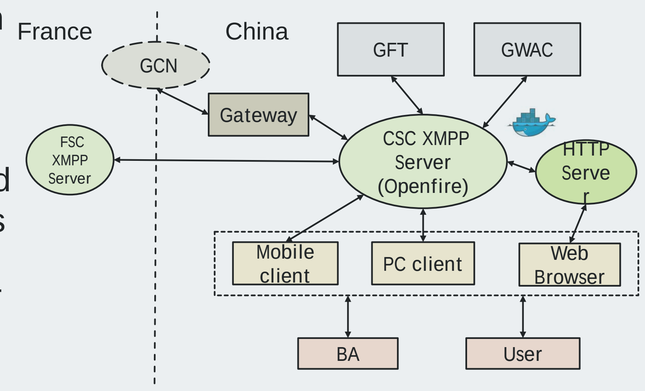
Raspberry Pi is a low cost, credit-card sized computer based on ARM. It provides enough performance to serve as brokers or filters in the network to select events for different science cases. We also use Docker container for fast distribution.



Prototype network based on XMPP

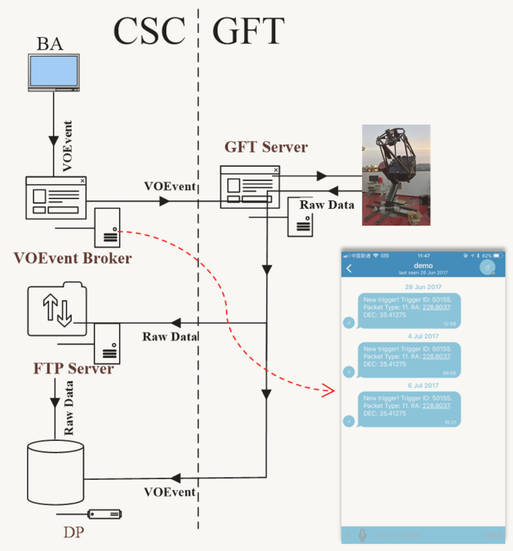
Compared with VTP, there are various alternatives cross-platform clients based on XMPP, even on mobile devices. Besides, the payload on a XMPP network is not limited to VOEvents, but also can be in other formats like text messages and pictures. Given these advantages, we carefully design the network structure to satisfy various use cases of different roles.

We use *Openfire Docker container* on the server side of the prototype network, which is an instant messaging and group chat server based on XMPP. Openfire is designed to be a centralized system that serves many clients. It not only forward VOEvents to telescopes such as GFT and GWAC, but also handles interactions between a variety of cross-platform clients, as well as web browsers through an HTTP server. BAs (burst advocates) and users can chat in natural language and sharing information between each other. BA also has the privilege to send VOEvents to telescopes.

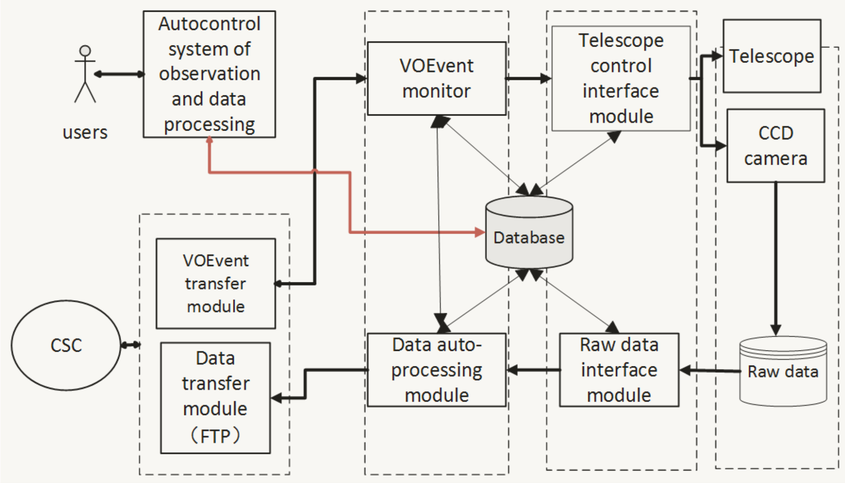


VOEvent flow chart between CSC and C-GFT

- A trigger is produced and sent from CSC to GFT & BA (through XMPP to mobile clients)
- GFT parse out the trigger information and followed by follow-up observations
- As the observation continues, the results will be produced and updated, these results will be formatted and encapsulated into a VOEvent packet and sent to CSC.
- When an observation task completed, GFT uploads all observational data to the FTP server at CSC and sends a VOEvent right before and after the transmission separately to notify CSC the data upload status, so that CSC can retrieve data from the FTP server and archive them into SSA (SVOM science archive) immediately.



Auto-observation and data reduction framework of GFT



For the interface to CSC, VOEvent module handles the alert messaging with CSC, while data transfer module uploads data products, data file checksum, and processing log to its FTP server for CSC to download and archive.

Future work

- Connect to Swift GS; receive alert about gravitational wave; do follow-up observations and data reduction; send back results
- Test VOEvent messaging & datalink performance
- Polish the software interface between VTP and XMPP