GENSO Presentation for the CubeSat Workshop in Logan, Utah

August 2011

by Craig Kief and Connor Lange

Problems to be Solved

How do we break the mold of one ground station – one satellite for science missions?

For a 3-6 month mission, is it worth it to build a ground station?

How do we facilitate the Ground segment to make it easier to get educational missions to space?

Can a larger community capitalize on these efforts?

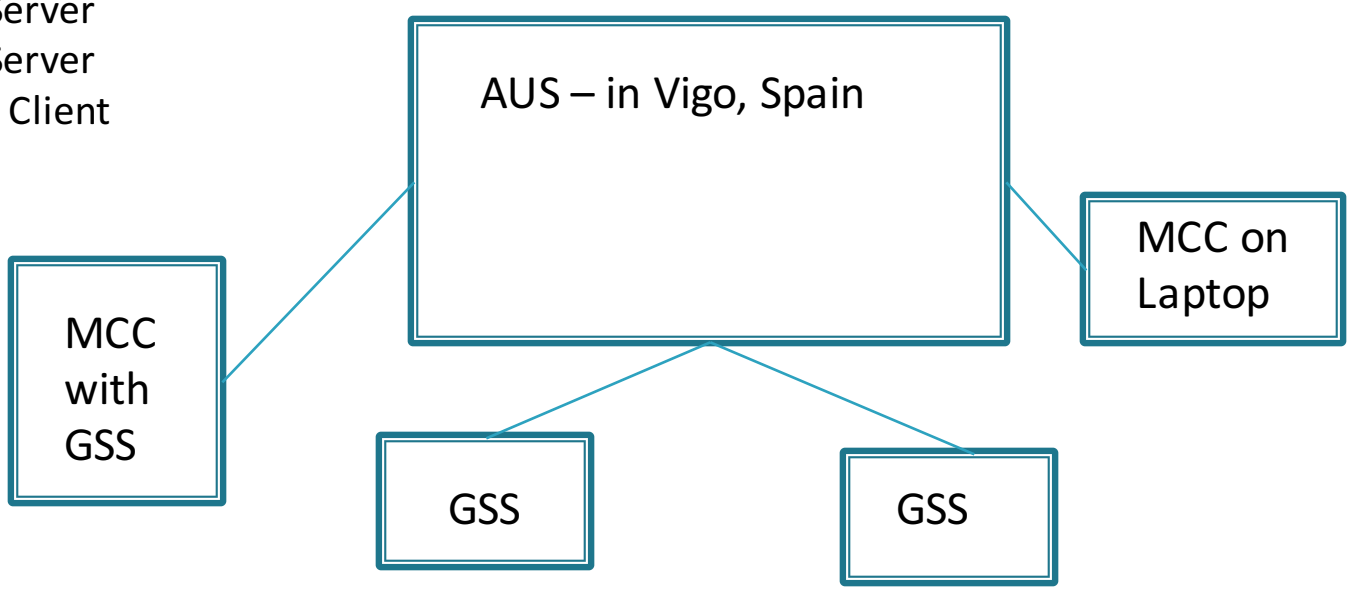
Background – GENSO

Global Education Network for Satellite Operations (GENSO) is a software standard which allows each ground station on the network to communicate with non-local spacecraft and transmit data to different ground terminals that have access to the specific satellite.

GENSO was developed primarily by volunteers in the educational / amateur radio community. ESA took the lead under auspices of the International Space Education Board

GENSO Network Details

*AUS = Authentication Server
*GSS = Ground Station Server
*MCC = Mission Control Client



One MCC will be assigned for each GENSO registered spacecraft when fully functional

All GSS receive and distribute a piece of the puzzle but only one MCC sees the entire picture. Since the GSS is tied to a physical ground station, it only sees what is available during a pass whereas the MCC has access to the aggregate of all downloaded data.

GSS – Ground Station Server

- Every GSS can be broken down into three parts (as will be shown in the demo)
  - Radio
  - TNC (Packet Modem)
  - Rotator Controller

GSS – Ground Station Server

- Groundstation connected to GENSO Network via Internet – 1 GSS per ground station
- Requires computer running GSS software to be connected to ground station hardware
- Tracks satellites via “Bookings”
  - Bookings encompass all network spacecraft
  - Can prioritize a single satellite above all others
- Tracked satellites yield pass reports which are forwarded to the MCC that registered the spacecraft

MCC – Mission Control Client

- Computer connected to GENSO Network
  - 1 MCC per spacecraft
- Only requires internet – no hardware needed
  - Can download satellite data from any location
- TLEs and other spacecraft data set by the person who registered it
  - Allows for automatic updates on all ground stations
- Able to directly connect to a GSS for uplink
  - Not automatic (must be approved by both parties)

AUS – Authentication Server

- “Central” node which:
  - Validates user interactions
  - Facilitates communication between GSSs and MCCs
  - Secures the network
- The current AUS node is located in Vigo, Spain.

R1E – Release 1 for ELaNa

- First mission test case
- Network created specifically for ELaNa I with GSSs running the R1 software
- Allow real-time distribution and use of TLEs in early mission stages
- Deployed February 2011
- Due to the launch failure of ELaNa I, R1E is currently being used to support UT Austin's FAST1 and FAST2 satellites

R1E – Code Development

- Java code is written to support new hardware
- Code is then compiled by someone and tested by the teams owning the hardware
- If acceptable, code is submitted for inclusion in future releases
- Netbeans and Eclipse are the most popular means of development
- No current VV&A accomplished

GENSO – Hardware Details

- With GENSO, any hardware can be used but you have to write your own drivers
  - Any hardware can be used
  - Driver development can take as little as one day
- Process to become active with GENSO is to:
  - 1. Complete and submit an application for the GENSO network
  - 2. Download the software
  - 3. If your equipment is not currently supported, write your own drivers, test them and then submit for future releases.

The R1E Network – Active Nodes

- Cal Poly
- Vigo (Spain)
- ISU (France)
- COSMIAC (Albuquerque, NM)
- UT Austin (Austin, TX)
- University of Kentucky
- Salish Kootenai College, MT
- Dave Mynatt of Pueblo, CO (KA0TIU)

Questions or Further Information

- Craig Kief craig.kief@cosmiac.org
- Connor Lange rclange@calpoly.edu

- If you are interested in a 60 minute Skype/Oovoo session for your team, please contact us