

Virginia Tech Ground Station - Satellite Mission Data Warehouse

SmallSat 2020

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Motivation:

- Provide centralized mission data management and data warehousing for the Virginia Cubesat Constellation (VCC)
 - Consists of 3 cubesats primarily developed by undergraduates at Virginia Tech (VT), University of Virginia (UVA), and Old Dominion University (ODU)
 - Mission to study effects of drag in the upper atmosphere

Project Goals:

1. Provide a centralized repository for storing all raw packet data and telemetry received by ground stations.
2. Implement functionality for converting raw packets to satellite specific telemetry and overall mission data (each satellite used a unique packet structure for telemetry data).
3. Provide tools and interfaces for analyzing and visualizing combined mission science data from the entire constellation
4. Maintain flexibility in design to support external or future satellite missions



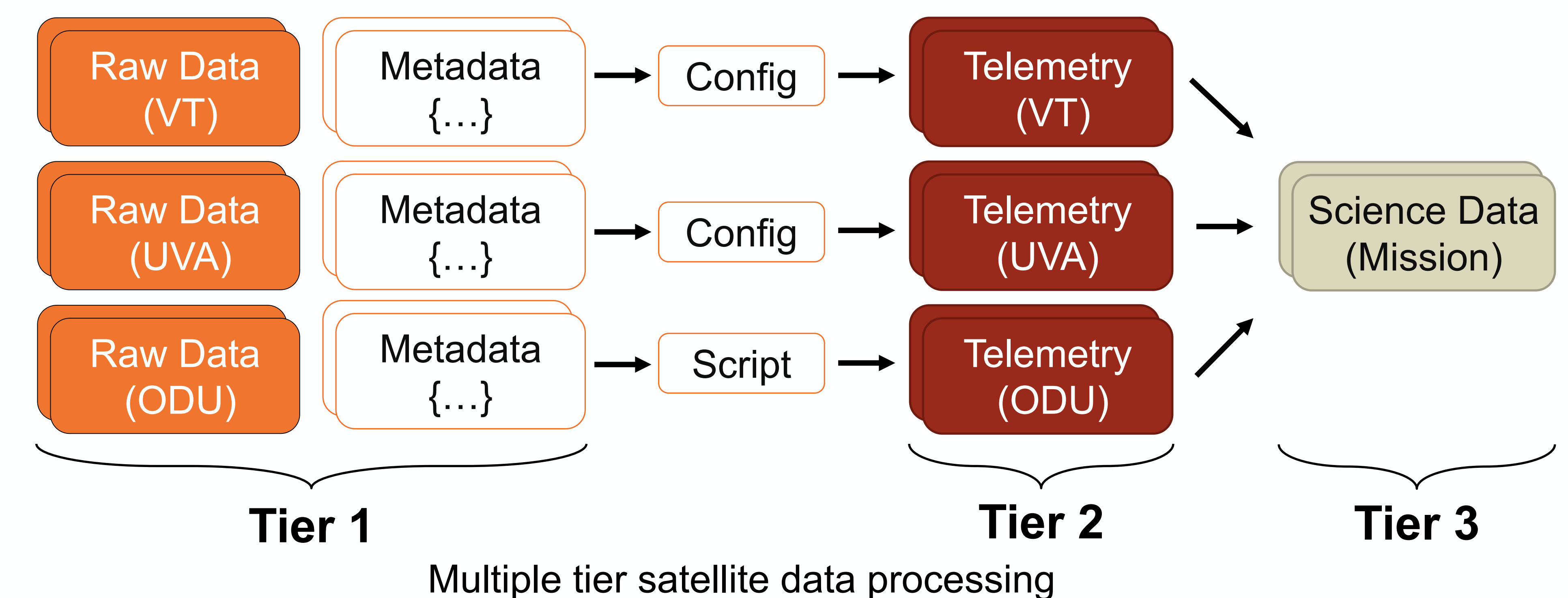
The VCC launch from the International Space Station
July, 3rd 2019 (Credit NASA)

Design:

- Implemented as a website with a MySQL database providing backend storage for application and mission data. (MySQL allows for quickly creating queries to access data)
- Users can be assigned to multiple missions/teams and can be assigned different permission levels for each:
 - Owner – Can add/remove users for the mission and upload/edit/view raw packets and science data.
 - Operator – Can upload/view raw packet and edit science data
 - Researcher – Can view/query science data for analysis

Design (Continued):

- Data is processed in three separate tiers:
 - *Tier 1:* Raw packet/data captures and associated metadata from the ground stations is uploaded using the Satellite Metadata Format (SatMF) specification also developed at VT
 - *Tier 2:* Raw data from multiple passes are deconflicted and decoded with user supplied scripts or configurations to satellite specific telemetry data.
 - *Tier 3:* Individual satellite telemetry is processed and combined with other satellite data to produce mission science data for the constellation which can be queried through the web interfaces



- Flexible design:
 - Can support multiple teams/missions with different users
 - Packet structure and science data can be defined per mission

Conclusion and Future Work:

- *Combining telemetry from individual satellites into useful science data is difficult if each satellite uses unique packet structures and telemetry fields.*
- *The mission data warehouse provides flexible functionality for storing raw received packets long-term and provides capability to process these packets into satellite specific telemetry.*
- *Final processing steps converts telemetry to mission specific data that can easily be queried for scientific analysis.*