Ultra-Low Latency System for Producing VIIRS, CrIS, and MODIS Products within 60 Seconds of Observation

Liam Gumley, Bruce Flynn, Steve Dutcher

CSPP User's Group Meeting, 2022

Introduction

- Description of the System

- Current participation/coverage

- Applications

- General Architecture

- Challenges

Real-time (DB_RT)
- Processing data immediately as it arrives
- Seconds

Near real-time (DB_NRT)
- Processing data made available after the satellite overpass ends
- Minutes

DbRTN ULL

Goal is to produce products within 60s

- Centralized Processing
  - Common set of software, LUTs, hardware
  - Consistency in generated products
  - Reduced maintenance
- 2 Modes of Operation
  - Streaming (DB_RT)
  - Hybrid (DB_NRT)
- Simultaneous reception
  - Merged and deduplicated
  - Maximizes coverage
  - Redundancy
- Sensor scan-based processing

- Modern "Cloud-ready" stack
  - Orchestrated and containerized
  - Highly available
  - Observability/Monitoring
- Receiving station client
  - Minimally intrusive
  - 3 Different options for contributing

NASA LANCE VIIRS Fires (VFire375)
- SNPP & NOAA20
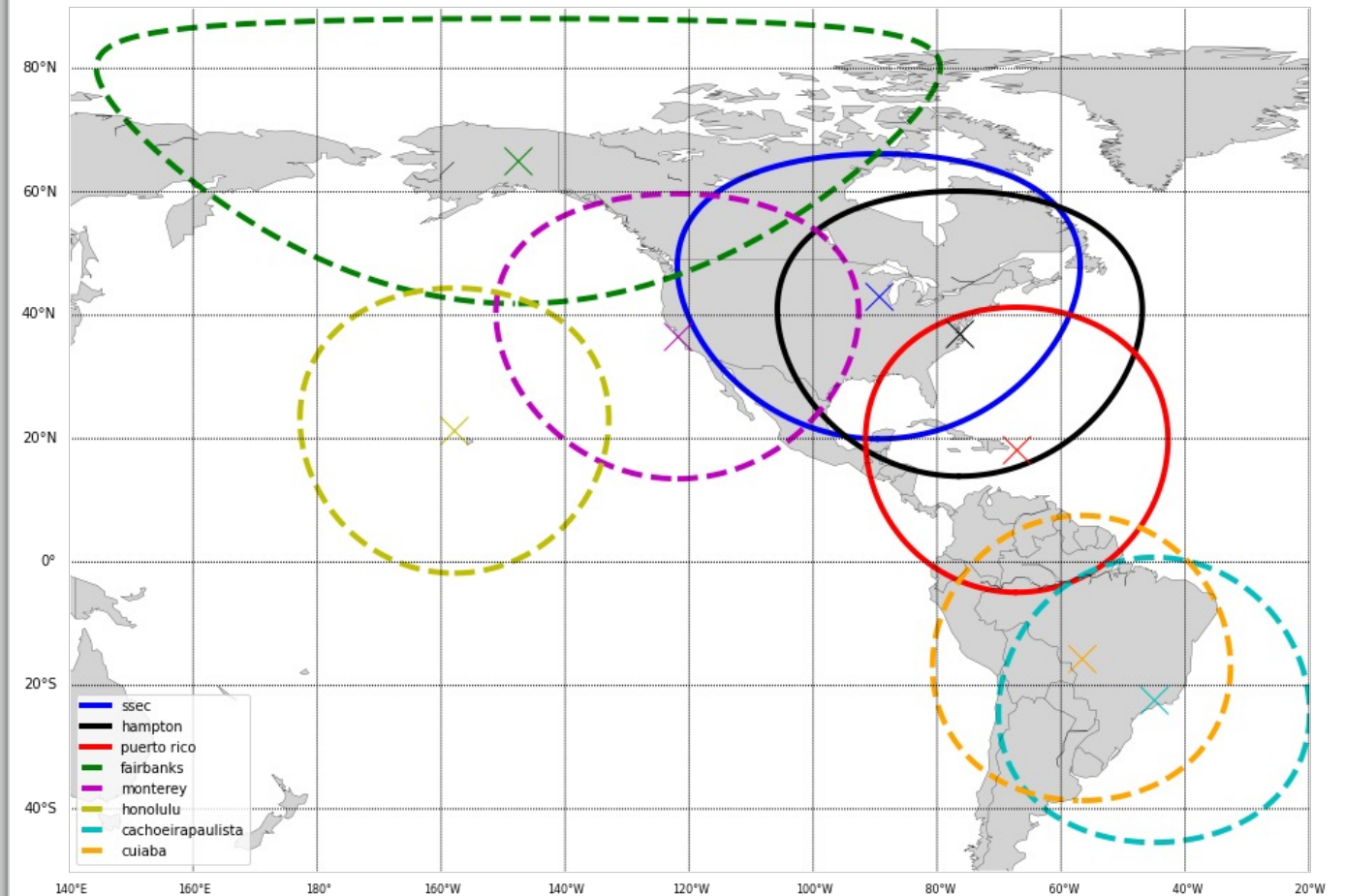
NASA LANCE MODIS Fires (MOD14)
- Aqua & Terra

NASA CrIS Level-1
- SNPP & NOAA20

DbRTN ULL: Coverage

- 4 DB_RT (solid lines)
  - SSEC x2 (M, V, C)
  - Hampton (M, V, C)
  - Puerto Rico (M, V, C)
- 5 DB_NRT (dotted lines)
  - Monterey (M, V, C)
  - Hawaii (V, C)
  - Fairbanks (C)
  - Cachoeira Paulista (V, C)
  - Cuiabau (V, C)

Satellite visible at the station 5° above horizon

Just tell me what the latency is!

Regular Latency

Ultra-Low latency!

Image from itv.com

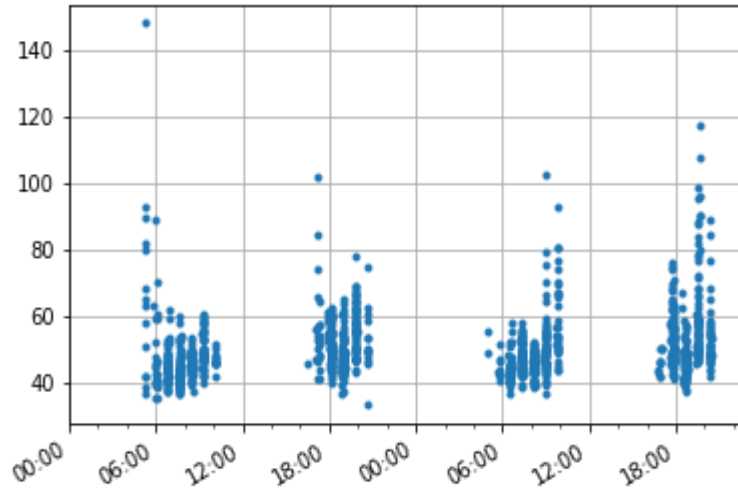# How low is ultra-low?
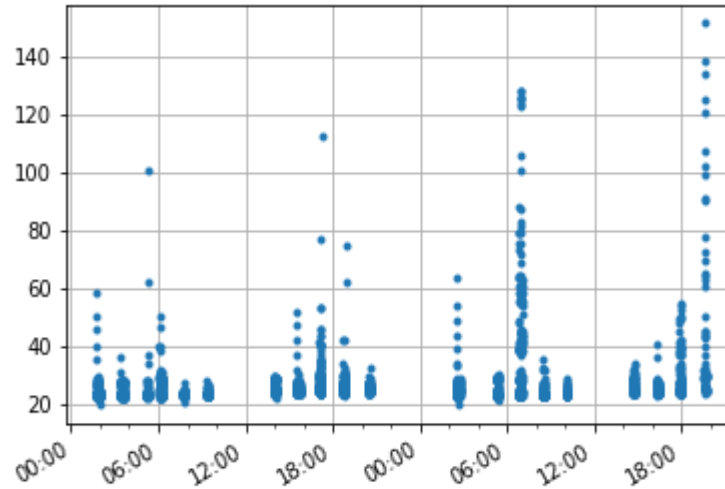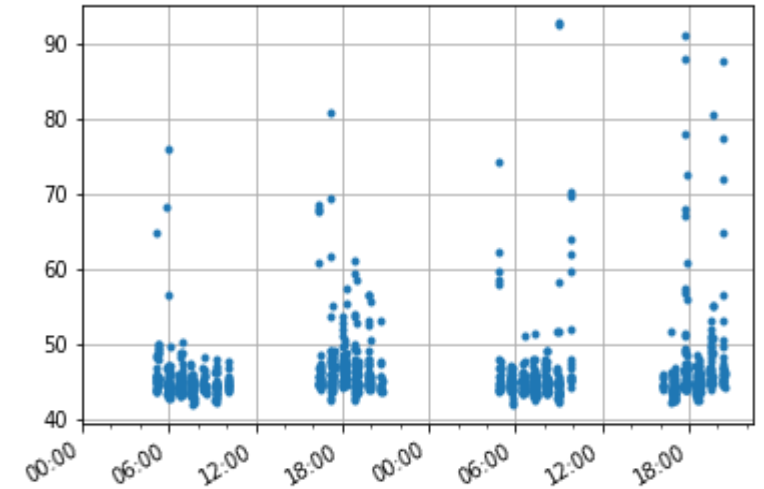
Goal: 60s from satellite observation

How low is ultra-low?

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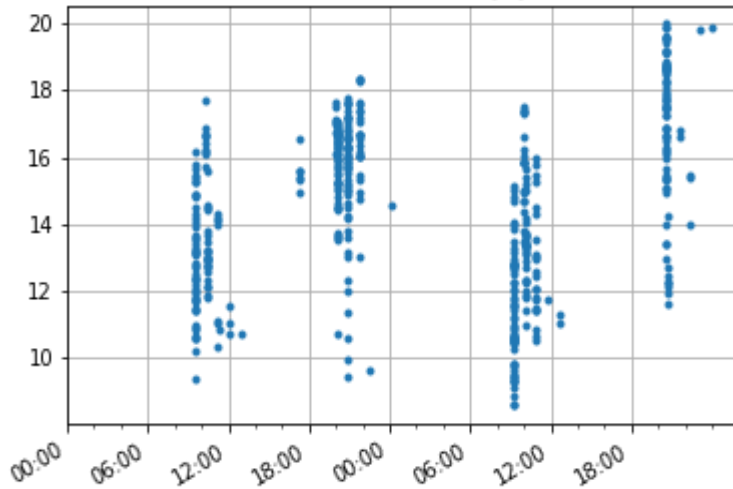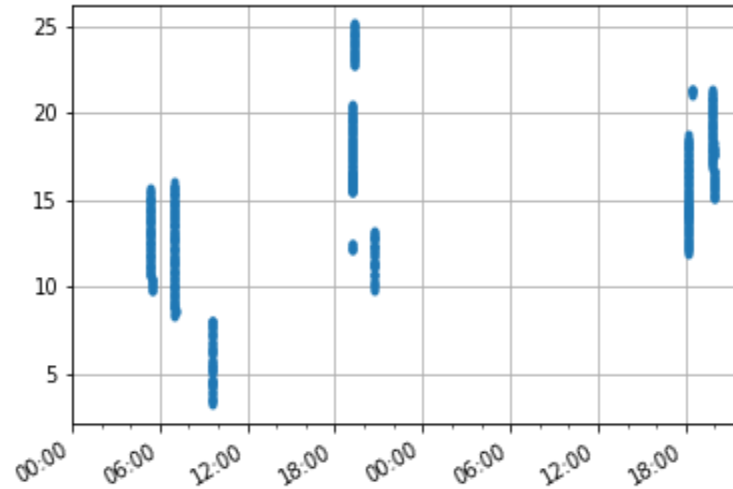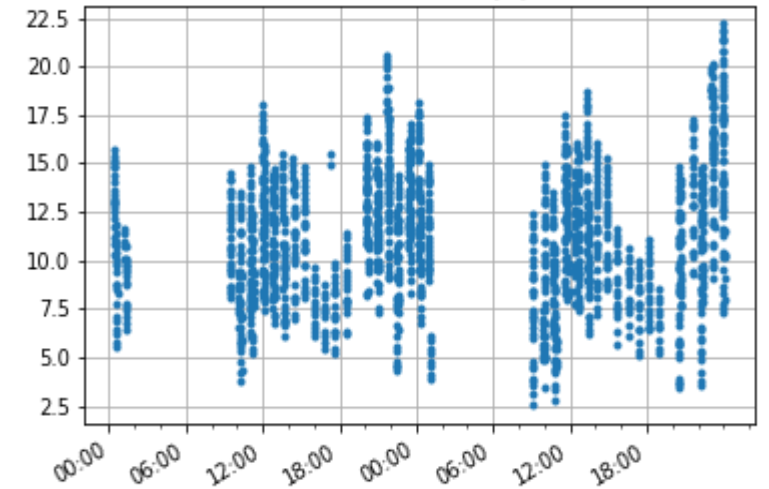
Applications

We've shown we can reliably produce data with ultra-low latency ...

Direct Broadcast

- Fire locations
  - NASA FIRMS Pilot Project
- Now-casting
- Volcanic Ash
- NWP

## What about SMD global?

- 3h NASA LANCE NRT requirement
- Multiple spacecraft providing NRT data approximately every 50m granule-based data
- Can we reduce latency for existing global NRT products?

Architecture

- Message Broker
- TCP Server
    - Legacy Support
- NRT Bridge
- Gateway
    - Merge/Deduplication
- Collector
    - Per Level-0 product/type
        - Sensor science data
        - Spacecraft data
- Submitter
    - Per Algorithm/Spacecraft
    - Collect microgranules required for algorithm
    - General purpose job description
- Workers
    - Process and store results
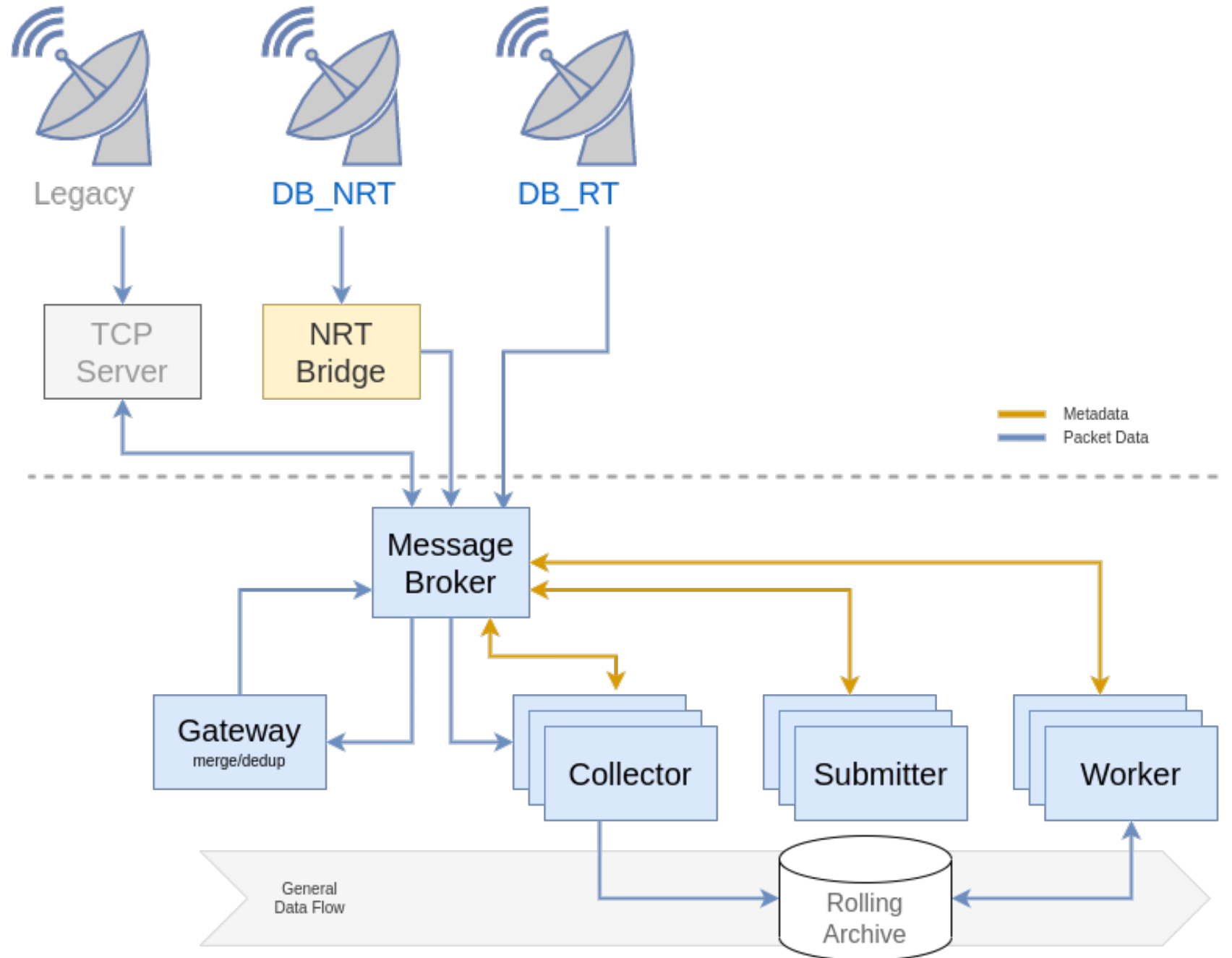
Challenges

- Science Software
  - Inherent granule-based assumption
  - Lots of reverse-engineering
- Level-0 Latency vs. Completeness
  - When is a micro-granule complete?
  - Timers and deadlines
- Product level Fan-in
  - Currently use-cases fan-out
  - Level-0 fan-in is straight-forward

- Legacy receiving stations
  - Old hardware/software

Thanks!

Bruce Flynn

brucef@ssec.wisc.edu

Steve Dutcher

steved@ssec.wisc.edu