CARR ASTRONAUTICS
Science at work

Streaming Weather Data

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Science at work
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Agenda

- Need
- Key Concepts
- Design
- Demonstration System
- Status
- Questions and Comments

Business Interest in Streaming Weather Data

- Weather data supports decisions for many applications (e.g., transportation, construction, recreation, field service, aviation safety, drone operation, insurance, agriculture, energy, emergency management, air quality, launch operations, military operations)
- Weather data is urgent and highly perishable
  - Nowcasting supports immediate decision making
  - Forecasting benefits from getting the most recent data into models as quickly as possible

Key Concepts

- Minimize time between wx observation (or derivative) & when it's available to user
  - Instead of minutes or hours, data is available to users in seconds
- Weather data (satellite, ground radar, radiosondes, IoT, etc.) is streamed in messages
  - These messages, referred to as "streaming objects", are self-contained, & processed & are independently usable by users
  - For raster data, such as satellite imagery and radar data where large geographic areas are observed in a cadence, data subsets are created to minimize latency
    - Enabled with an architecture supporting concurrency of sensing, processing to make sensed data usable, distribution, & utilization by user application
- Push based on users' subscriptions
- Form of weather data made available to user is easily processed
  - Open, standards based, and self describing
  - Use the best weather data engineering technology available
    - Unidata's NetCDF / Common Data Model / Climate and Forecast Metadata Conventions

Enabling Technology

- Unidata has developed & continues to enhance technologies to store, access, & display geoscience data & weather data in particular

Unidata Technology	Description
Network Common Data Form (NetCDF)	File format, data model, & API
Common Data Model (CDM)	Layered abstraction for data access, georeferencing, & weather features, & s/w tools
Climate & Forecast (CF) Metadata Conventions	Provides for open, standards-based, & self-describing datasets needed for cost-effective, next generation weather applications

- CF Metadata Conventions make weather data locatable in space & time, & also captures other weather data semantics

Streaming Object Design

- Streaming objects are CDM datasets
- CDM datasets have all required capabilities, except:
  - Data users often need streaming objects to be assembled into more traditional product datasets/files that have a greater extent in space & time with low latency & high fidelity
  - Need mechanism to relate streaming objects w/ parent product
  - Need mechanism(s) to capture streaming object coordinate variable values in cases when streaming object contents are irregular w/ respect to parent product arrays
    - e.g. gridded data parent product's streaming objects, each having one time of observation, may cover a different geographic extent
- Providing native support for streaming objects in NetCDF-CF would be ideal

Streaming Object Design (cont'd)

- Method to relate streaming object with parent
  - In streaming object definition, declare one or more parent product coordinate variables w/ boundary variables to capture space & time extents of parent product
    - Only needed for those coordinates for which streaming object is a subset of parent product
  - Attribute added to parent product coordinate variable to flag its identity
    - In our demo system, we added :streaming_parent = "true"
  - Relationship between a streaming object's coordinate variable & corresponding parent coordinate variable achieved w/ "axis" or "standard_name" attribute

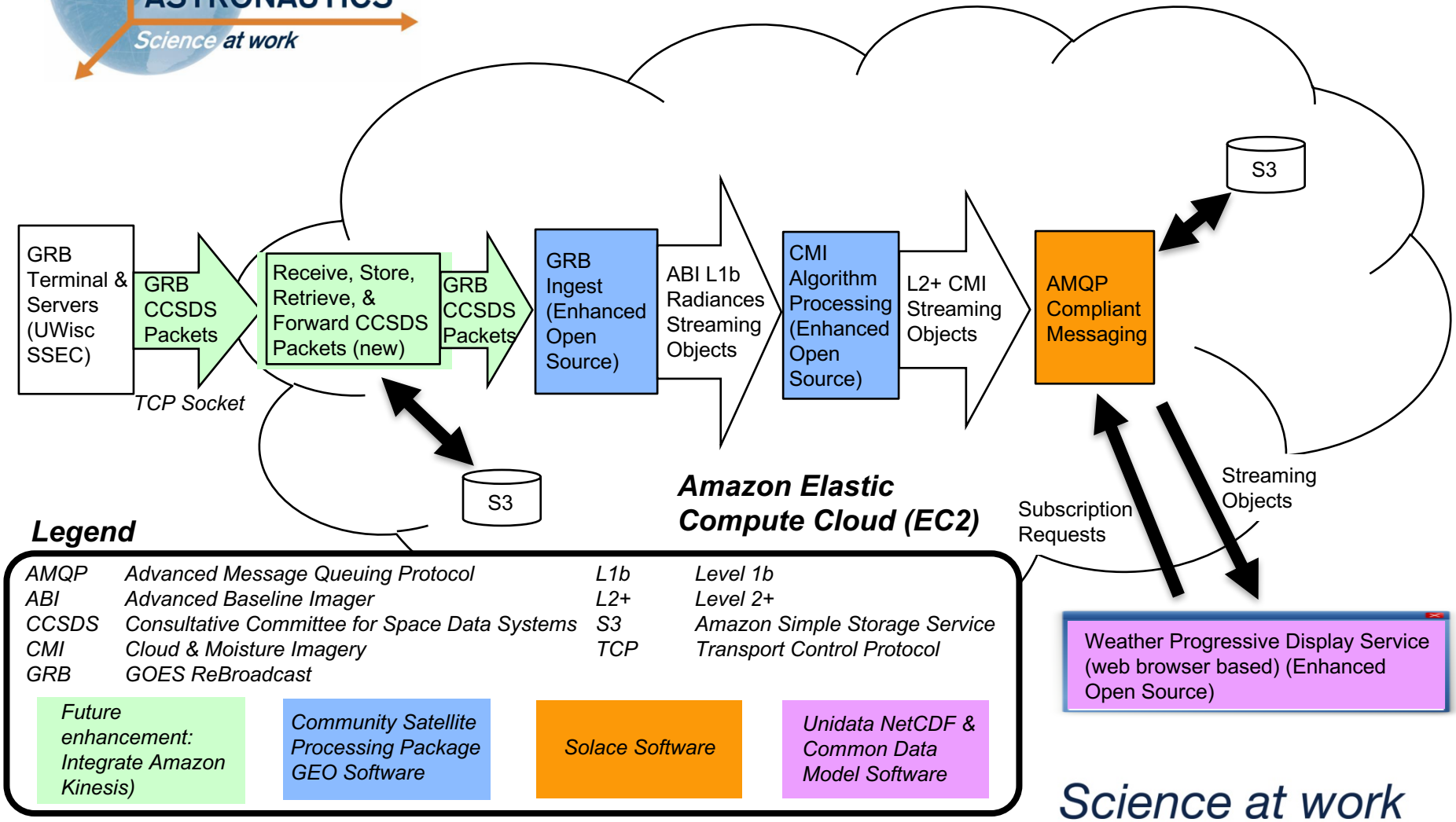
Streaming Object Design (cont'd)

- Mechanism(s) to capture streaming object coordinate values in cases when streaming object contents are irregular w/ respect to parent product
  - No solution needed for our initial demonstration system
  - CF conventions applied in context of extended data model can likely provide solution(s)

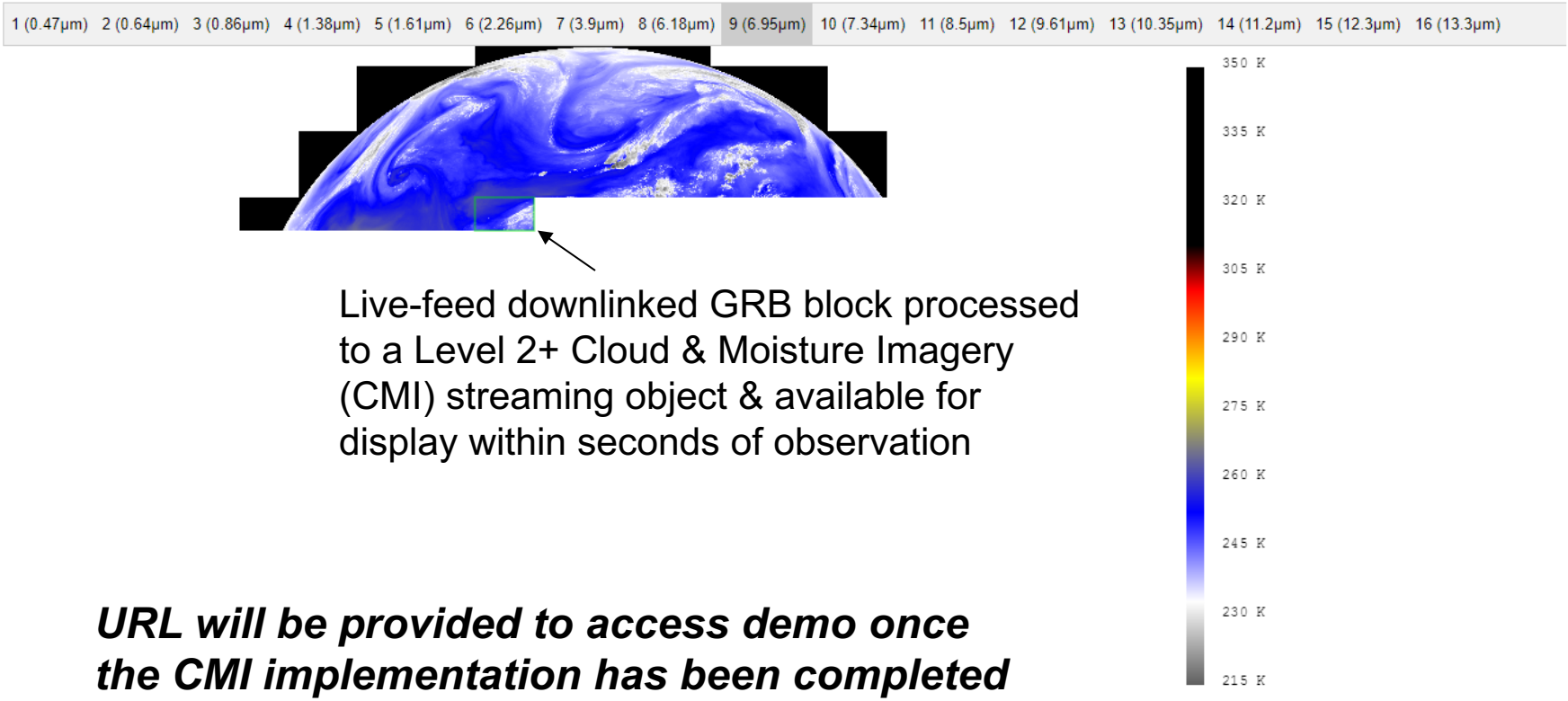
Demonstration System

- Developed a proof of concept
- Selected a compelling, high value new data source
  - Geostationary Operational Environmental Satellite Series R (GOES-R) launched last year and coming on line later this year
- Use GOES-R ReBroadcast (GRB) as data source
- Deploy in commercial cloud
  - Use Amazon cloud

Demo Software Architecture



Demonstration System Visualization



Live-feed downlinked GRB block processed to a Level 2+ Cloud & Moisture Imagery (CMI) streaming object & available for display within seconds of observation

URL will be provided to access demo once the CMI implementation has been completed

Status

- Streaming weather data demonstration system fully functional by end of September
  - Support for GOES-R Cloud and Moisture Imagery (16 spectral bands)
  - Support for other GOES-R products, & other data sources & types is TBD
- Marketing the concept & technology to Government & commercial customers who can benefit from streaming weather data

Questions & Comments ?