
Real-Time Data Flow and Product Generation for GNSS

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Overview of Position Paper

- **Prototype Architecture for Data Distribution**
- **Real-Time Products**
- **Recommendations**



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Prototype Architecture for Data Distribution

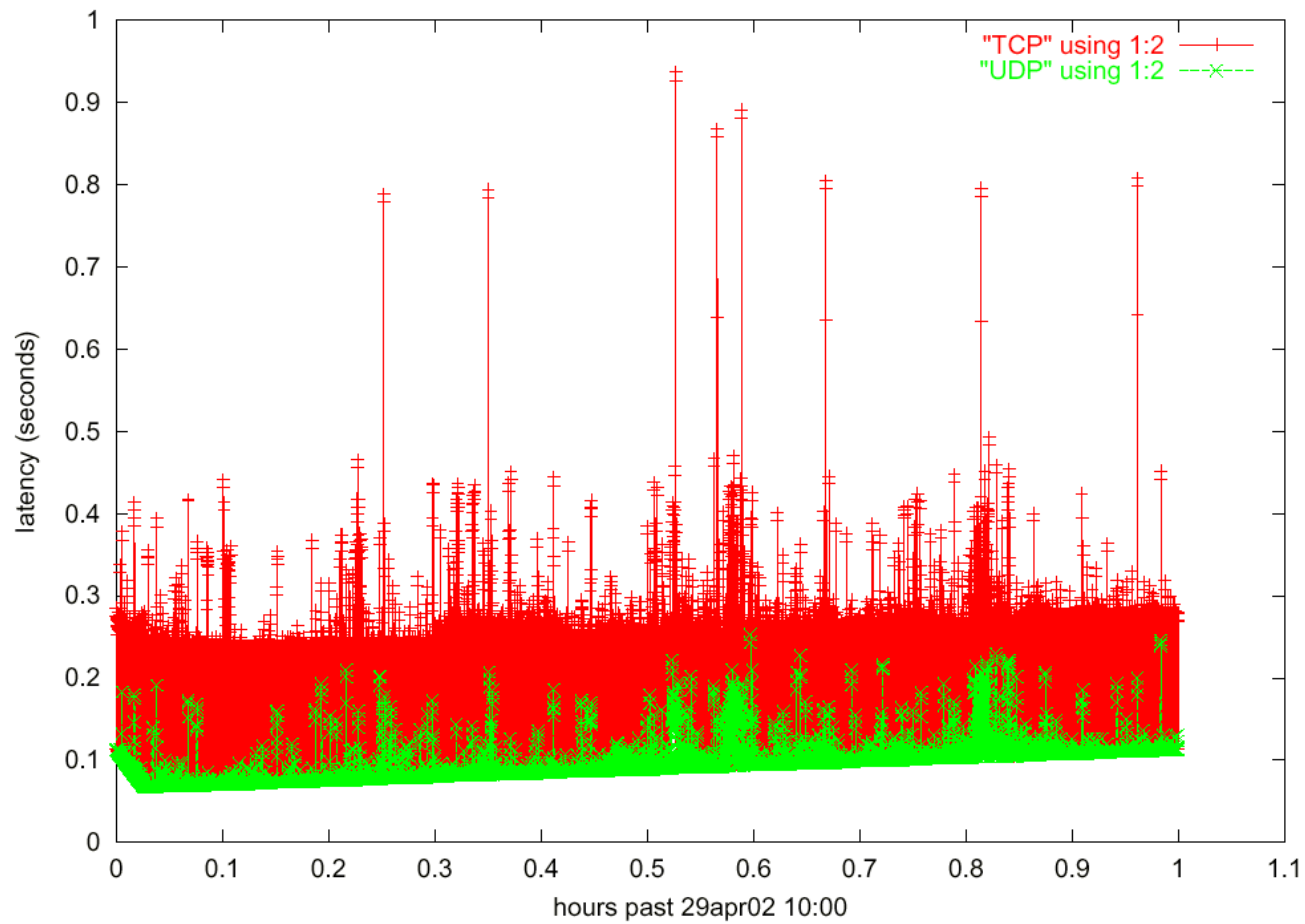
- **TCP/IP family of protocols in connectionless**
- **Transport protocol**
 - TCP used when reliability more important than speed
 - UDP used then speed is more important than reliability
- **JPL, NRCan, and GFZ constructed effective architectures utilizing connectionless UDP protocol**



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RTWG Common Data Format

- **4 basic message types defined**
 - Type 100, station configuration message
 - Type 200, GPS observable
 - 21 bytes per GPS observation
 - Type 300, GPS broadcast ephemeris
 - Type 400, Meteorological observation
 - (Type 0, JPL implemented request for data)
- **Unified header for all message types**
- **NRCan udpRelay layers**
 - 24 byte header
 - 16 byte Message Authentication Code (MAC)



11 byte unified header format

<u>type</u>	<u>variable</u>	<u>meaning</u>
unsigned short	rec_id	indicates record type
unsigned short	sta_id	unique station id
		not defined for 0 or 300
unsigned long	GPSTime	seconds past 6-Jan-1980
		good to year 2116
		current time or obs. time
		(not iode time however)
unsigned short	num_bytes	bytes in this message type
unsigned char	IODS	station configuration flag
		not defined for 0 or 300

Not included in the header

- preamble
- packet sequence number



Station Management

- **Issue of data station (IODS)**
 - type 100 transmitted at slower intervals
 - IODS byte included in all observation messages
 - original meaning of type 100
 - Ensures validity of data
 - change in IODS indicates station configuration change
 - IODS byte flag can be mapped back to web page
 - practical meaning to type 100
 - Provides means to announce data availability for stations
 - Reduces bandwidth to user of unwanted data
 - Might be useful to indicate quality of data with bit flag in the IODS byte



Network Management

- **Centralized architecture approach**
 - Data (re)transmission provided by central authority
 - Ease in providing data to end-users in common format
- **Distributive architecture approach**
 - Direct access to accumulating organizations
 - RTWG has proposed a common data format and method for universal access of available streams
- **In both approaches, useful statistics to monitor are:**
 - Percentage availability
 - Data latencies
 - IODS (station configuration change)
 - GPS observability (holes in network)



Differential Systems

- **measurement and position domain services**
- **state-space approach**
 - **Superior spatial decorrelation properties**
 - **Fewer reference stations required**
 - **Minimal bandwidth to user**
- **RTK**
 - **Double difference biases are resolved**
 - **Reference stations required with 30 kilometers of user**
 - **High bandwidth to user**



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Real-Time Correctors

- **RTCM-104**
 - Traditionally associated with Maritime Services
 - Measurement or position domain (types 1/3)
 - Version 2.1 supplemented to support RTK (18/19/20/21)
 - Version 2.2 enhanced for GLONASS
 - NTRIP, US Coast Guard model

- **RTCA-159**
 - Traditionally associated with Aviation Services
 - State-space approach
 - WAAS, EGNOS, MSAS



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Real-Time Correctors

- **JPL correctors**
 - state-space
 - designed to be low bandwidth
 - permits resolution for sub 10 cm user positioning
- **NRCan correctors**
 - state-space
 - modification of RTCA-159
- **New and Improved Clock and Ephemeris**
 - proposed for modernized GPS signals
 - improves curve fit with additional parameters
- **State Vector Representation (R. DiEsposti, et al)**
 - user numerically integrates force models from I.C.
 - eliminates fit errors
 - permits long term ephemeris and covariance propagation



Recommendations

- **UDP transport preferred for protocol**
- **Continue with real-time network prototype development**
- **Encourage organizations operating real-time data networks to reformat a subset of their data and permit easy access to data stream**
- **Provide file representations of real-time streams to IGS data centers in timely fashion**
- **Chose common methodology and message format consistent with RTWG charter**



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Potential Developments

- **Timely access to near-time file representations for IGS Data Centers**
- **Phase 2 of RTWG**
 - **Develop real-time combination of orbit, clock and ionospheric products**
 - **Develop real-time robustness and reliability/integrity monitoring methods**



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