



IMPLEMENTATION OF INTENSITY FRONTIER BEAM INFORMATION DATABASE

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Mission

- The IFBeam Database system is responsible for extraction of data from the FNAL accelerator division systems and providing it to the different experiments involved in the Intensity Frontier programs.

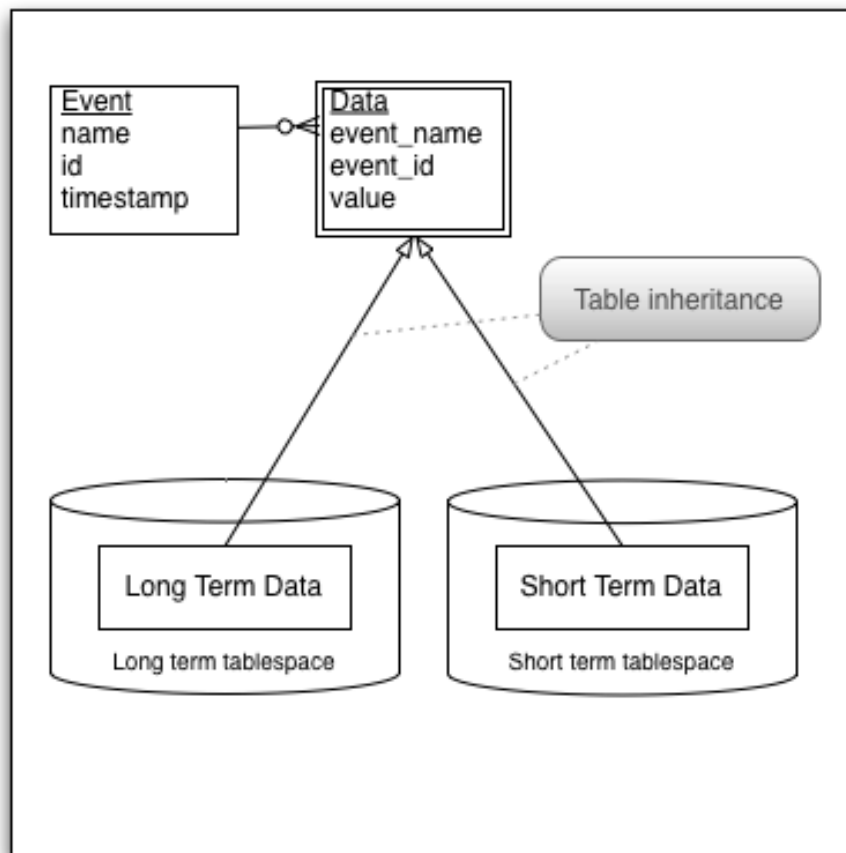
Requirements

- Receive beams conditions data from the accelerator in real time
- Store information in the relational database
- Make the data available to online monitoring, data processing and analysis systems of the intensity frontier experiments
- Data loss must be minimized
- Acceptable data latency is 1 hour for long term data and ~minute for monitoring data
- Data preservation and recovery procedures
- Long term data should be stored forever
 - Used for data processing
- Short term data should be stored for several days
 - Used for online monitoring

Data Streams

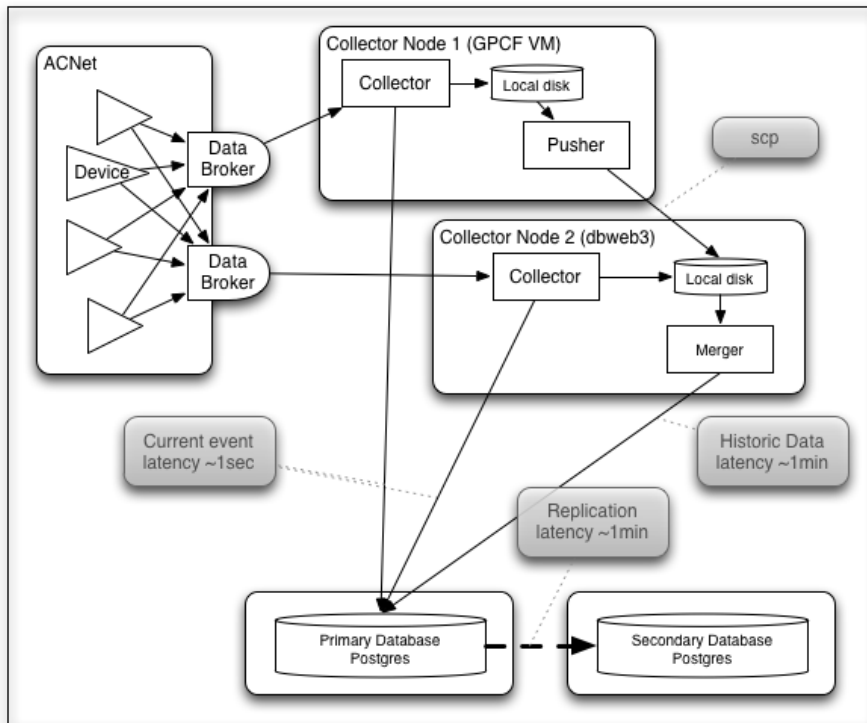
- Slow data stream
 - All data (short term and long term) stored in the database
 - Buffered on the collector nodes and stored later by the Merger
 - Latency ~5 minutes
- Fast event stream
 - Only last event is stored in the database
 - Stored by the Collector directly
 - Latency < 1 second
 - Can be lost
- Event timestamps
 - Sent as a UDP message from the Collector to the Web Server
 - Latency < 1 second
 - Can be lost

Database Schema



- Data tied to event via foreign key
- Short term and long term data stored in 2 different tables, inheriting from common “data” table
- Daily short term data cleanup uses “concrete” short term table
- Data access from “abstract” table

IFBeams Data Collection

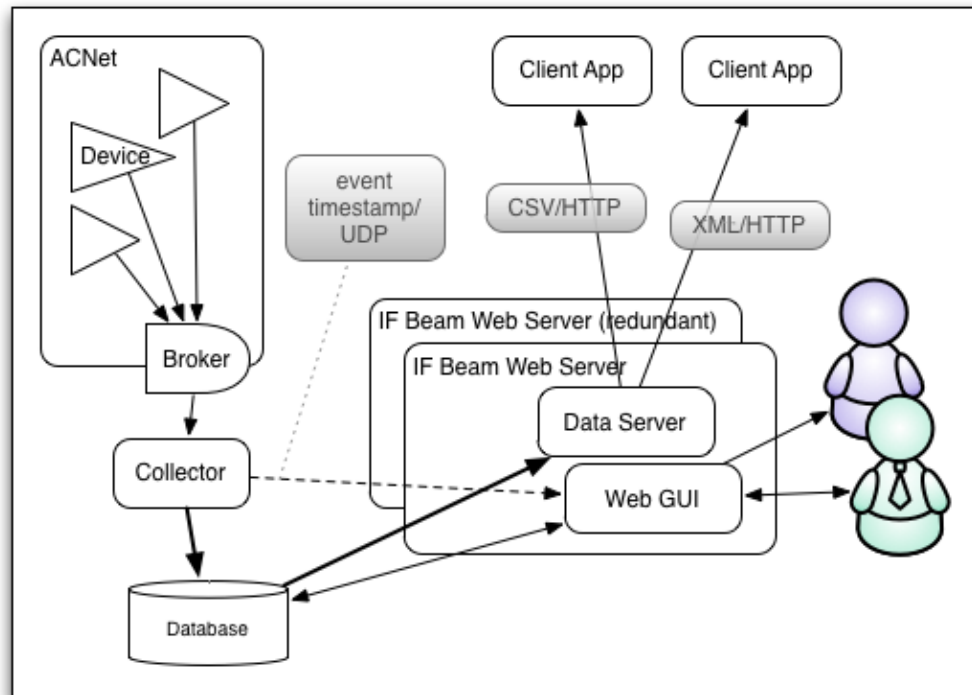


- Event rate – from 0.5Hz to 15Hz in peak
- Data per event
 - ~ 50 devices, ~1500 floating point numbers – long term
 - ~450 devices, ~2000 f.p. numbers – short term
- Current counts:
 - Long term data 400M
 - Short term data 20M
 - Events: 52M
- Current size:
 - 250 GB
 - mostly long term data (200GB, including 60GB index)
 - Estimated growth 0.5-1TB/year
 - Estimated end of life size ~10TB

Reliability of Data Collection

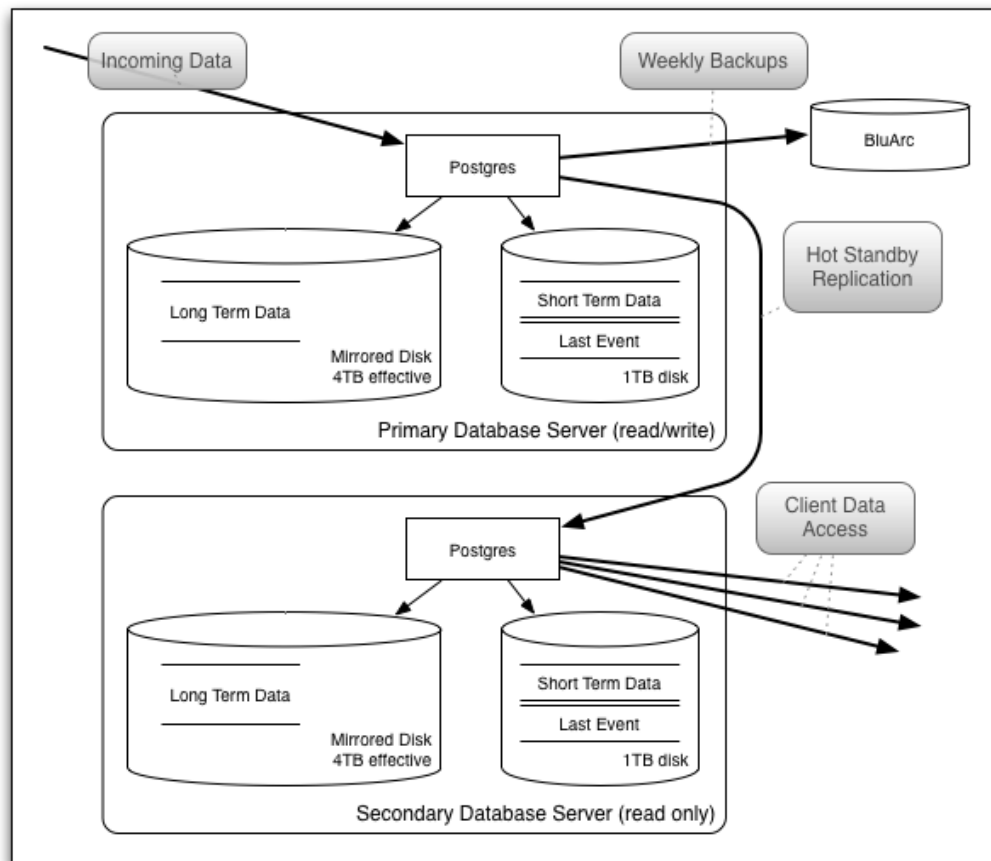
- Data is redundantly collected and buffered by 2 identical Collectors running on 2 different computers
 - Merger eliminates the redundancy and stores data into the database
 - More Collectors can be added
- Any one Collector can be turned off without any effect on the system
- Data can be buffered by Collectors for weeks in case of database or network outage

Data Access



- Applications get data via REST/HTTP from the web data server
 - XML
 - CSV
 - JSON
- Redundant web server infrastructure increases availability
- Interactive Data Browser
- Dashboard
- Data collection controls

Reliability of Storage



- Data is stored on 2 computers
- Postgres hot standby replication is used for replication
- Loss of any single computer is easily recoverable
- Disaster recovery: weekly backups to external network attached storage

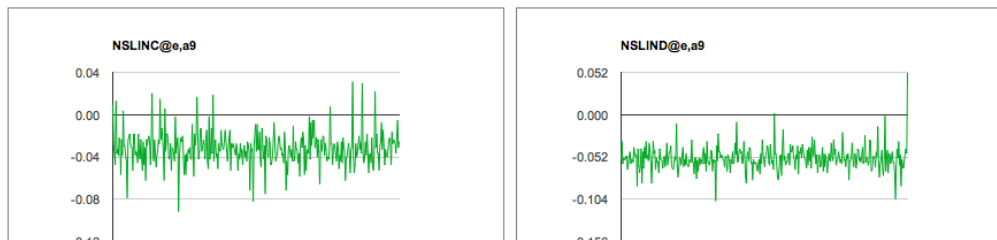
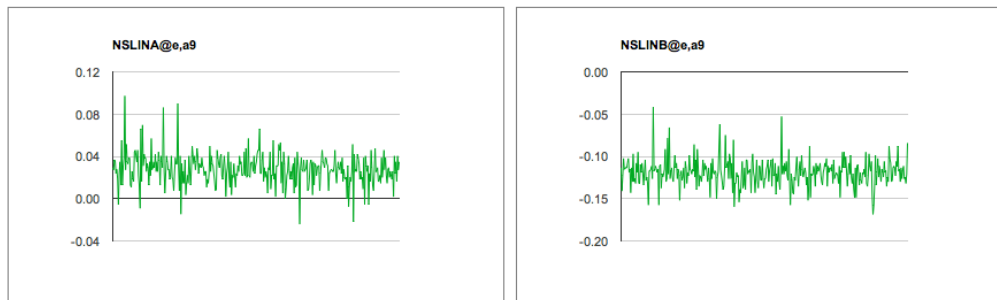
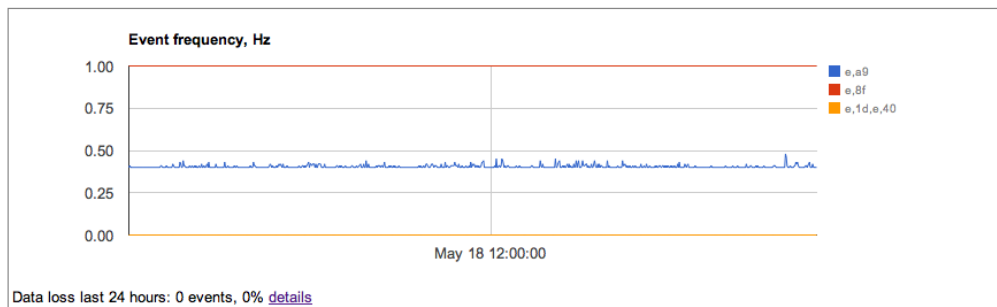
Dashboard

IF Beam Data Server

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Dashboard

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- Used to monitor health of all the components of the system, from the collector to web data server
- Recorded event frequency
- Measurements from key devices