COBE SAT

COsmic Box Event Server and Analysis in real-Time

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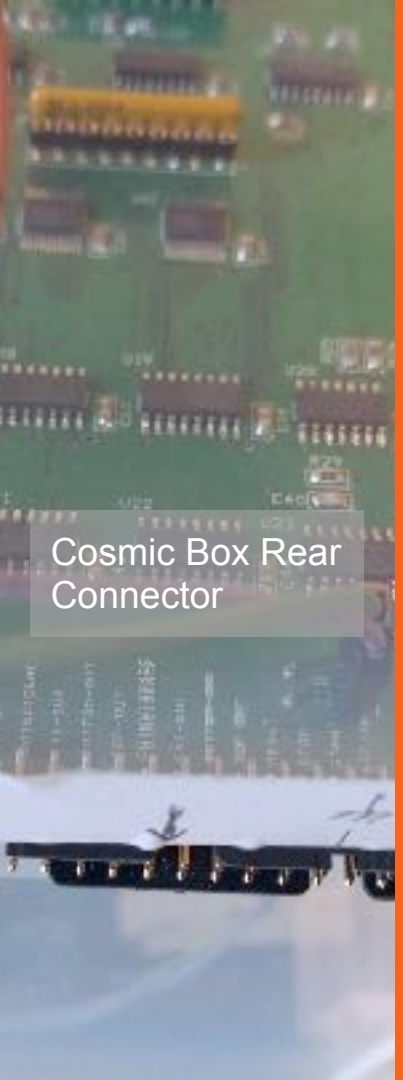
Cosmic Box

A Cosmic Box is a small cosmic ray detector which has two scintillators inside of it. Thus allowing us to tell when a charged particle passed through both of them decreasing the error rate due to noise compared to a single scintillator.



Cosmic Box Rear Connector

Our Challenges

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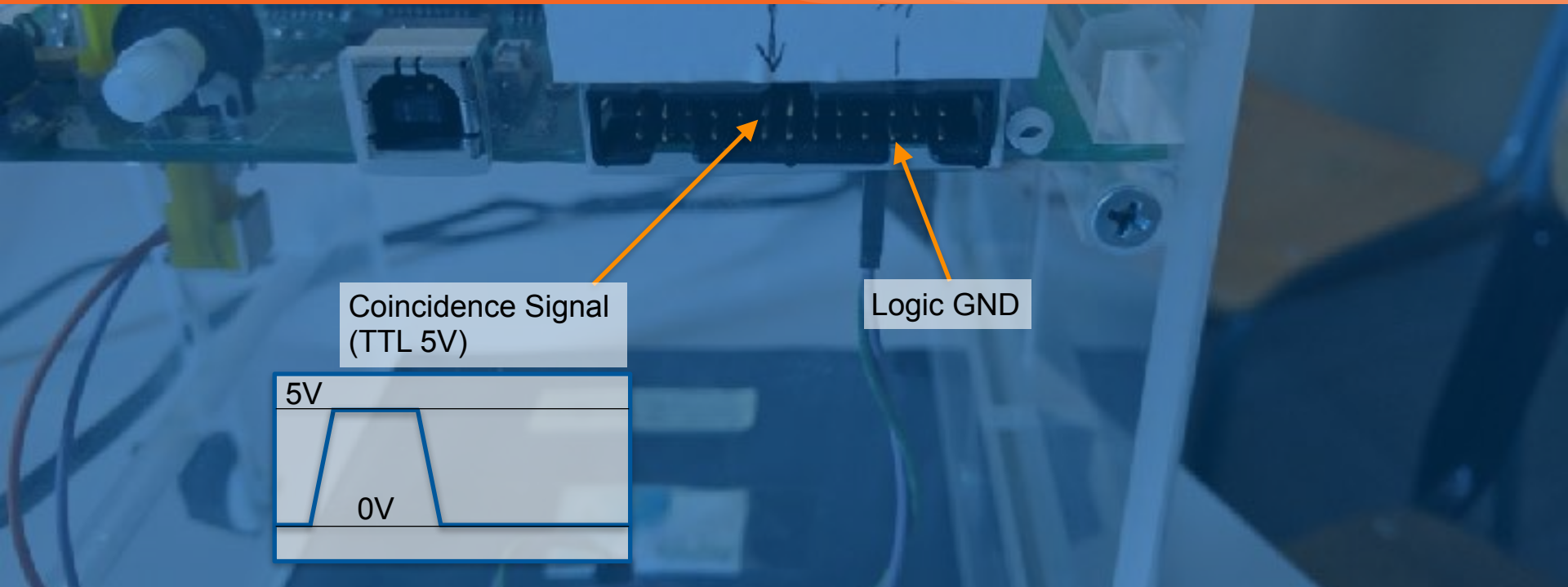
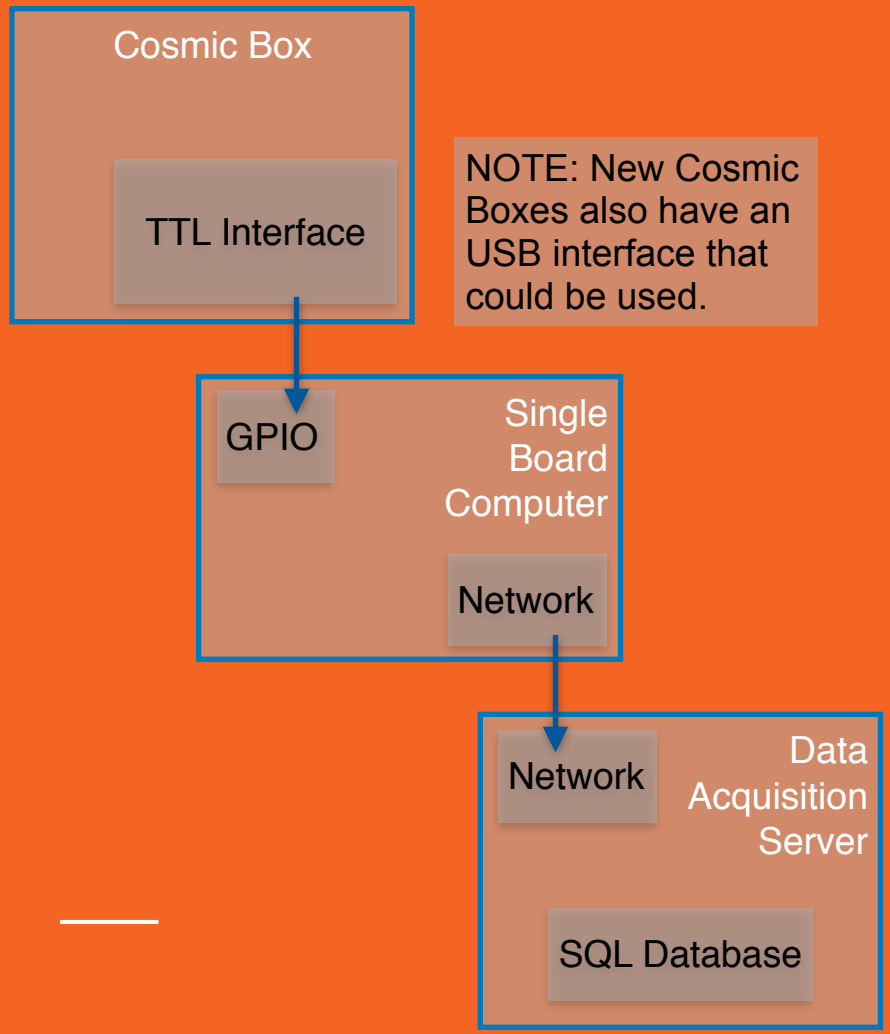
- Data acquisition automation
- No user intervention
- Continuous transmission

Connection to the Cosmic Box



System Architecture

- Cosmic Box (TTL)
- Single Board Computer (RTC)
- Data Storage Server (SQL)



Data Acquisition Server

- SQL Database
- Mean rate of ~ 1Hz
- 100000 events each day
- Get CSV data for desired timeframe
- Simple user interface


```
1   time
2   2016-12-11T16:19:12.712Z
3   2016-12-11T16:19:12.815Z
4   2016-12-11T16:19:17.552Z
5   2016-12-11T16:19:19.507Z
6   2016-12-11T16:19:20.816Z
7   2016-12-11T16:19:23.299Z
8   2016-12-11T16:19:25.985Z
9   2016-12-11T16:19:26.731Z
10  2016-12-11T16:19:27.744Z
11  2016-12-11T16:19:30.925Z
12  2016-12-11T16:19:35.315Z
13  2016-12-11T16:19:36.774Z
14  2016-12-11T16:19:40.663Z
15  2016-12-11T16:19:42.362Z
16  2016-12-11T16:19:45.274Z
```

An example CSV file with events

What kind of analysis can be made out of this data?

- Read CSV files using different programming languages
- Many possibilities
- Example: Event rate histogram (by timeframe)

Timing Improvements

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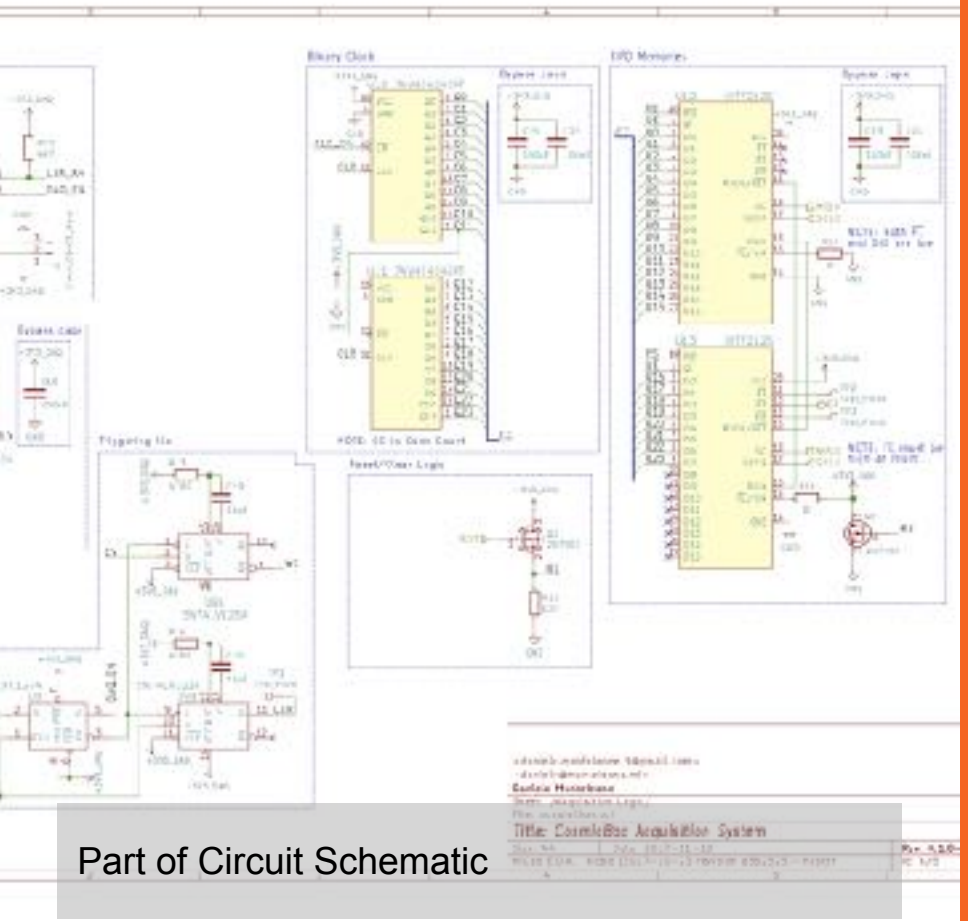
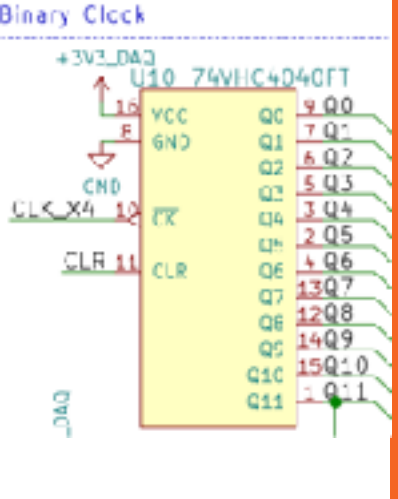
- Computer’s RTC (Real-Time Clock) is not accurate
- NTP (Network TIme Protocol) synchronization works but doesn’t fix the problem
- Could we use GPS timing systems?
- Down to 100ns accuracy!

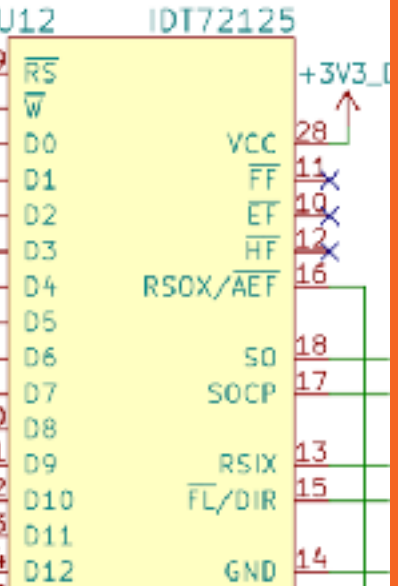


Part of Circuit Schematic

GPS Timing

- Triggering system for sub-millisecond accuracy
  U-Blox GPS Module
- GPS Synchronized Clock pulse
- Triggering system for sub-millisecond accuracy
- 4MHz Clock (synchronized with pps signal)





- Two 12bit counters (16,777,216 ticks/s)

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- Gates and triggering system
- FIFO memories
- Wi-Fi connected microcontroller

Planned Features

- Add a quick way to visualize data, such as automatic daily or hourly chart generation
- Manage more than one Cosmic Box at once

Thanks for the attention

- Acquire data, without user intervention
- Event timestamp, not only events count
- Timing improvements, using GPS timing system
- Analysis tool, web based
- Aggregate multiple Cosmic Boxes’ data