

# **IceCube Trigger System: Structure, Current Status & To Do**

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*PSU*

**AMANDA/IceCube Collaboration Meeting**

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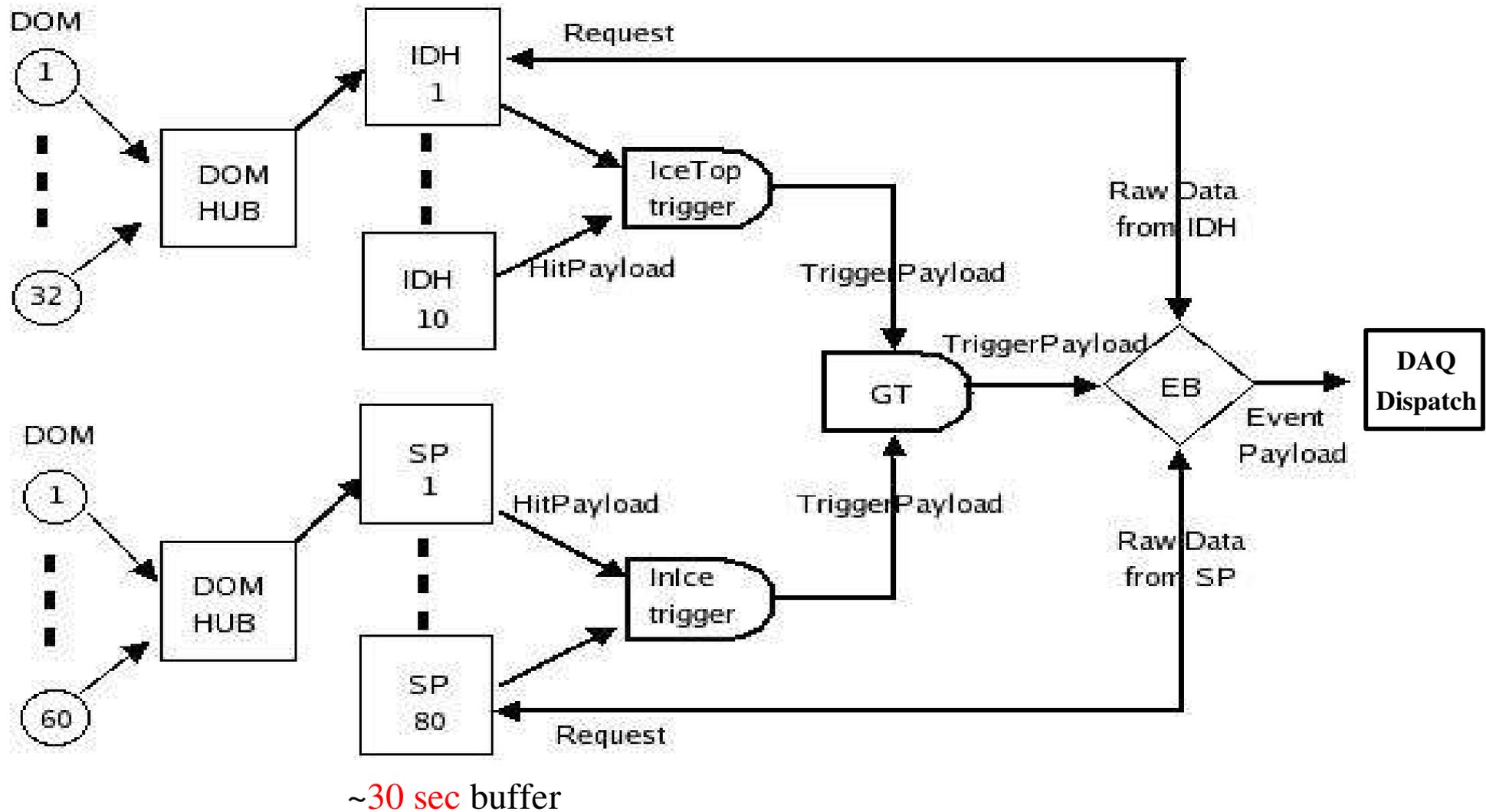
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# Outline

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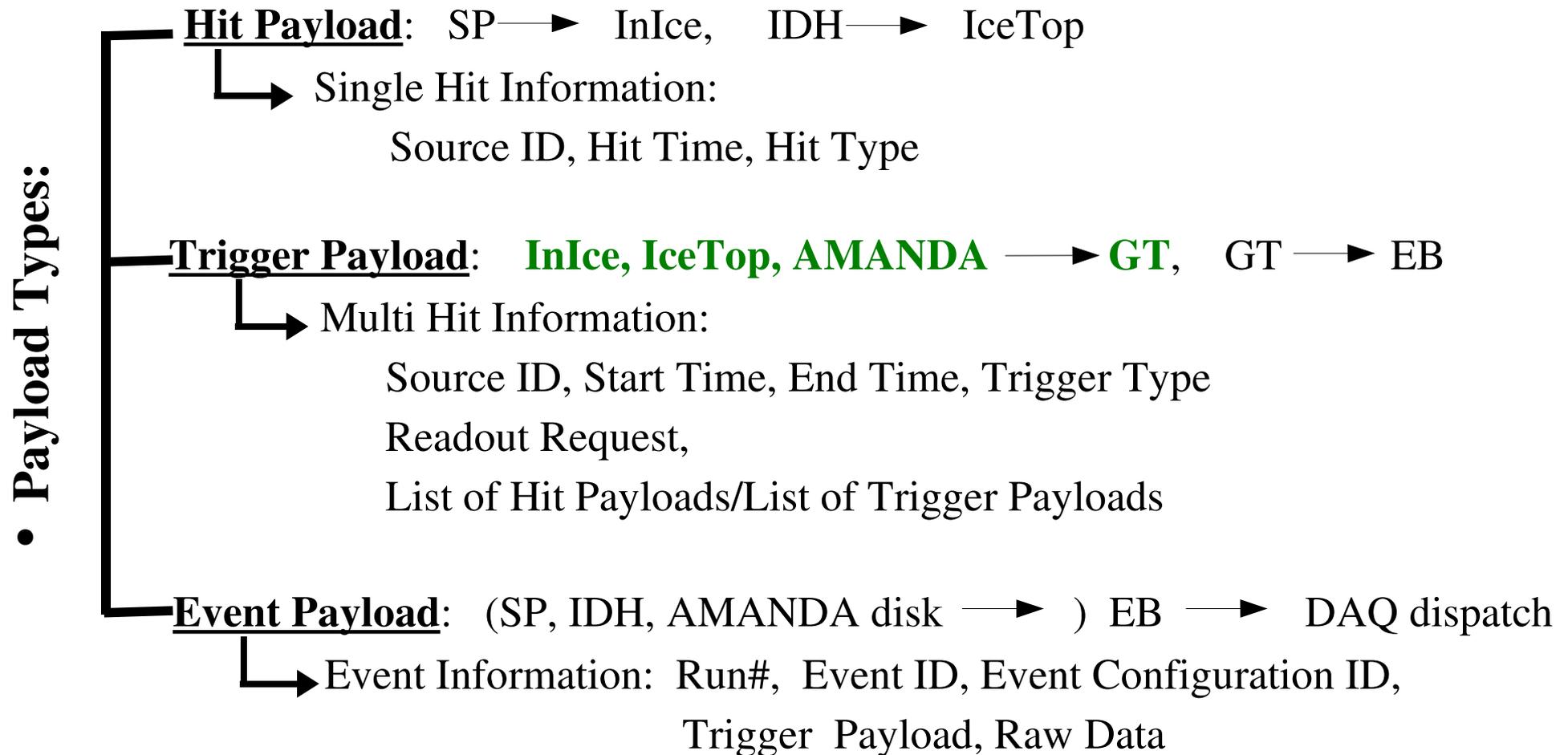
- Overview of IceCube Trigger System
- Payloads: messaging
- Global Trigger: Input, Algorithm, Timing diagrams, Output
- Data Readout Request Examples
- Current Status & Future Plan
- Integration w/ AMANDA
- Summary

# Overview of IceCube Trigger System



# Payload: messaging

**Payload:** a vehicle to transport trigger information from lower level to higher level trigger system.



# Global Trigger: input

## Trigger Request Payload

---Source ID: InIce, IceTop

---Trigger Type:

- Phys. Trigger: (---Note: Blue colored words stands for future trigger.)  
Simple Majority ( $M \geq 8$ , TBD), **Topology Trigger** <--- InIce  
Shower Trigger ( $M \geq 10$ , TBD), **Horizontal Shower Trigger** <--- IceTop
- Calibration Trigger
- Utility Trigger: Min.Bias ( $M=1$  w/ prescale)  
Random Trigger <--- for detector diagnostics  
Null Trigger <--- to avoid splicer stall (unprocessed inside GT)
- Merged Trigger: any combinations of above but Null Trigger.

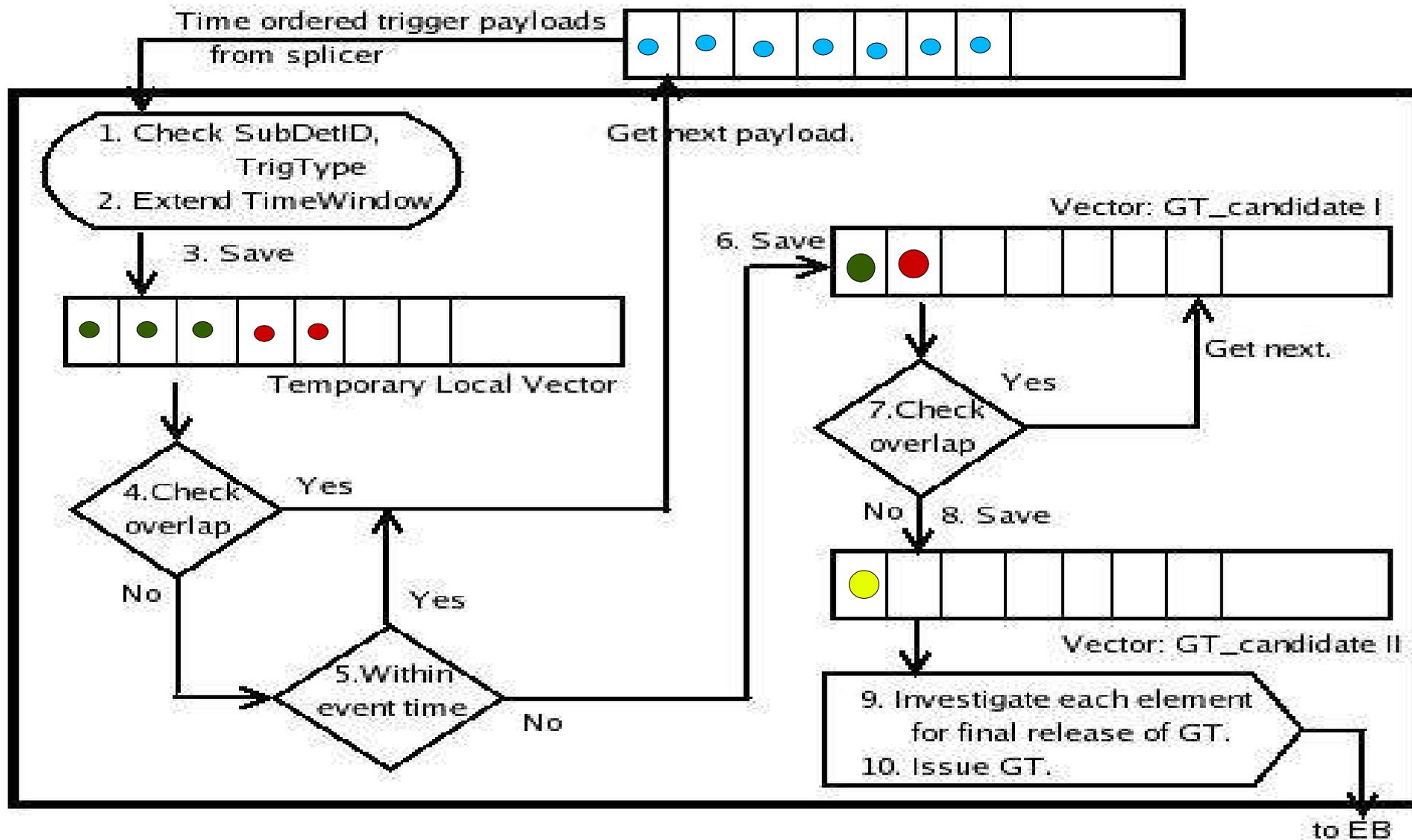
---Readout request: readout some strings/DOMs, readout all InIce, etc...

---Start Time: UTC time of 1<sup>st</sup> hit

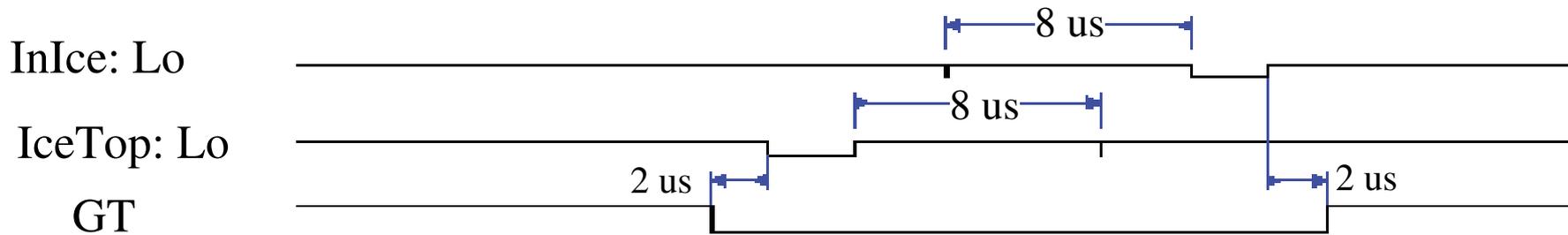
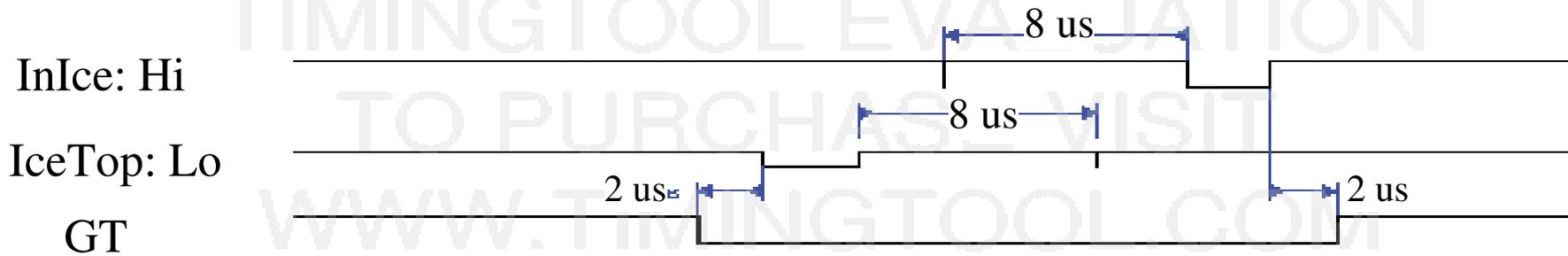
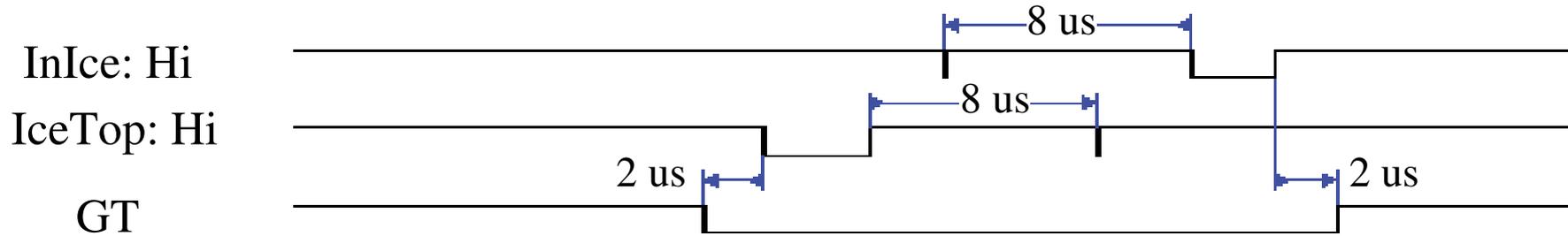
---End Time: UTC time of last hit

---List of Hit Payloads: hit payloads consisting of this trigger payload

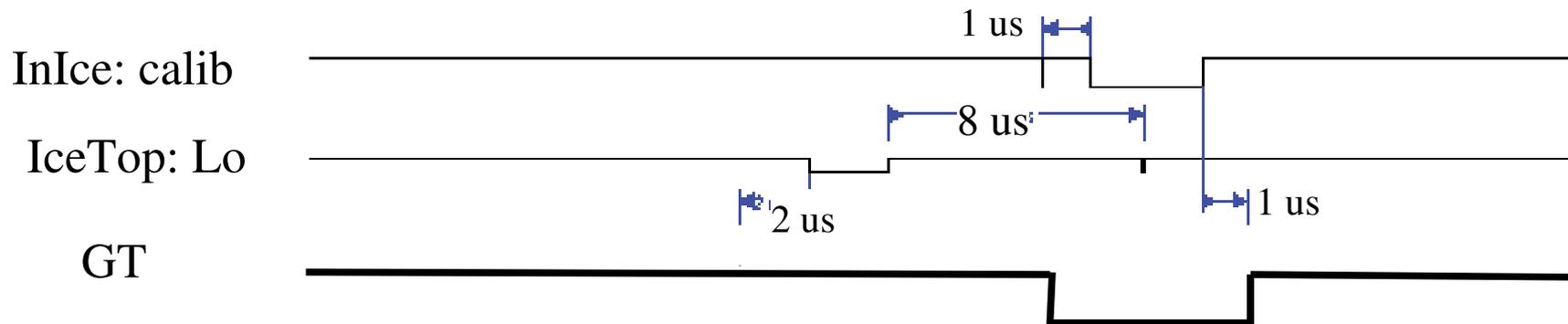
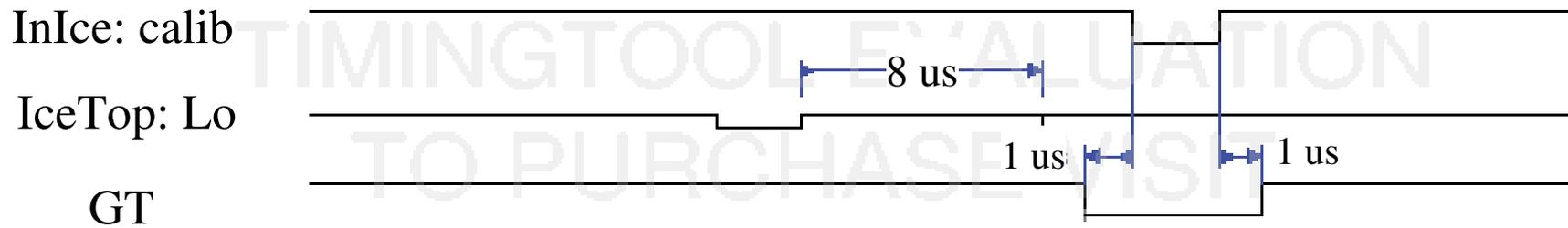
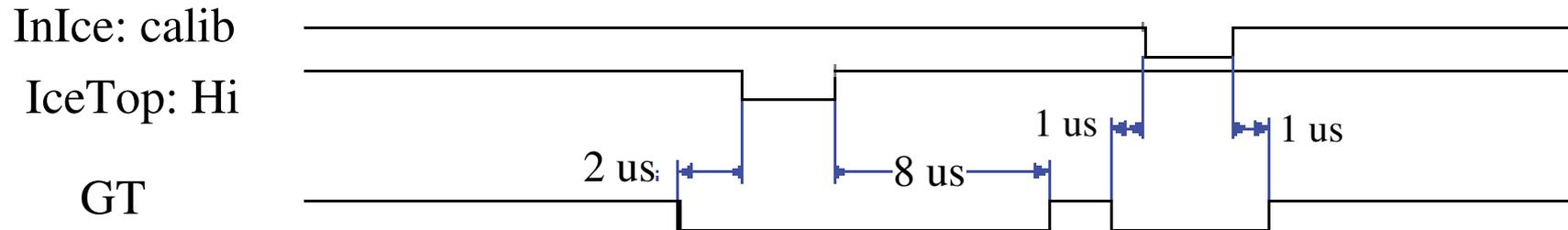
# Global Trigger: algorithm



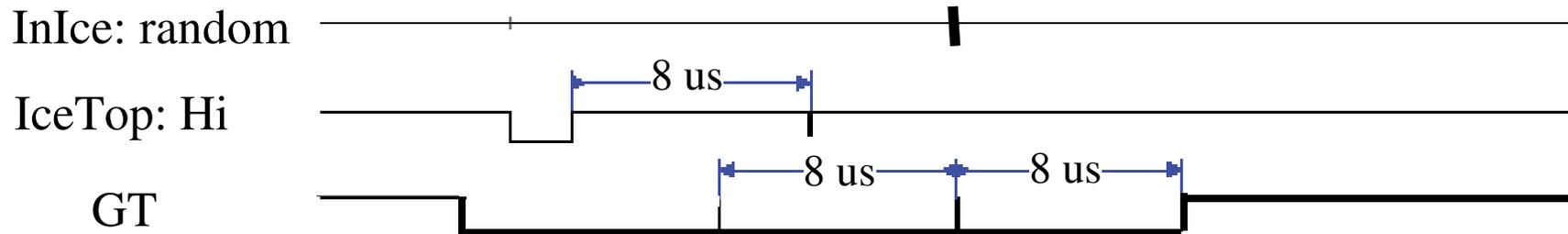
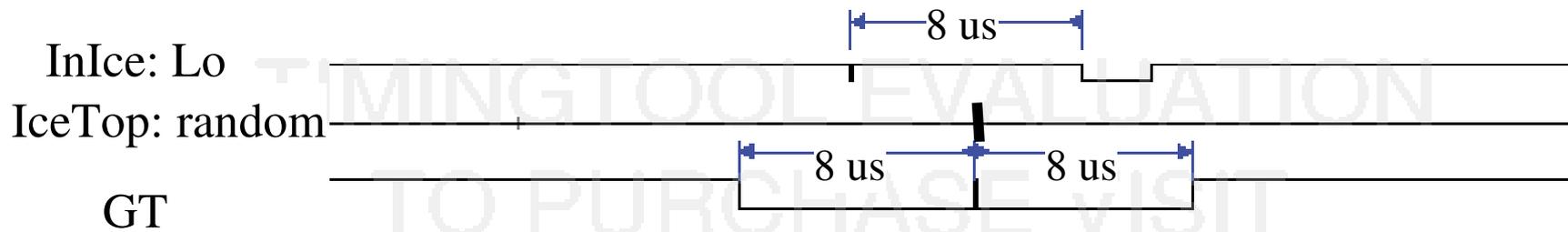
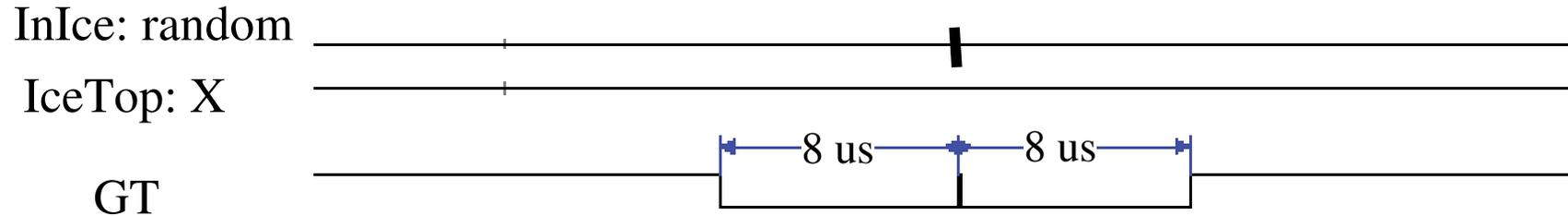
# Global Trigger: timing diagrams



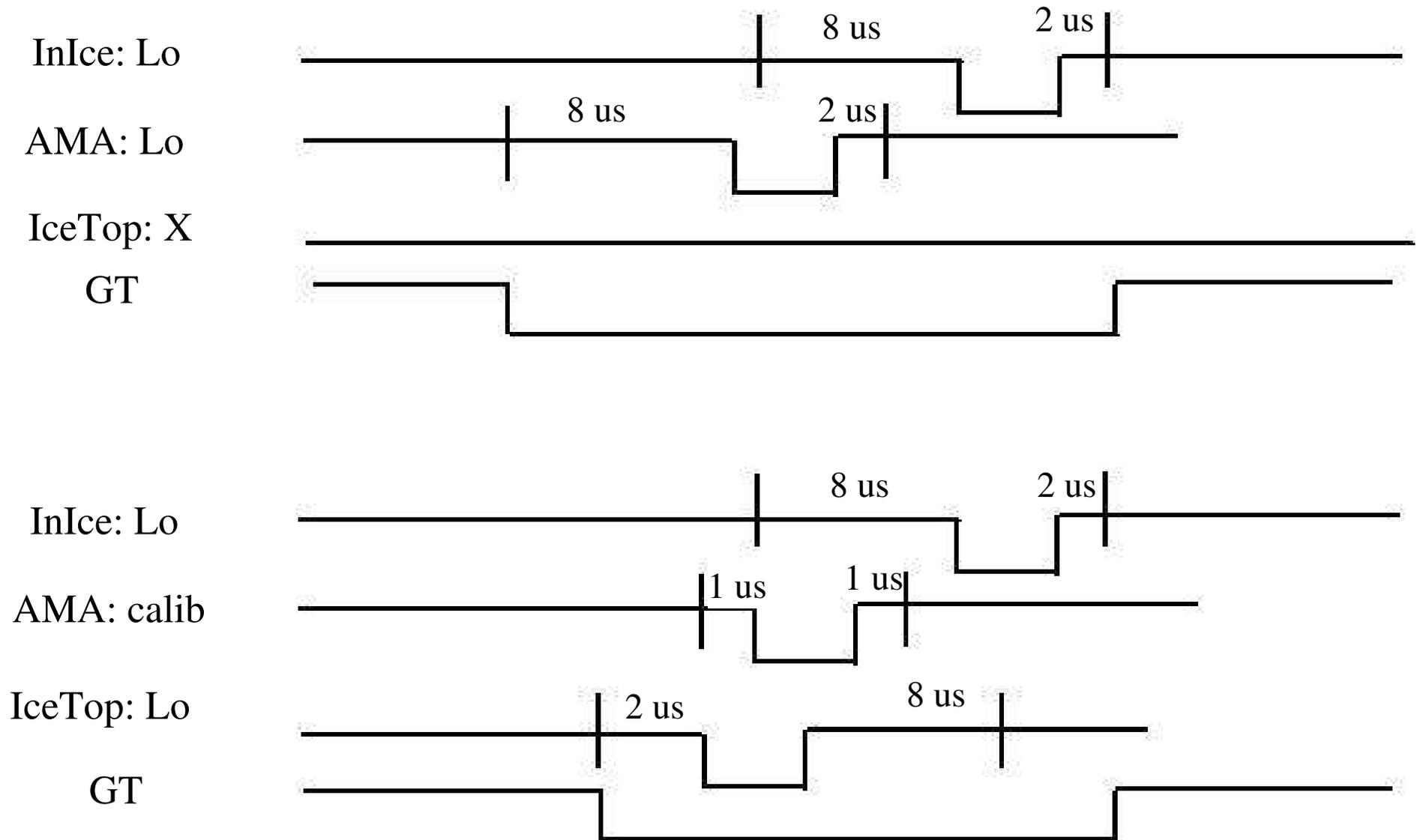
# Global Trigger: timing diagrams



# Global Trigger: timing diagrams



# Global Trigger: timing diagrams



# Global Trigger: output

**Trigger Request Payload** : output of GT (= input to EB)

---**UID**: Event #

---**Source ID**: GT

---**Trigger Type**: InIce, IceTop, or InIce && IceTop etc...

---**Start Time**: Extended UTC Time Start

---**End Time**: Extended UTC Time End

---**Readout Requests**: InIce+IceTop, InIce only, IceTop only,  
or some strings/DOMs

---**List of Trigger Payloads**: trigger payloads consisting of this GT event.

# Data Readout Request Examples

Triggers			Readout		
AMANDA	InIce	IceTop	AMA	InIce	IceTop
Lo/Hi	Lo/Hi	Lo/Hi	all	all	all
Lo/Hi	calibration	Lo/Hi	all	all	all
calibration	Lo/Hi	Lo/Hi	all	all	all
Hi	calibration	calibration	all	all	all
Lo	calibration	calibration	X	part	part
calibration	Lo	calibration	part	X	part
calibration	random trig	Lo	all	all	X
Lo	random trig	random trig	X	all	all

# Current Status & To Do

## Phases of DAQ Evolution

- **Monolith**: (*for initial period*) **current** (Jan.2005) -----> IO and beyond (?)
  - currently running in SP ---> works well!  
(thanks to D. Whalton, P. Toale and M. Hellwig.)
  - no separate InIce, IceTop and Global Triggers.
  - use TestDAQ output file as input.
- **IO**: (*for transition period*) by June 2005 (?)
  - separate InIce, IceTop and Global Triggers.
  - three trigger systems will be run **in integrated DAQ-sys. environment**  
being developed by C. McParland, C. Days and S. Patton.
  - use **TestDAQ output** as input.
- **Discovery**: (*final goal*) by Dec. 2005 (?)
  - same as IO but uses **RealDAQ!**

# Current Status & To Do

## Now, we are here:

- Trigger algorithms and code implementations of InIce, IceTop and GT for current year are almost ready.
- InIce, IceTop and Global triggers tested their messaging (payload system) w/ simulated HitPayloads using File IO.
- However, we have not thoroughly checked our trigger algorithms using those simulated hits, which was generated by Mathematica code (written by D. Seckel).

## Short Term To Do:

- Should THOROUGHLY test trigger algorithms using simulated data.: currently, simulator of hitPayloads written in JAVA is being developed (by S. Seo; **project = sim-hitPayload in cvs**).
- Should use real MC to get trigger rates.: current work is being done by A. Bouchta et al. but not quite ready yet.

# Trigger Rates

(Note: all measured values are from String21 using current TestDAQ & monolith)

Local Coincidence rate:

w/ DOM rate = 800 Hz, LC time window = 800 ns

==> **Measured = ~10 Hz/DOM**

InIce trigger rate:

SM ( $\geq 8$ ): measured = ~6Hz/DOM, MC simulation = coming up soon...

IceTop trigger rate:

SM ( $\geq 10$ ): measured = ~1Hz/DOM, MC simulation = coming up soon...

Global trigger rate:

measured: not yet available..., MC simulation = coming up soon...

# Requirements in Integration w/ AMANDA

## 1. Time synchronization: **possible but needs some work.**

- AMANDA/IceCube will use one GPS clock.: started by **H. Leigh (DESY), G. Przybylski (LBNL), D. Nygren, and J. Joshep (LBNL).**
- Flasher can be used for the time synchronization.
- Down-going muon can be used as well.

## 2. Interface: **not a problem but needs some work.**

- AMANDA uses C and should provide trigger payloads written in Java.
- Working people: W. Wagner, T. Messarius, and S. Seo

## 3. Buffer size: **not a matter.**

- As far as IceCube uses AMANDA-triggered data.
- Note: AMANDA data triggered by IceCube alone can NOT be read due to smaller buffer size in AMANDA.

# Summary

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- Currently InIce and IceTop triggers (and GT very soon) run well in Monolith.
- Using simulated data, soon we will do integration of all trigger components for debugging and checking robustness.
- With successful integration, Monolith ---> IO phase.
- We will need real trigger simulation soon (Adam) to estimate trigger rates.
- As for the preparation of integration between AMANDA and IceCube, we will work on the interface to use payloads in AMANDA software trigger.