

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY  
- LIGO -

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY

<b>Document Type</b> LIGO-T960035-00 - E 3/8/96
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<h1>LIGO Data Tape Features</h1>
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*Distribution of this draft:*

Data Analysis Working Group

This is an internal working note  
of the LIGO Project.

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## 1.0 Purpose

This LIGO Data Tape Requirements describes the current set of requirements placed on the “Master Tape” to be delivered by the Control and Data System (CDS) based on the needs placed on that tape by both the CDS and the anticipated data analysis scenario.

The requirements stated within this document do not represent a complete set of requirements on the LIGO data tape and are expected to evolve as the data analysis scenario matures. However, it is representative of the requirements necessary to allow the CDS to continue with their design requirements for the data acquisition system.

## 2.0 Recorded Data

The “Master Tape” will contain a complete set of interferometer data necessary to make off-line data analysis and data channel correlations possible.

- One “Master Tape” per interferometer
- Record all IFO *time series* outputs
- Record all PEM *time series* outputs
- Record all CDS *time series* outputs
- information on the pre-A/D whitening filters used to compress the dynamic range of signals such as the strain, acoustic, accelerometer, etc.
- a quality flag or hierarchical set of flags will be written to the tape using a logical condition which may change as our understanding of the interferometer evolves. This flag will facilitate the qualification of data during analysis
- Transfer functions and IFO state vectors be written to the “Master Tape.” This information will appear in the “Master Tape” header and in a specialized frame each time these data vary outside of a TBD “dead-band.”

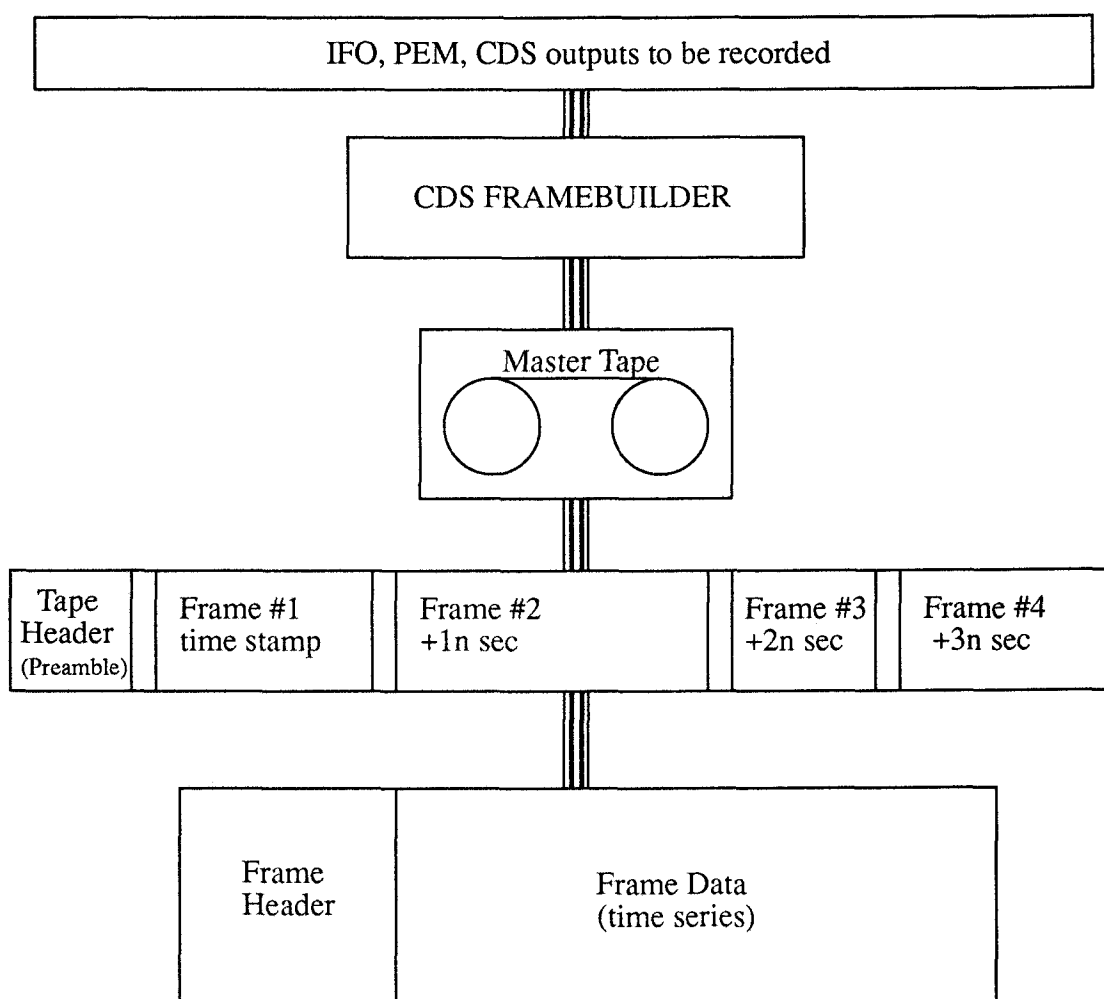
## 3.0 Data Structure

The structure of the data stored on the “Master Tape” will at the highest level consist of frames. Each frame will consist of a self describing header followed by the time series data from all the recorded outputs(channels). The “Master Tape” will have a tape header with information pertinent to the entire tape and/or long stretches of the tape.

- Frames will contain all data for a fixed intervals of time (frames may vary in byte size)
- Frames time intervals will be an integer number of seconds but no less than one second time intervals (GPS constraint)
- Frames will not be so long in time interval as to make data extraction excessively time consuming on standard data analysis computer environments looking at data from multiple interferometers.

- Frame headers will have a time stamp marker corresponding to the start/TBD time of the data contained in the frame.
- Frame headers will contain sufficient self descriptors to identify the type of frame and other TBD characteristics of the frame
- The frame header will be followed by the time series data in a TBD data format for all recorded outputs.

## 4.0 Conceptual Diagram



## 5.0 Tape Preambles

The "Tape Header" will at a minimum provide the following preamble to identify the tape. These are meant to characterize the whole tape or at least long stretches of the tape.

- Sequential Tape ID (may have encoded within, the Site & IFO number)
- Site
- IFO number
- Date (both local and GMT)
- Time (both local and GMT)
- Detector location (latitude & longitude)
- Detector arm orientation (convention needed)
- Frame Builder version
- IFO mode (recycled, dual-recycled)
- Operation mode (normal observation, research & development)
- Initial IFO state vector (~10's of kilobytes)
- Initial Transfer Functions (~ 10 kilobytes)
- Pre-A/D whitening filters used to reduce dynamic range
- A FLEXIBLE FORMAT that allows for expansion of this list

## 6.0 Tape Summary

The "Tape Header" will contain a pre-allocated space which will contain summary and statistical information of various characteristics of the data and the interferometer such as the total time the interferometer is in "lock" on that particular tape. This summary information will be written into the pre-allocated space after the tape has recorded its last frame and been rewound and advanced to the appropriate point on the tape. After the summary is recorded the tape will be fully rewound.

## 7.0 Hardware Considerations

Current tape technology provides for data collection at a rate of 6 megabytes per second for periods of several hours to a single tape. The frame builder / tape writing system needs to support tape swap-outs. This would be useful if detection of an astrophysical event were made by other detection methods such as a supernova observation from optical, gamma ray burst or neutrino detection.

- 6 megabytes per second is the expected data rate per interferometer
- 4(TBD) hours is the expected data collection time per tape (90GB/6MB/sec)