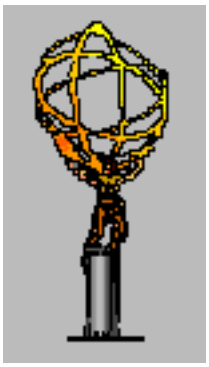
21st October 1998

Level-1 Calorimeter Trigger DAQ Infrastructure Requirements

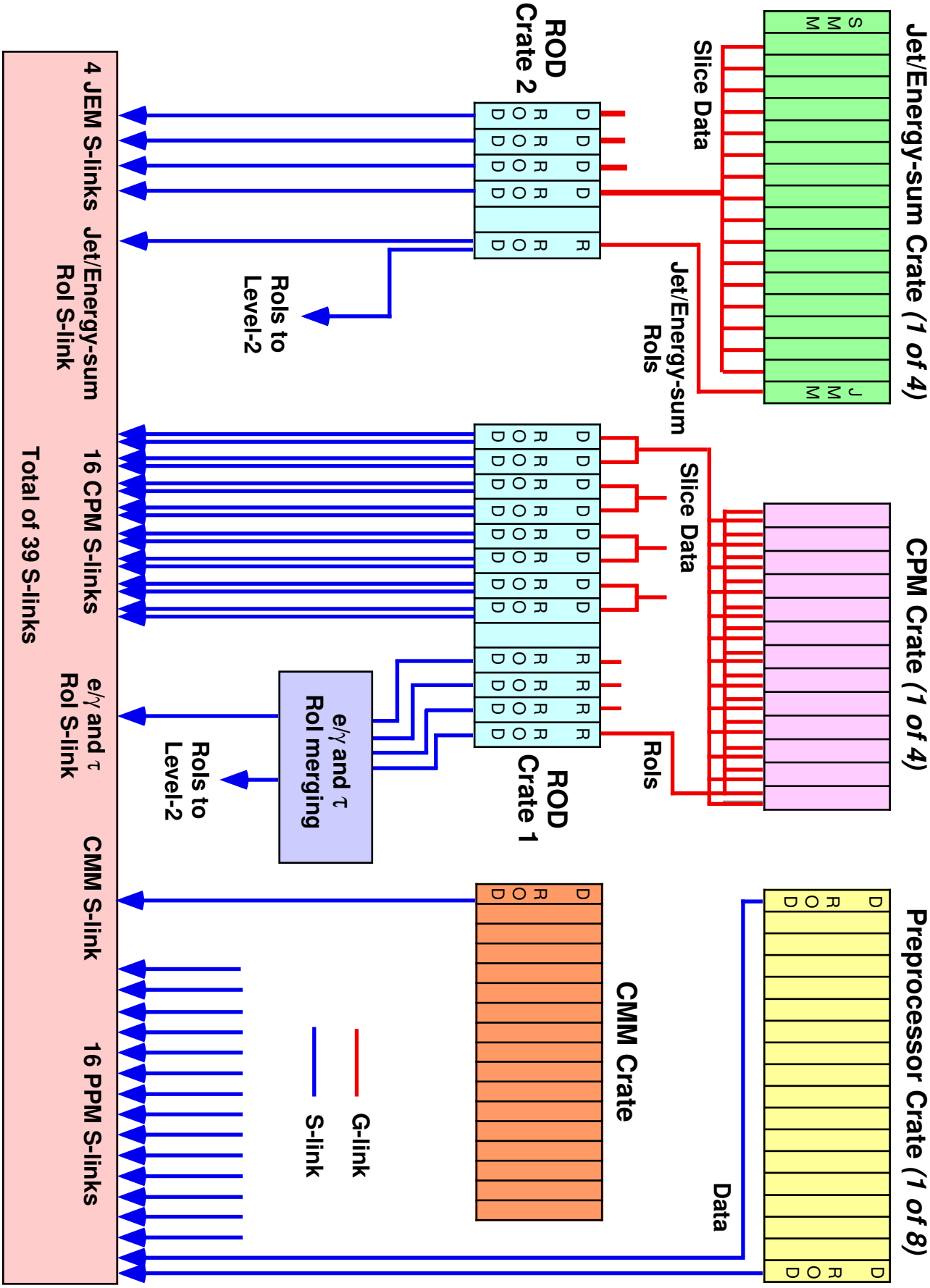
C .N .P .Gee
Rutherford Appleton Laboratory



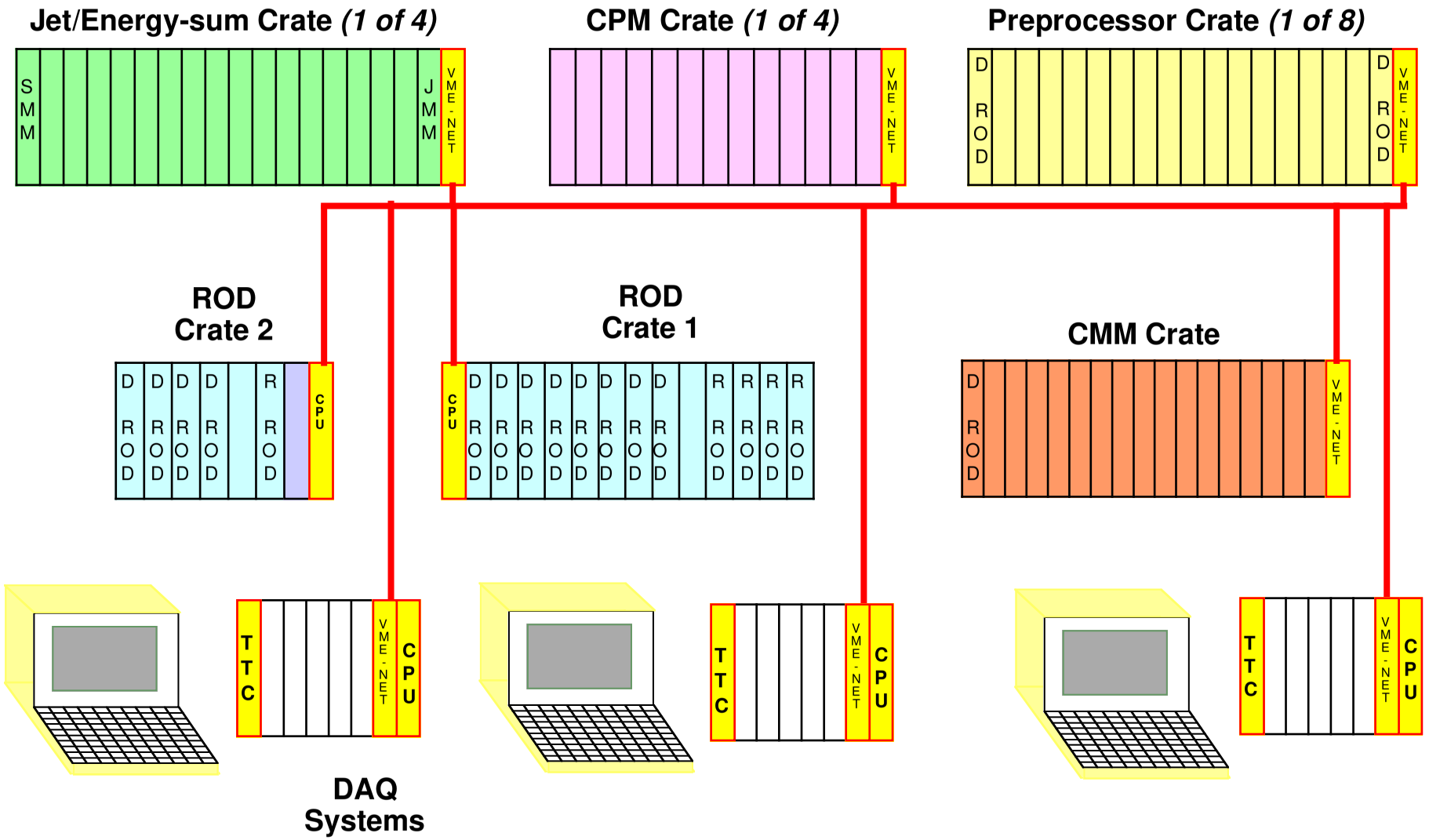
Overview

- **Tasks performed in the ROD**
- **Proposed event fragment data format**
- **DAQ Infrastructure Requirements**
- **Trig/Daq requirements to 2004**

Level-1 ROD Overview



Level-1 ROD Overview



DAQ Infrastructure for Control, Monitoring, Diagnostics & Installation

ROIDAQ 010998

Tasks performed in the ROD

We have three types of ROD - Pre-processor RODs, R–RODs and D–RODs. R– and D–RODS use the same hardware with different FPGA algorithms.
All RODs have (VME?) interface to the dedicated level-1 computer system.

Pre-processor RODs

- **Control and arbitrate the PPr crate Pipeline bus**

At configuration time:
- **Accept configuration data from VME and download into pre-processor modules.**

When running:
- **Receive pre-processor time slices over PipelineBus;**
- **Format into standard event fragments;**
- **Transmit over S-link to level-2.**

R–RODs

- **Receive RoI data over G-links**
- **Check bunch counter fields;**
- **Handle error conditions - count, signal to TTC for reset or set bits in output RoIs;**
- **Discard empty RoIs;**
- **Discard all except first 30 RoIs;**
- **Build surviving RoIs into event fragments;**
- **Inject into S-Links to Level-2;**

D–RODs

- **Receive time slice data over G-Links;**
- **Format into standard event fragments;**
- **Transmit over S-link to Level-2.**

Tasks performed in the ROD(2)

Other tasks where requirements are still to be specified:

Generate & transmit messages when faults are detected

Copy data from selected events to buffer for readout & monitoring (by level-1 computer);

Check test data patterns injected during LHC long gaps. Signal errors;

Assist in internal timing setup of the trigger;

Assist in trigger system diagnostics & Debugging;

Provide test data patterns or dummy data to level-2.

Data format on S-Link

The ATLAS S-Link Data format (version 1.1 with word counts at the end) is probably suitable for us.

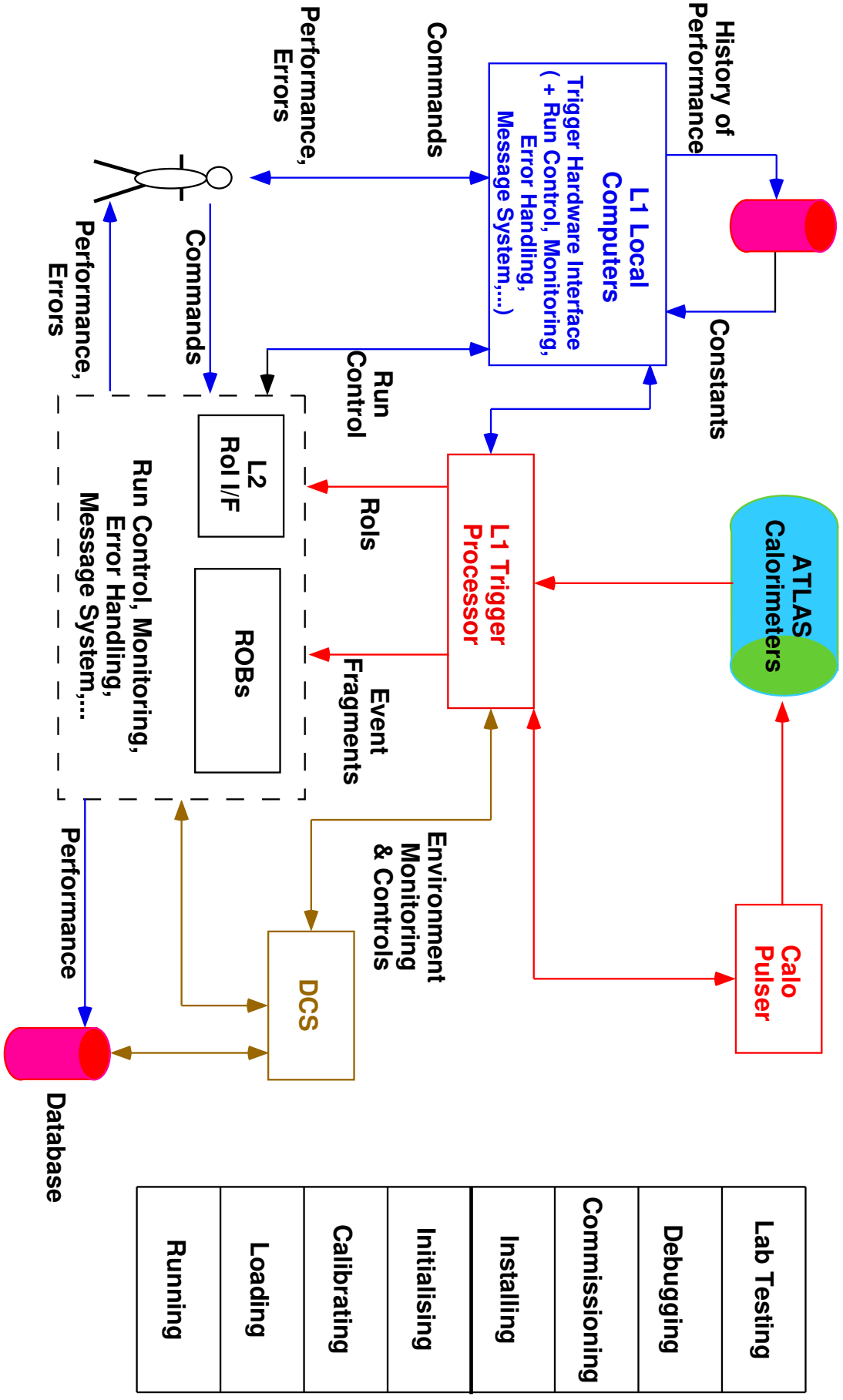
We're designing prototype ROD now, so agreed "frozen" format is needed soon.

Would prefer to see BYTES not WORDS in documentation and data lengths (because "word" means 16 or 32 or 64 bits to different people). Or at least, always say "32-bit words" in documentation.

"Big- or Little-endian" should be specified.

In some running modes, we need to use data compression for readout from pre-processor into RODs. We have already built some options into ASIC prototypes. There should be a list of preferred compression formats.

Software Infrastructure Requirements



Software Infrastructure Requirements

Software Integration

- **We (the level-1 calorimeter group) need to develop an integrated set of software covering the complete development cycle from lab testing of prototypes through to final installation and running in ATLAS.**

- **Almost all development and testing of hardware & software will be done outside CERN**

- **To develop our "final" software, we need…**

  - **Copies of the ATLAS DAQ software, +**
  - **Access to tools to modify it as needed, +**
  - **A route to influence the design**

- **…in the INSTITUTES.**

- **Our TDR timetable shows us running a prototype version of our final software within two years.**

HOW DO WE DO THIS?

Infrastructure Requirements(2)

Our detailed requirements are not yet discussed. We would be interested in contributing to a DAQ URD in this area.

Making the DAQ work during testing, debugging, commissioning, etc is harder than making it work for the running experiment. But it is essential.

Special triggers

- **These will be needed to time in the trigger, to measure and check calibration (using a calorimeter pulser), to simulate data taking outside beam.**
- **If we need triggers for diagnostic purposes, do these need to be passed to level-2?**

Databases

- **We expect to store DCS parameters, trigger setup parameters (timing and physics), performance history, configuration details.**
- **Database structure should be modifiable while the experiment is running.**

Run Control

- **Need a state-oriented system which can cope when parts of the hardware or software are missing.**

Error handling,

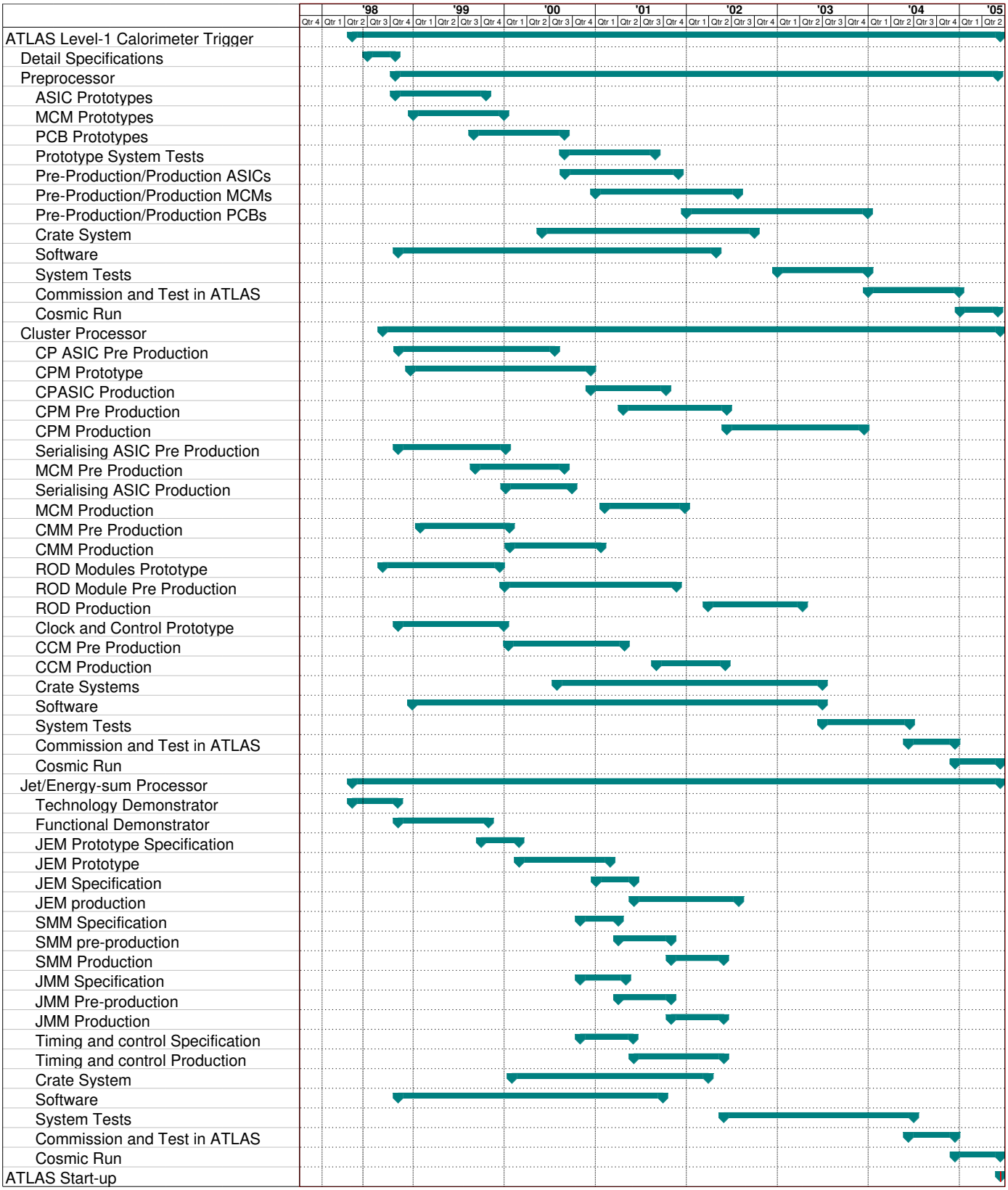
- **Our trigger hardware includes internal error checking. Some errors may be cleared by hardware resets over TTC (which should be counted). Others will indicate a failed module or corrupted settings. There should be a list of errors and corrective actions.**
- **Some errors will be detected by monitoring software.**
- **If software breaks, is this to be handled as an error?**

Monitoring,

- **We need to check both the physics performance and the technical operation of the trigger.**
- **How do we check events which fail level-2 or higher levels?**
- **It must be possible to change and debug monitoring software during a run?**

Calibration

Partly internal to the trigger, partly using calorimeter pulse systems.
Results must be associated with individual trigger hardware modules and possibly firmware settings.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ATLAS Level-1 Calorimeter Trigger
Detail Specifications
Preprocessor
ASIC Prototypes
MCM Prototypes
PCB Prototypes
Prototype System Tests
Pre-Production/Production ASICs
Pre-Production/Production MCMs
Pre-Production/Production PCBs
Crate System
Software
System Tests
Commission and Test in ATLAS
Cosmic Run
Cluster Processor
CP ASIC Pre Production
CPM Prototype
CPASIC Production
CPM Pre Production
CPM Production
Serialising ASIC Pre Production
MCM Pre Production
Serialising ASIC Production
MCM Production
CMM Pre Production
CMM Production
ROD Modules Prototype
ROD Module Pre Production
ROD Production
Clock and Control Prototype
CCM Pre Production
CCM Production
Crate Systems
Software
System Tests
Commission and Test in ATLAS
Cosmic Run
Jet/Energy-sum Processor
Technology Demonstrator
Functional Demonstrator
JEM Prototype Specification
JEM Prototype
JEM Specification
JEM production
SMM Specification
SMM pre-production
SMM Production
JMM Specification
JMM Pre-production
JMM Production
Timing and control Specification
Timing and control Production
Crate System
Software
System Tests
Commission and Test in ATLAS
Cosmic Run
ATLAS Start-up

Trigger/DAQ Requirements to 2004

- **We have at present no further plans for Test Beam work. Our technology has been proved in annual test beam runs 1992 - 1997.**

- **We may ask to collect module-0 calorimeter pulse samples.**

- **The schedule shows commissioning and testing in ATLAS in January 2004.**

- **Testing of ROD prototypes should be complete by end 1999, and of pre-production RODS by end 2001. Some joint tests with level-2 RoI builder & RODS would be useful.**

There should be a scheduled set of combined tests of the whole Trigger & Daq system over the next few years.