Thesis Outline

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Abstract (1 page)

Content will take roughly half a page but after formatting a full page will be dedicated here.

Table of Contents (1 page)

Should take up a page, potentially two if there are a lot of subsections.

Introduction (2-3 pages)

This will introduce the LHC as well as the upcoming upgrades to luminosity and how that will be reflected in increased data. Segway will mention the high radiation environment the readout chip and DAQ systems deal with. There will be some figures.

Single Event Effects (5-6 pages)

This will be an introduction to single event effects. Topic includes the varieties and their effects on devices. Basics including how they are measured, characterized, etc. that’s relevant for further discussion will be mentioned here. Embedded will be statistics and data for how they affect the DAQ systems in the LHC. This will eventually transition into mitigation/recovery methods at which point logical radiation hardening is introduced as the goal of this thesis. This will conclude with a discussion on how these analog events will be emulated in logic / how they affect the data and logic of a system at the binary logic level. There will be some figures.

YARR Rx/Tx Architecture (5 pages)

This section is an introduction with input and output logic that are relevant to understand what kind of data is being passed to the DAQ and why it comes through the way it does. This will include the recurring blocks such as IDLE and SYNC, will discuss the aurora 66/64 protocol and go over the major blocks (SERDES, Gbox and Scramblers) in the tx and rx. Extra time will be spent in the rx to account for additional blocks such channel bonding, and then the sync recovery system will be briefly mentioned as a segway. Several high level figures.

Original Recovery System (8-9 pages)

Here I will discuss the original resync system in the YARR rx. This is split into 3 sections:

*Description (5 pages):*

First section is a description/explanation of the recovery system. This will be a discussion on the SEDES bit slip, the Gearbox slip and then the “algorithm” which alternates between the two along with its error tolerance. This will resemble the format and language of the last section and should look like a natural extension of it. Many figures.

*Results (2-3 pages):*

Second section is where graphs and results will go. This will be filled mostly with graphs and explanations for why the graphs look the way they do. The graphs come from the bit dropped regression test, and then additional data will come from the random testing simulations. Recovery time for x bits dropped/added, average recovery time, average data loss. Weighted (with probabilities) average data loss and recovery time. Resource Util?? Lots of graphs.

*Flaws and Areas of Improvement (1/2 – 1 page):*

Final section will go over the multiple flaws of this system, points of improvement or other useful notes to understand the changes that ensued. Smarter search, collapse all slips into gearbox, smarter error tolerance.

New Recovery System (6-8 pages)

Here is the result! I’d like to frame this as a proposal to replace the original.

*Description (3-4 pages):*

Like the previous description section. This will go over the gearbox slip fsm, the additional hardware to accommodate it, the search unrolling, the improved tolerance, and bit slipping algorithm as well the parameters that allow us to tune each of these things. Many figures.

*Performance (2-3 pages):*

Once again lots of graphs. Aim to make sure these are the same graphs as before however I may have additional copies to point out “optimal” parameters for unrolling depending on whether the aim is resources, recovery speed, or otherwise. Other interesting configurations may also be mentioned.

*Remaining Flaws (1/2 page):*

The solution won’t be perfect and will without a doubt result in downsides that the original doesn’t have. Not totally sold on this section yet.

Results Comparison (4 pages)

Finally, the most relevant differences in the two sets of data are compared and discussed here. Pros and cons will be outlined between the two and a case will be made for why my version is better. More graphs, some data may be repeated from earlier results sections but it’ll be overlayed and or differently formatted.

Future Works (1 page)

This is the stand in for a conclusion. It will zoom back out of the hierarchy. Start with additional changes or modification to the recovery system will be talked about here and may be a second half to the “Remaining Flaws” section. Some discussion on additional forms of radiation hardening being done on the readout system may be mentioned as well. I’ll know what to put here more once the entire paper is written I think.

Acknowledgements (1/2 page)

References (1-2 pages)