



# Internship Summary Presentation

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  - Overview of the Internship
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  - Background
  - Theory of Operation
  - Key Components
  - LLS Model GUI
  - Future work
- **Split Lot Test**
  - Background
  - Test Environment and Tools
- **My Role in the Project**
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  - What did I learn?
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- **Future**
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# Introduction

- 2011 Net Revenue of **\$7.39 Billion**  
Founded in **1991**
- Initial Public Offering in **April 1998**  
(NASDAQ-BRCM)
- A **Global Leader** in Semiconductors  
for Wired and Wireless  
Communications
- Broad IP Portfolio with More than  
**17,800** U.S. and Foreign Patents and  
Applications
- One of the **Largest Volume** Fabless  
Semiconductor Suppliers
- ~**11,200** Employees Worldwide



Apple® iPhone® 4S



*Features Broadcom Bluetooth and Wi-Fi Technologies*

Apple iPad® 2



*Features Broadcom Bluetooth, Wi-Fi, and GPS Technologies*

Roku® 2



*Features Broadcom Bluetooth, Wi-Fi and Apps Processor Technologies*

Nokia® Lumia 800



*Features Broadcom Bluetooth and Wi-Fi Technologies*

Nokia 700



*Features Broadcom Multimedia Processor and Baseband Technologies*

Samsung® Galaxy Tab™ 10.1



*Features Broadcom GPS, Bluetooth, Wi-Fi, and FM Technologies*

Samsung Galaxy S™ II Mobile Phone



*Features Broadcom Bluetooth, Wi-Fi, and GPS Technologies*

Samsung Galaxy Y™



*Features Broadcom Bluetooth, Wi-Fi, FM, GPS, Baseband, and Cellular RF Technologies*

DIRECTV® H25 HD DVR Receiver



*Features Broadcom Set-Top Box Technology*

NETGEAR® NTV200 NeoTV Streaming Player



*Features Broadcom Over The Top (OTT) Technology*

NETGEAR WNDR4500



*Features Broadcom Wi-Fi and Gigabit Switch Technologies*

TomTom® GO 2535



*Features Broadcom GPS, Bluetooth, and PMU Technologies*

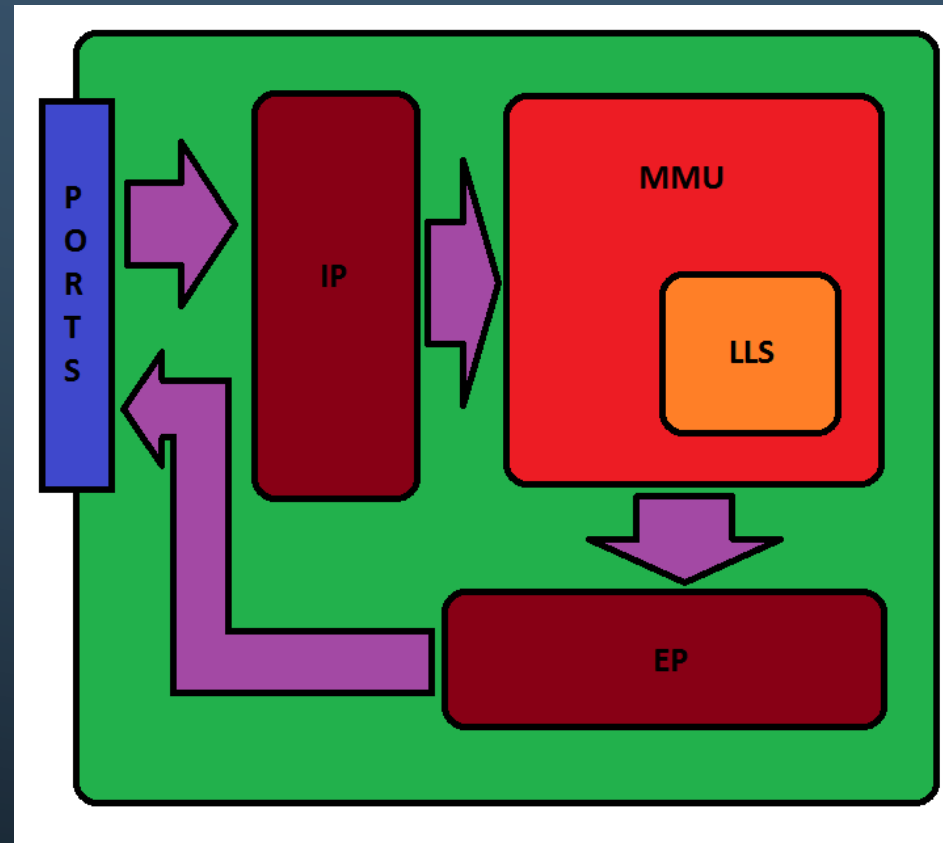


# OVERVIEW OF THE INTERNSHIP

- BCM Andover Office (Infrastructure and Network Group)
- From Jul 23, 2012 to Dec 21, 2012
  - Summer: Full-time
  - Fall: Part-time
- Major 2 Projects:
  - Linked List Scheduler
  - Split Lot Test

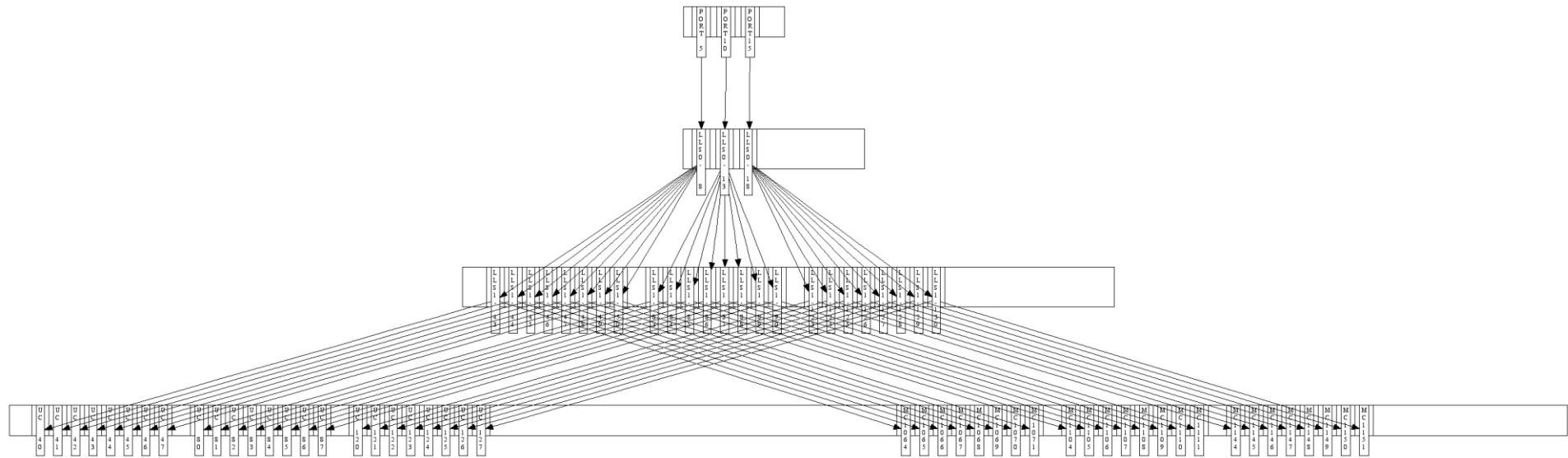
# Linked List scheduler(LLS)

- What is MMU?
  - The Memory Management Unit (MMU) is capable of providing line rate buffering across all packet sizes for 100Gbps of Ethernet traffic.
  - It all started with queuing. A network processor has a certain amount of processing ability. If the rate of the coming packages reached a point, any packages that arrives at the chip has to go through so waiting time. During the waiting time, they resident inside the memory and we have to figure out a way to deal with these waiting packages and make sure everyone got the service they deserve. So here we have the MMU.



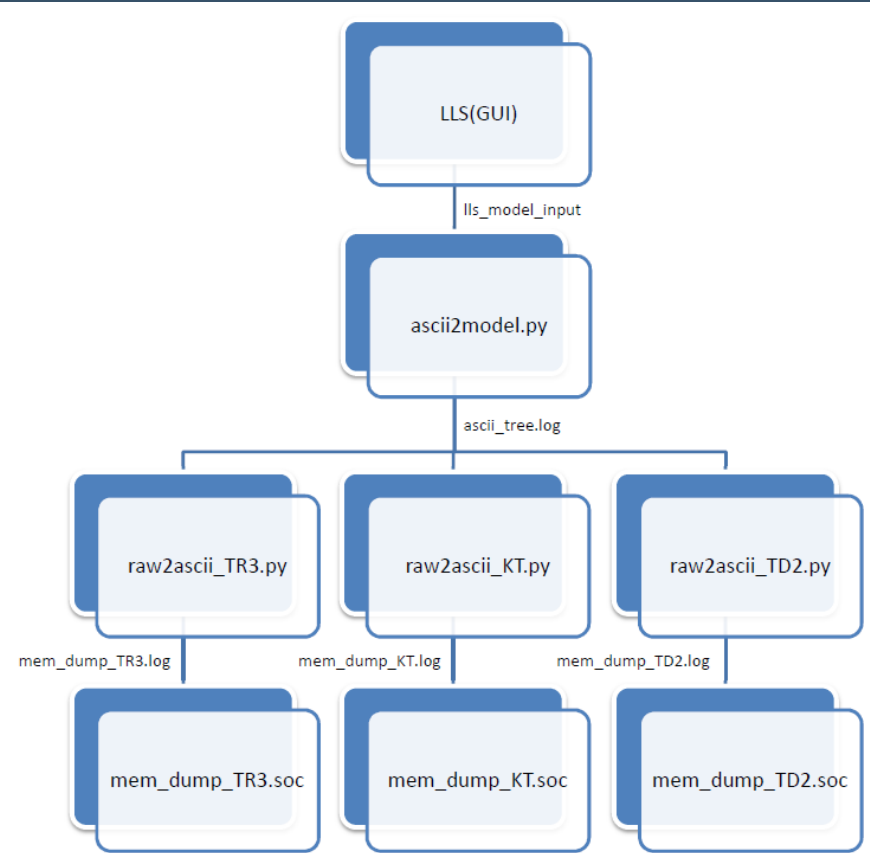


- What is LLS?
  - The Linked List Scheduler design operates as part of the larger MMU(Memory Management Unit) design that includes the Queuing and Payload Storage components.
  - is responsible for selecting which queue is next to transmit a packet within each port, applying strict priority, minimum guarantees, weighted fairness and max shaping scheduling policies.



- Modeling Of LLS
  - The LLS modeling exists to provide an easy path to visualize the settings of the LLS within all devices that contain the LLS (typically found inside the MMU of XGS devices when present).

- Theory Of Operation
  - mem\_dump
    - Collects the raw memory
  - Ascii\_tree
    - Convert into a human readable file
  - Tree to CSV
    - Convert into a machine readable file





# Linked List Scheduler(LLS)

- Demonstrations

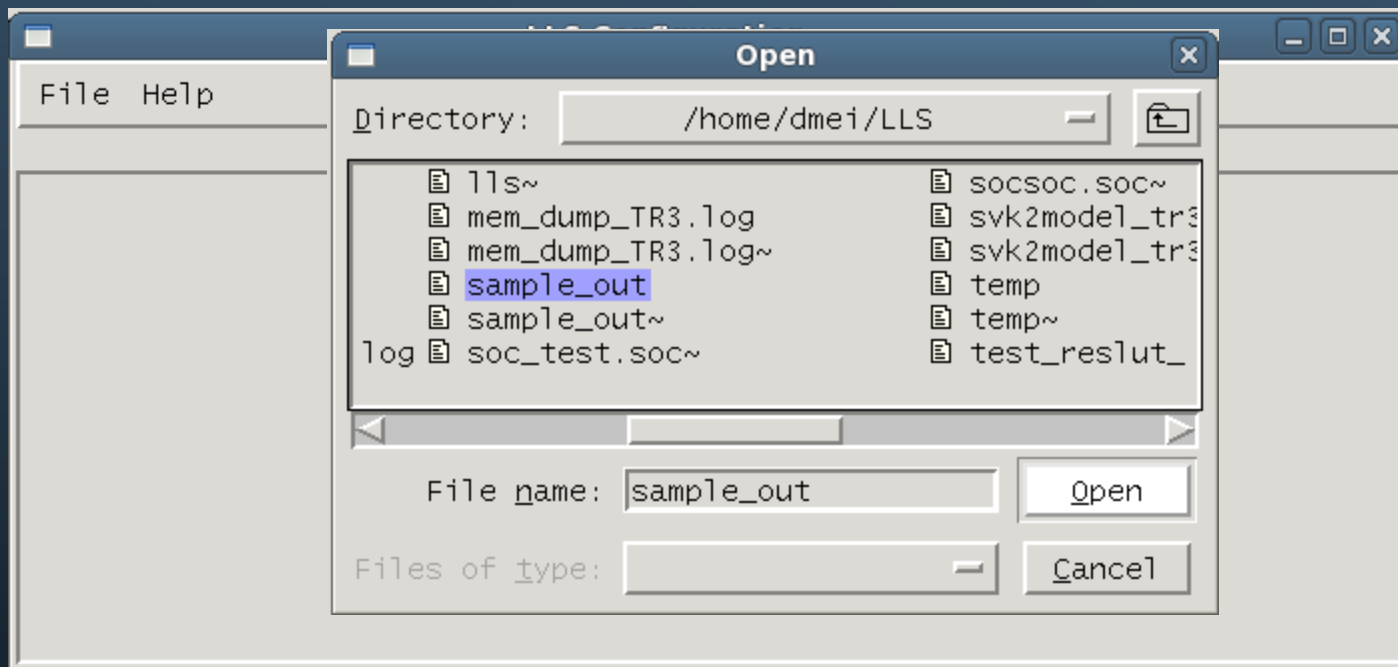
LLS Configuration

File Help

(Parent, Node)  Show:  Num  Min  Max  Wt/SP  In  Out  Drop

Level 1 Nodes						Level 0 Nodes											
in	Max	Wt/SP	In	Out	Drop	Num	Min	Max	Wt/SP	In	Out	Drop	Num	Min	Max	Wt/SP	In
480M	9.4480M	10				85	22.4960M	22.4960M	58				29				58
		50				86			55				30	150.0160M	150.0160M		3
520M	8.3520M	50				87	127.4880M	127.4880M	55				31				64
220M	1.3220M	62				88			8				32	150.0160M	150.0160M		21
600M	3.3600M	34				89			24				33	150.0160M	150.0160M		50
000M	14.4000M	16				90	127.4880M	127.4880M	7				34				54
680M	1.3680M	60				91			14				35				57
		31				92	22.4960M	22.4960M	4				36	150.0160M	150.0160M		36
0000K	714.0000K	56				93	15.0000M	15.0000M	38				37	150.0160M	150.0160M		23
540M	1.7540M	62				95			27				38				30
		51				96	135.0400M	135.0400M	13				39	150.0160M	150.0160M		64
0000K	904.0000K	28				97	225.0240M	225.0240M	27				40				3
0000K	764.0000K	47				98			51				41	150.0160M	150.0160M		64
000M	1.0000M	33				99	1.2749G	1.2749G	25				42				29
0000K	484.0000K	51				100			32				43	150.0160M	150.0160M		39
		37				101			32				44				53
520M	4.3520M	7				102	225.0240M	225.0240M	12				45				39
900M	3.4900M	26				103	1.2749G	1.2749G	45				46	150.0160M	150.0160M		7
		46				104			19				47	150.0160M	150.0160M		1
080M	4.9080M	51				105	1.2749G	1.2749G	11				48				9
		49				106			30				49	1.5002G	1.5002G		41
600M	22.5600M	48				107			13				50				11
480M	38.0480M	62				108	225.0240M	225.0240M	27				51	1.5002G	1.5002G		18
440M	54.1440M	37				109			46				52				13
900M	1.8900M	17				110	225.0240M	225.0240M	32				53				28
280M	9.5280M	24				111	1.2749G	1.2749G	33				54	1.5002G	1.5002G		9
400M	8.8400M	36				112			64				55	1.5002G	1.5002G		60
		6				93			59				56				6
460M	3.7460M					9999							9999				

- Bringing Up the GUI



- Navigate the Tree

LLS Configuration

File Help

Sort order: (Parent, Node) Show:  Num  Min  Max  Wt/SP  In  Out  Drop

**Queues**

NODE CONFIG						
Num	Min	Max	Wt/SP	In	Out	Drop
272	1.2060M	1.2060M	37	10.0000M	1.2060M	8.7940M
273			53	10.0000M	10.0000M	
274	1.5620M	1.5620M	55	10.0000M	1.5620M	8.4380M
275	606.0000K	606.0000K	43	10.0000M	606.0000K	9.3940M
276	8.1920M	8.1920M	6	10.0000M	8.1920M	1.8080M
277	6.8640M	6.8640M	4	10.0000M	6.8640M	3.1360M
278	4.1240M	4.1240M	28	10.0000M	4.1240M	5.8760M
279			23	10.0000M	10.0000M	
56	1.7140M	1.7140M				
57			50			
58	2.4740M	2.4740M	33			
59	96.0000K	96.0000K	37			
60	9.7120M	9.7120M				
61	7.5280M	7.5280M	59			
62	7.0440M	7.0440M	50			
63			20			
280	13.2880M	13.2880M				
281			57			
282	6.8960M	6.8960M	1			
283	13.0320M	13.0320M	61			
284	75.2640M	75.2640M				
285			37			
286	106.4960M	106.4960M	38			
287	6.4440M	6.4440M	19			
64			53			
65	1.2260M	1.2260M	41			
66	830.0000K	830.0000K	61			
67	1.3160M	1.3160M	58			
68	2.7040M	2.7040M	25			
69	8.1920M	8.1920M	62			

**Level 1 Nodes**

Num	Min	Max	Wt/SP	In	Out	Drop
3	22.4960M	22.4960M	44	13.3740M	13.3740M	
4			16	29.1800M	29.1800M	
5	17.1360M	17.1360M	16			
6			63			
7	132.8640M	132.8640M	6			
8			10			
9	22.4960M	22.4960M	23			
10			50			
11			37			
12	127.4880M	127.4880M	15			
13	127.4880M	127.4880M	30			
14			54			
15	22.4960M	22.4960M	18			
16			57			
17	22.4960M	22.4960M	28			
18			24			
19	127.4880M	127.4880M	44			
20			17			
21	22.4960M	22.4960M	32			
22			35			
23			58			
24	127.4880M	127.4880M	13			
25	127.4880M	127.4880M	15			
26			55			
27	22.4960M	22.4960M	33			
28			60			
29			26			
30	22.4960M	22.4960M	61			
31	127.4880M	127.4880M	29			
32			60			

**Level 0 Nodes**

Num	Min	Max
2	150.0160M	150.0160M
3	150.0160M	150.0160M
4		
5	150.0160M	150.0160M
6		
7		
8	150.0160M	150.0160M
9	150.0160M	150.0160M
10		
11	150.0160M	150.0160M
12		
13		
14	150.0160M	150.0160M
15	150.0160M	150.0160M
16		
17		
18	150.0160M	150.0160M
19		
20	150.0160M	150.0160M
21		
22	150.0160M	150.0160M
23		
24	150.0160M	150.0160M
25	150.0160M	150.0160M
26		
27	150.0160M	150.0160M
28		
29		
30	150.0160M	150.0160M
31		

- Error Check:

	Error Type	Note
1	Not Leading to an actual Port	Finished
2	EF and WERR cannot be configured at the same node	Finished
3	L2 nodes must be Strict Pri if marked as EF	Finished
4	In a group of queues that lead to I1, only one of the queues in the set is allowed to be EF	Finished

- Supported Device

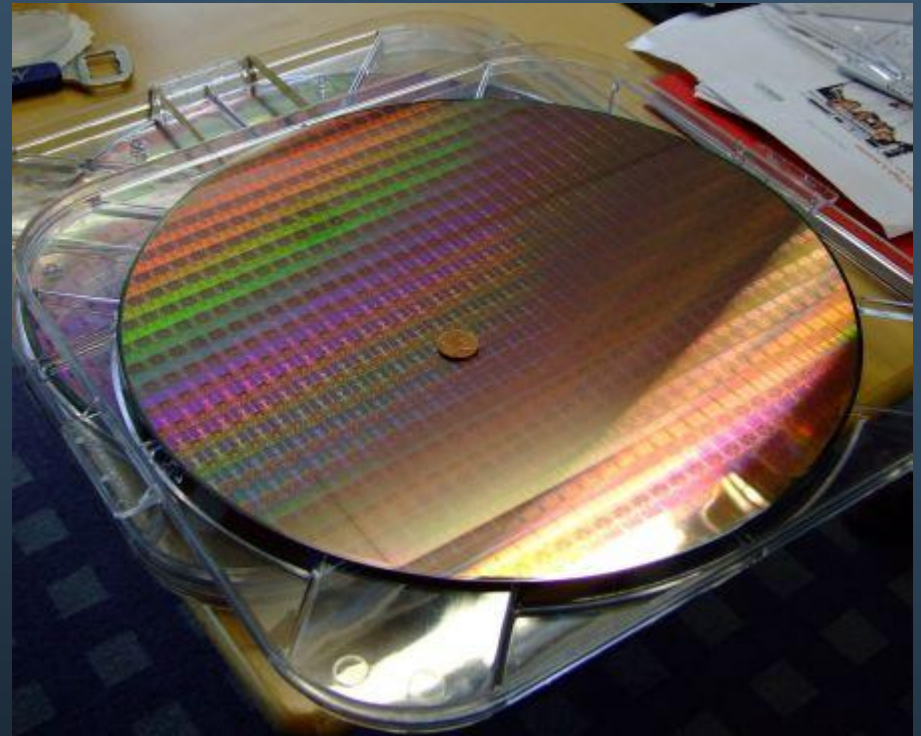
	Device name	Note
1	Triumph 3	Fully Supported
2	Katana	Fully Supported
3	Katana 2	Fully Supported
4	Trident 2	Started memory dump



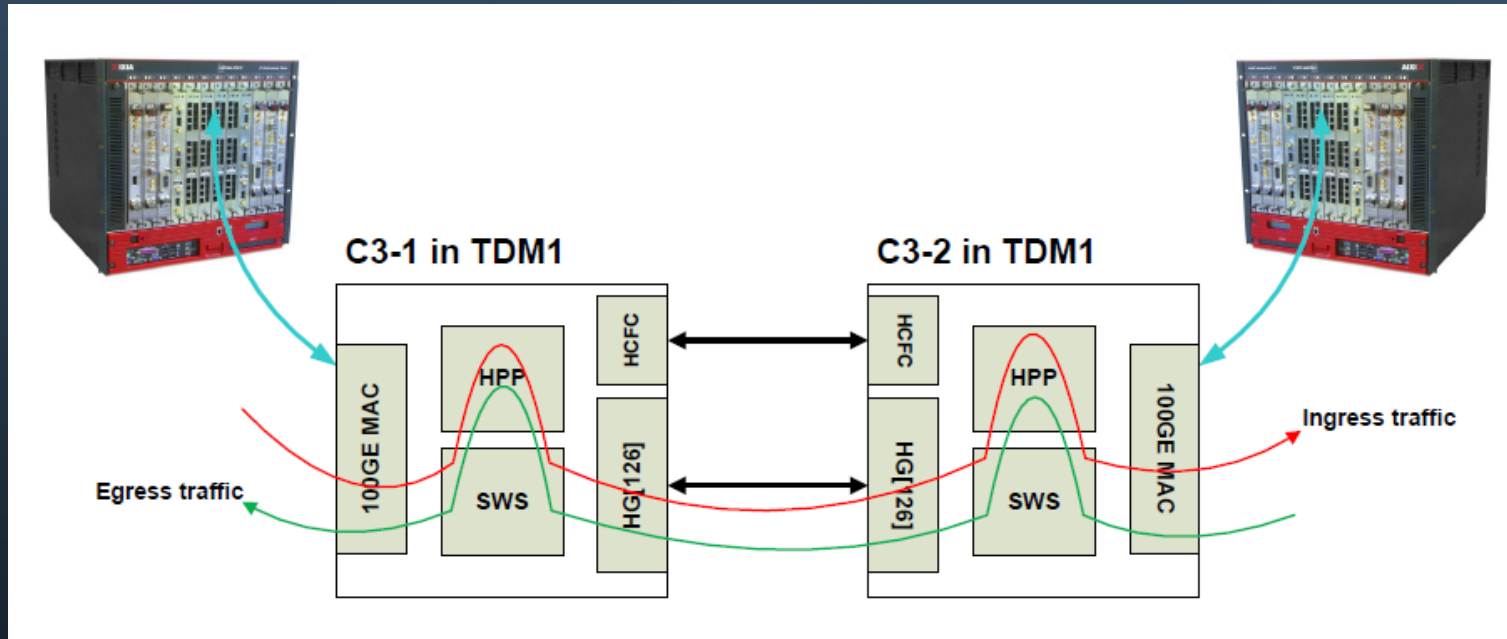
- Future Work
  - Allow the user to change the parameters and see impact on traffic
  - Reverse Function
  - Support more devices and scheduling features

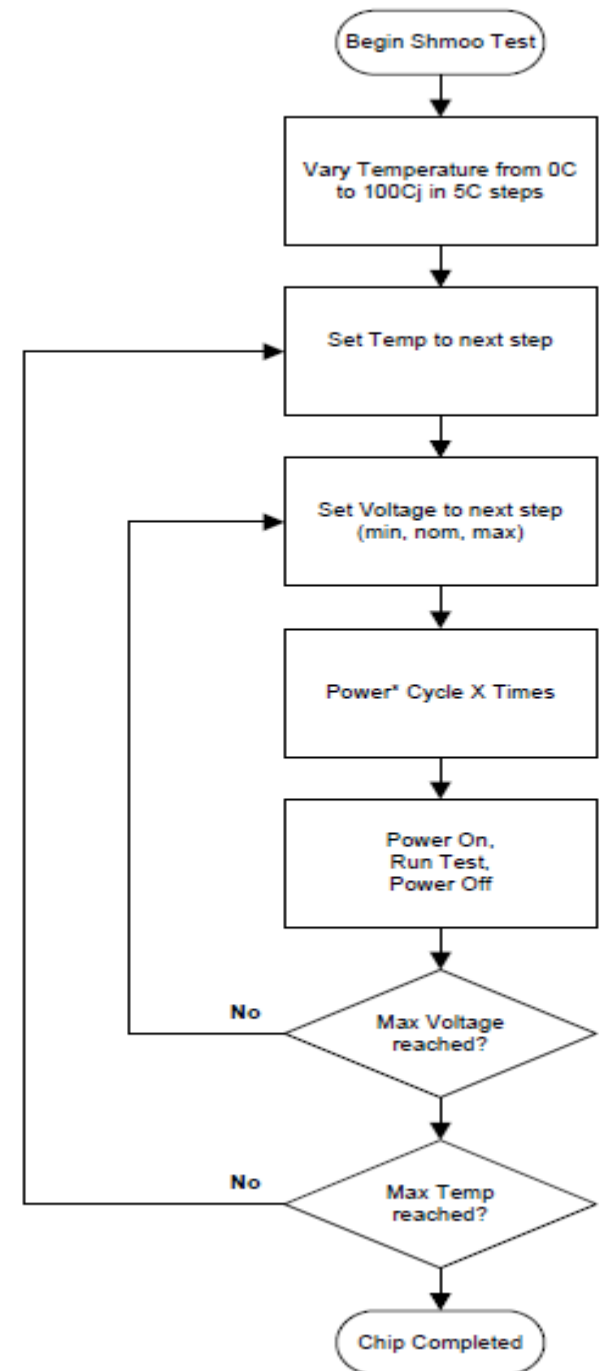
# Split Lot Test

- Background
  - Fabrication Parameters change during manufacturing
  - Corners: FF, FS, SF, SS, TT
  - Temperature:  $-40\text{ }^{\circ}\text{C}$  ~  $110\text{ }^{\circ}\text{C}$
  - Voltage:  $-3\%$  ~  $+3\%$



## Test Environment





- My contributions to the test
  - Executed 65% Split Lot tests
  - Developed a TCL script that automates the Thermo Stream
  - Developed a test case monitoring power consumption for FF parts in high Voltage
  - Maintained a database for test results



# Conclusion



- What was ultimately achieved for the sponsor?
  - A set of tools: feed in memory dump, gives out the graphic tree.
  - Currently EA1. Aimed to have a Release Version 1.0 by the end of this year
  - Targeted user: Application Engineers. Try to give to customers in the future



- What did I learn from the internship?
  - Programming language: Python, TCL, Perl
  - Unix - general operation
  - Perforce - source code control
  - Jira - issue tracking
  - Confluence - wiki

- How will the internship impact my academic learning at WPI?
  - Motivation
    - Better choice in course selecting, skill developing and tool set learning
  - Management
    - Balance life, work and study
  - Multi-skills
    - Programming language, communicational skills, problem solving



# Future

- How will the internship prepare me for my future career as an engineer?
  - Inspiration
    - Engineers are like designers
    - Design is Boundless
  - Co-operation
    - Being capable and willing to work with others
  - Education
    - Learning curve is steep

- What are my next steps?
  - A Future engineer
- Some of my thoughts...
  - Take advantage of our hallmark
    - Being proud of a WPI student
  - Research: Turn money into Technology /  
Innovation: Turn technology into money

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