



Internship Summary Presentation

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- **Introduction**
 - About Broadcom
 - Overview of the Internship
- **Linked List Scheduler(LLS) Modeling**
 - Background
 - Theory of Operation
 - Key Components
 - LLS Model GUI
 - Future work
- **Split Lot Test**
 - Background
 - Test Environment and Tools
- **My Role in the Project**
- **Conclusion**
 - What was achieved?
 - What did I learn?
 - Internship <-> school
- **Future**
 - As an engineer
 - My Plans
- **Reference**



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

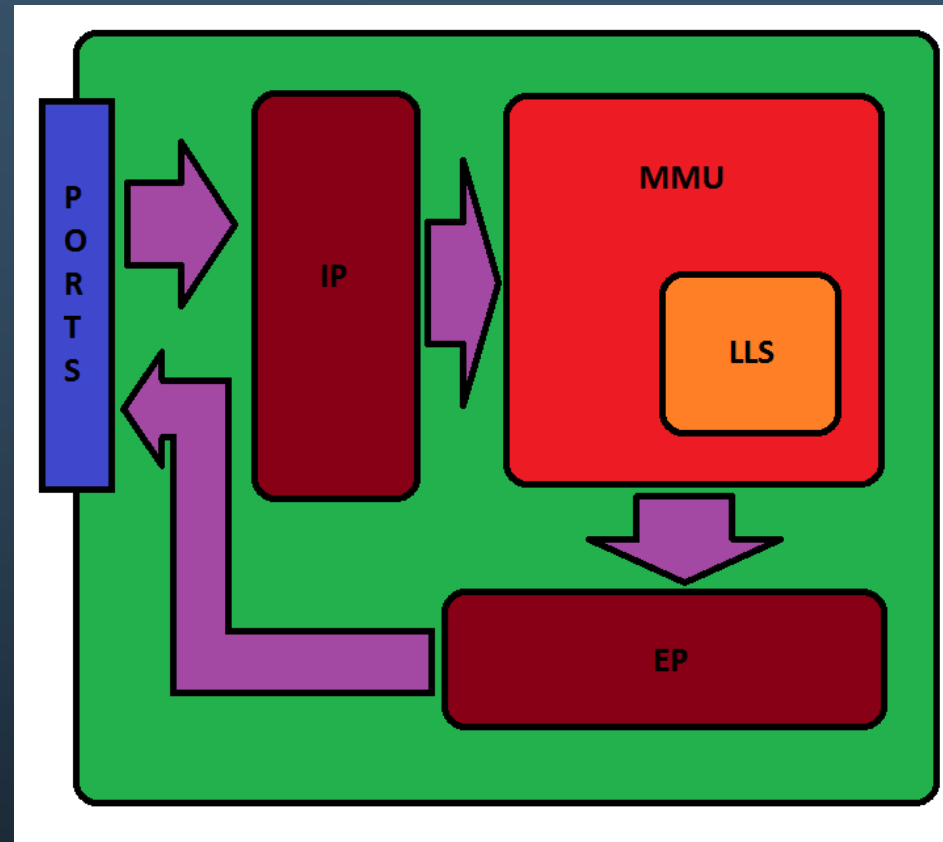


OVERVIEW OF THE INTERNSHIP

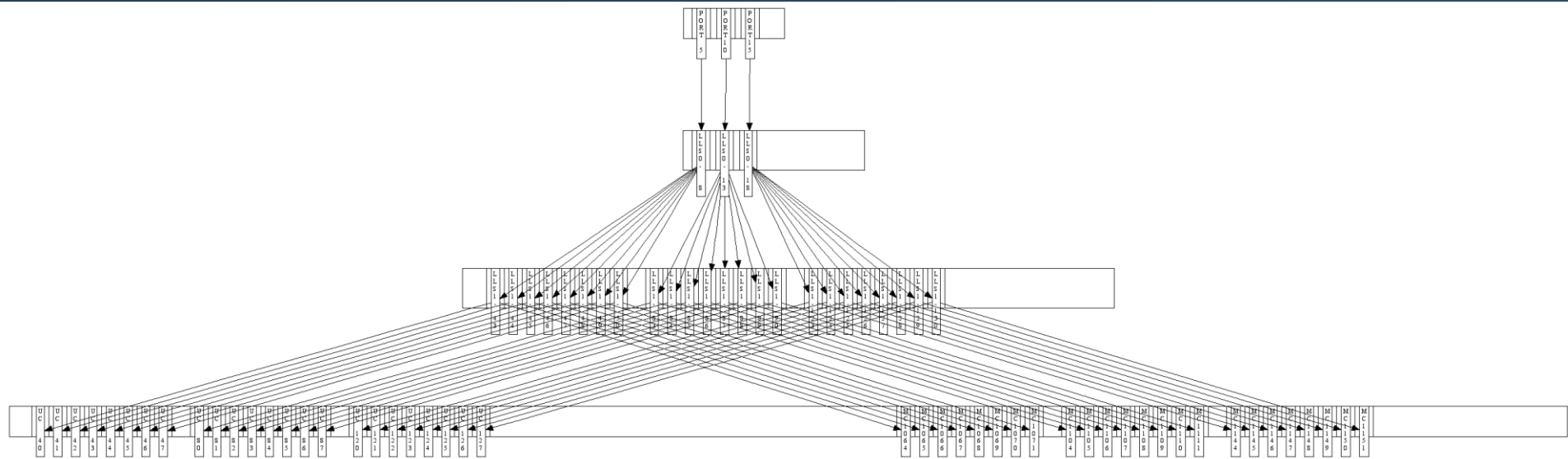
- BCM Andover Office (Infrastructure and Network Group)
- From Jul 23, 2012 to Dec 21, 2012
 - Summer: Full-time
 - Fall: Part-time
- Major 2 Projects:
 - Linked List Scheduler
 - Split Lot Test

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.

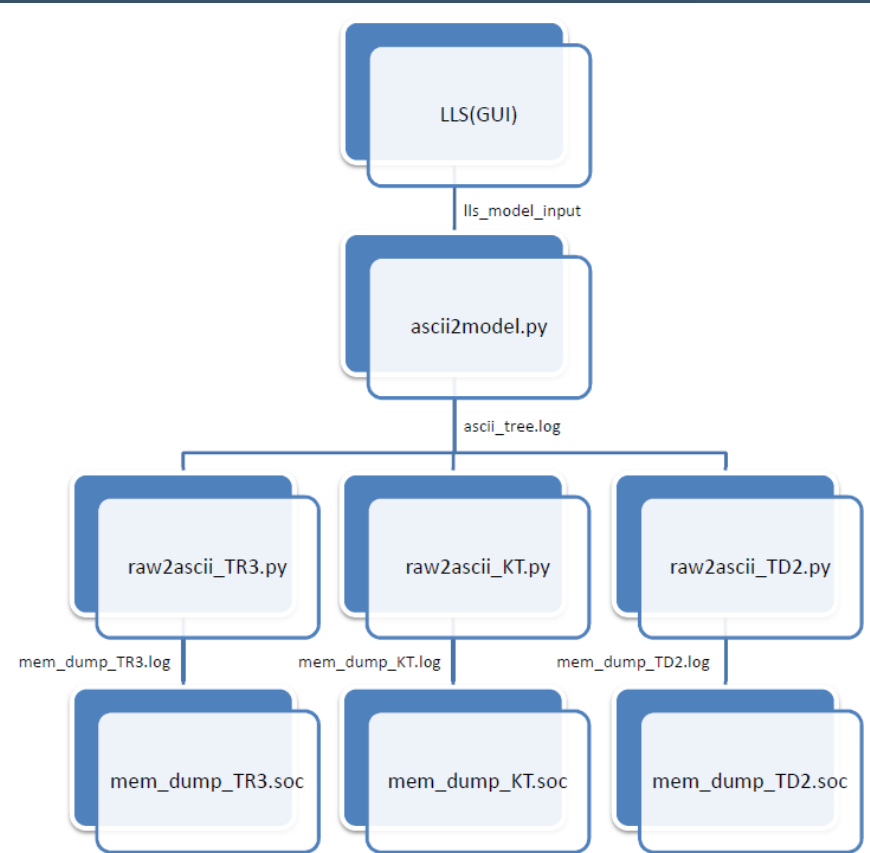


- What is LLS?
 - The Linked List Scheduler design operates as part of the larger MMU(Memory Management Unit) design that includes the Queuing and Payload Storage components.
 - is responsible for selecting which queue is next to transmit a packet within each port, applying strict priority, minimum guarantees,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

in	Max	Wt/SP	In	Out	Drop
480M	9.4480M	10			
		50			
520M	8.3520M	50			
220M	1.3220M	62			
600M	3.3600M	34			
000M	14.4000M	16			
680M	1.3680M	60			
		31			
0000K	714.0000K	56			
540M	1.7540M	62			
		51			
0000K	904.0000K	28			
0000K	764.0000K	47			
000M	1.0000M	33			
0000K	484.0000K	51			
		37			
520M	4.3520M	7			
900M	3.4900M	26			
080M	4.9080M	51			
		49			
600M	22.5600M	48			
480M	38.0480M	62			
440M	54.1440M	37			
900M	1.8900M	17			
280M	9.5280M	24			
400M	8.8400M	36			
		6			
460M	3.7460M				

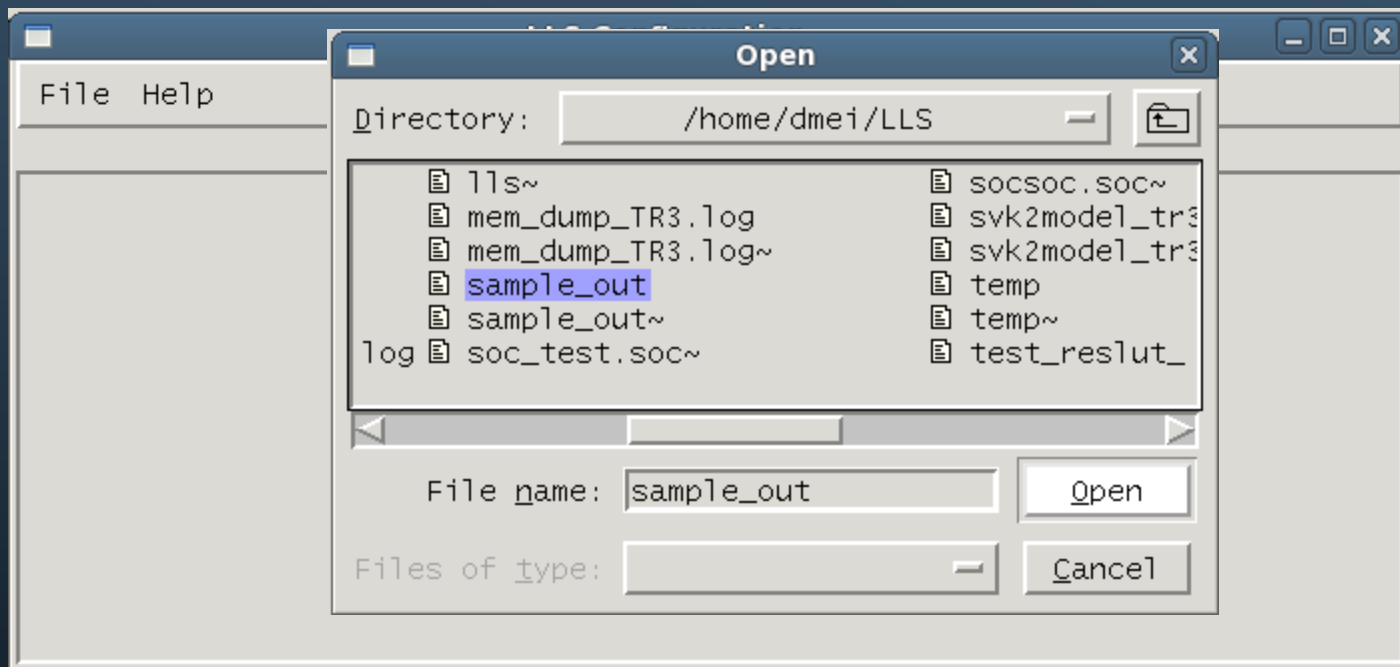
Level 1 Nodes

Num	Min	Max	Wt/SP	In	Out	Drop
85	22.4960M	22.4960M	58			
86			55			
87	127.4880M	127.4880M	55			
88			8			
89			24			
90	127.4880M	127.4880M	7			
91			14			
92	22.4960M	22.4960M	4			
93	15.0000M	15.0000M	38			
95			27			
96	135.0400M	135.0400M	13			
97	225.0240M	225.0240M	27			
98			51			
99	1.2749G	1.2749G	25			
100			32			
101			32			
102	225.0240M	225.0240M	12			
103	1.2749G	1.2749G	45			
104			19			
105	1.2749G	1.2749G	11			
106			30			
107			13			
108	225.0240M	225.0240M	27			
109			46			
110	225.0240M	225.0240M	32			
111	1.2749G	1.2749G	33			
112			64			
93			59			
9999						

Level 0 Nodes

Num	Min	Max	Wt/SP	In
29			58	
30	150.0160M	150.0160M	3	
31			64	
32	150.0160M	150.0160M	21	
33	150.0160M	150.0160M	50	
34			54	
35			57	
36	150.0160M	150.0160M	36	
37	150.0160M	150.0160M	23	
38			30	
39	150.0160M	150.0160M	64	
40			3	
41	150.0160M	150.0160M	64	
42			29	
43	150.0160M	150.0160M	39	
44			53	
45			39	
46	150.0160M	150.0160M	7	
47	150.0160M	150.0160M	1	
48			9	
49	1.5002G	1.5002G	41	
50			11	
51	1.5002G	1.5002G	18	
52			13	
53			28	
54	1.5002G	1.5002G	9	
55	1.5002G	1.5002G	60	
56			6	
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

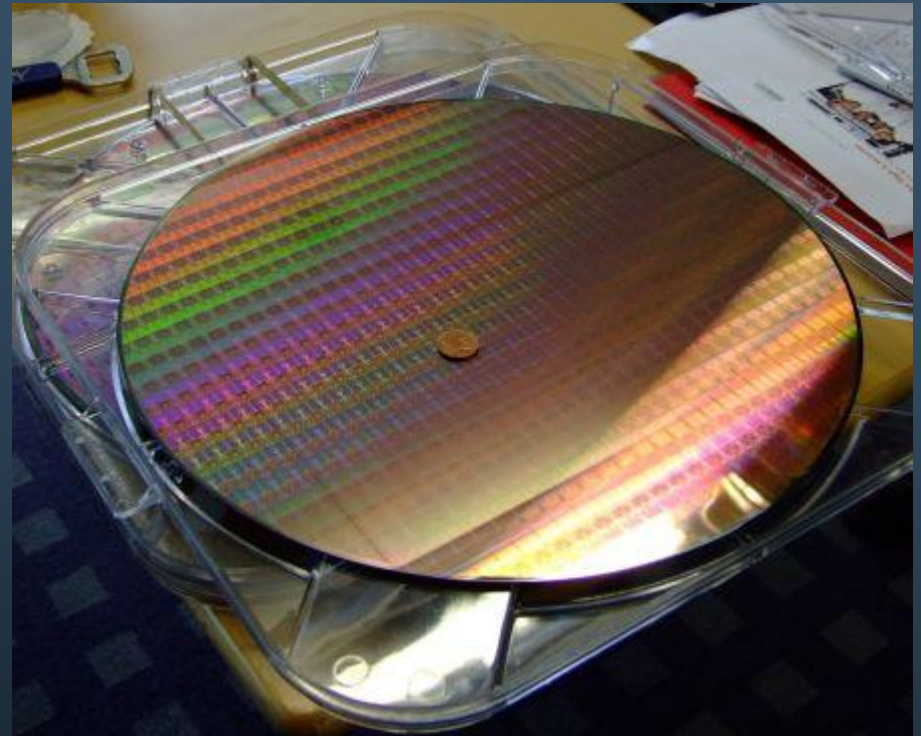
- Supported Device

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

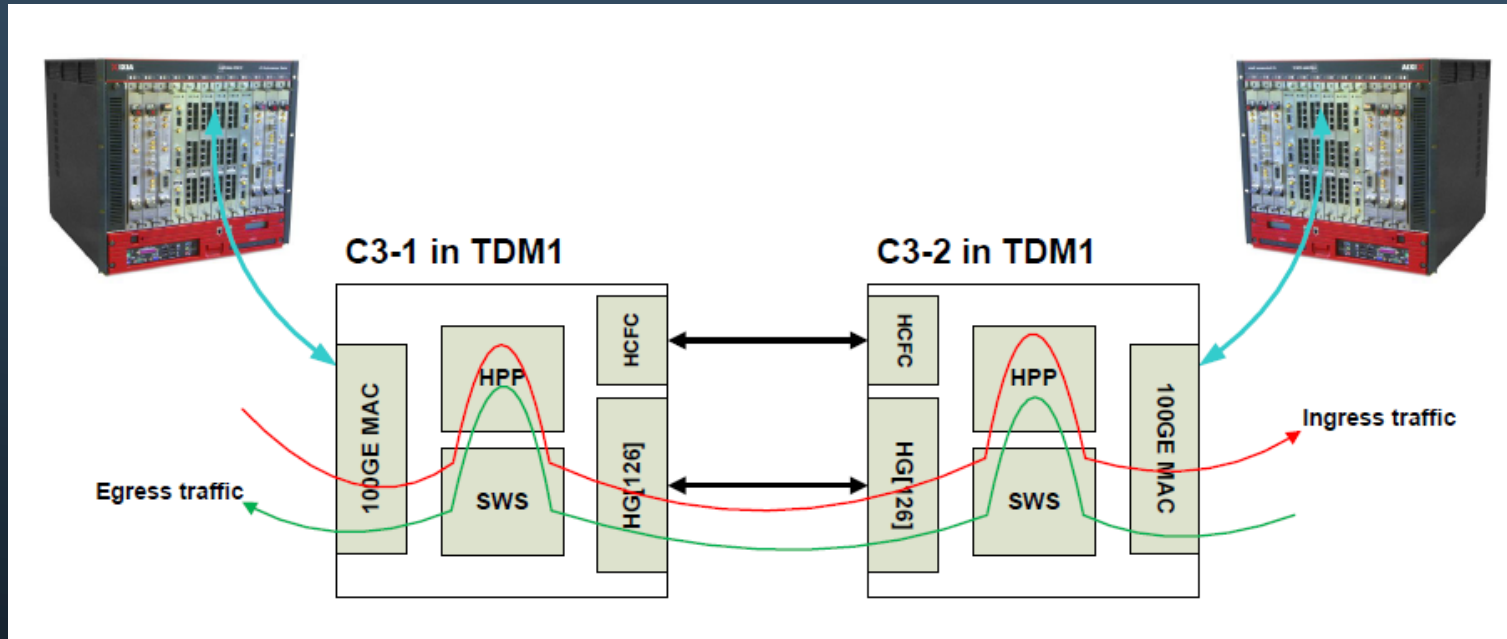
- Future Work
 - Allow the user to change the parameters and see impact on traffic
 - Reverse Function
 - Support more devices and scheduling features

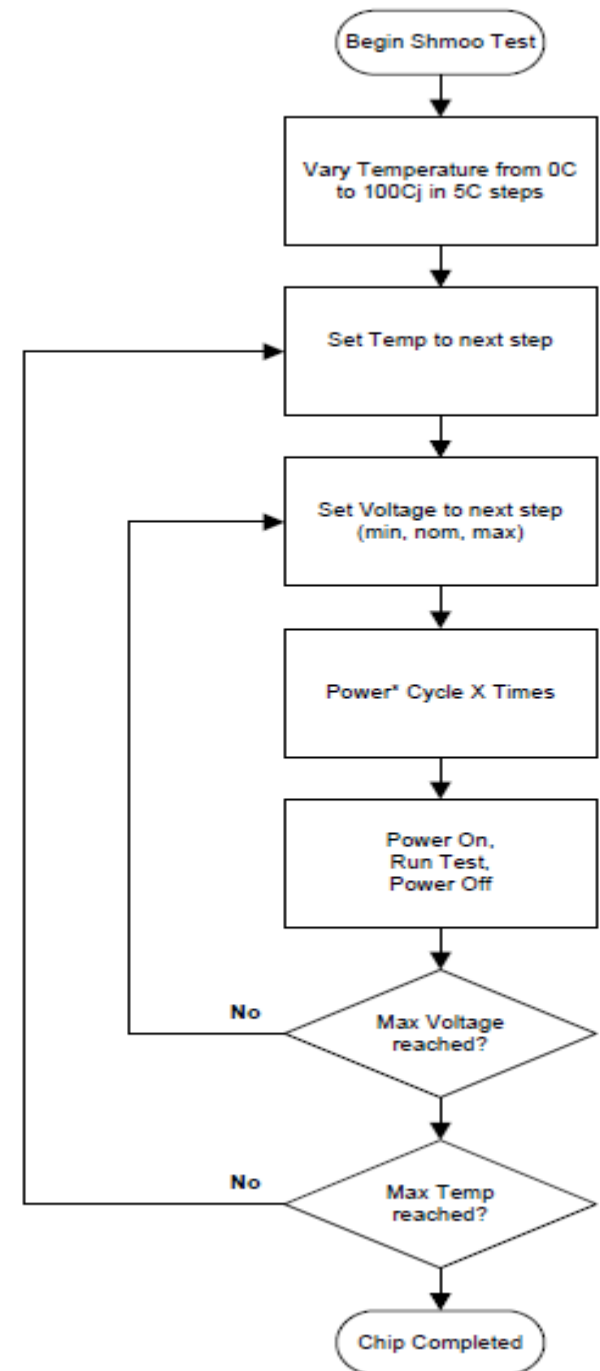
Split Lot Test

- 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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