


Long-Range GasP with Charge Relaxation


Swetha Mettala Gilla
Marly Roncken
Ivan Sutherland

Asynchronous Research Center
Maseeh College of Engineering and Computer Science

 Portland State
UNIVERSITY

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Photo: "TECOTOSH" - Maseeh College (Ed. Carpenter, March, 2006)



Title: TECOTOSH
T_{ension} + C_{ompression} + T_{orsion} + S_{hear}

Location: Maseeh College
Installed: March 2006.
Dimensions: 130' x 40' x 40'.
Materials: Stainless steel truss, laminated dichroic glass, stainless steel cables and hardware. Aluminum light housings.

Engineers:
Bob Grummel and Grant Davis.
Project Manager: Oanh Tran.

Introduction

2008 Infinity chip (90nm CMOS by TSMC):

- 10% degradation of peak throughput
- for 5000 versus 500 lambda long interconnect
 - $\lambda = 50 \text{ nm}$
 - and so: $5000 \lambda = 0.25 \text{ mm}$

First wire delay study (Prasad Joshi – USC):

- Logical Effort + Lumped Capacitance model
- confirms measured observations
- inadequate for wires above 5000 lambda

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Introduction (2)

Second wire delay study (Swetha – PSU):

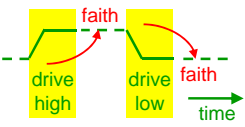
- uses Distributed RC model for interconnect
- distinguishes voltage levels at both wire ends

Distinguishing both wire ends matters!

- The two ends play a different role in single-track handshake signaling
 - **NEAR-END: starts and stops the forward drive**
 - **FAR-END: starts and stops the reverse drive**
- True for ALL single-track signaling methods

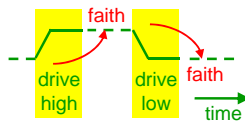

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Introduction (3): Faith versus Measurement

Single-Track Handshake	Multi-Track Handshake
<ul style="list-style-type: none"> • Wires are driven briefly • Changes are triggered by the response at the "near-end" 	
uses FAITH in engineering and tools	

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Introduction (3): Faith versus Measurement

Single-Track Handshake	Multi-Track Handshake
<ul style="list-style-type: none"> • Wires are driven briefly • Changes are triggered by the response at the "near-end" 	<ul style="list-style-type: none"> • Wires are driven at all times • Changes occur after receiving response on the reverse wire 
uses FAITH in engineering and tools	uses MEASUREMENT built into the design

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Introduction (4) Putting Things in Perspective

FAITH versus MEASUREMENT is everywhere

- Designs usually have a bit of both
 - Examples of Faith: isochronic fork, bundled-data
 - Examples of Measurement: 1-of-N data

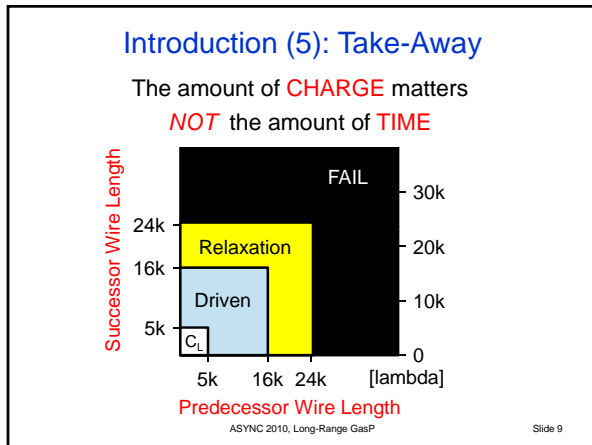
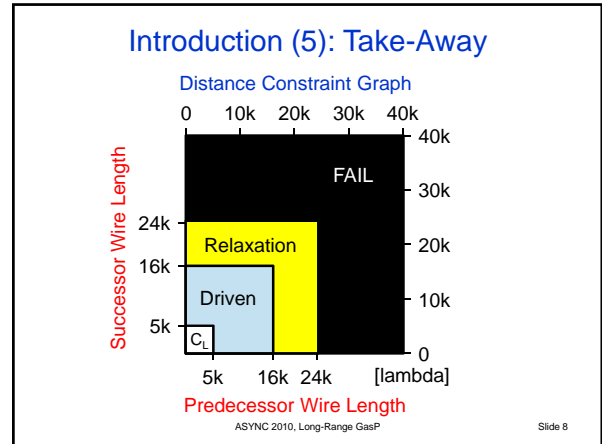
Our Goal:

- Test the limits of FAITH in single-track handshaking

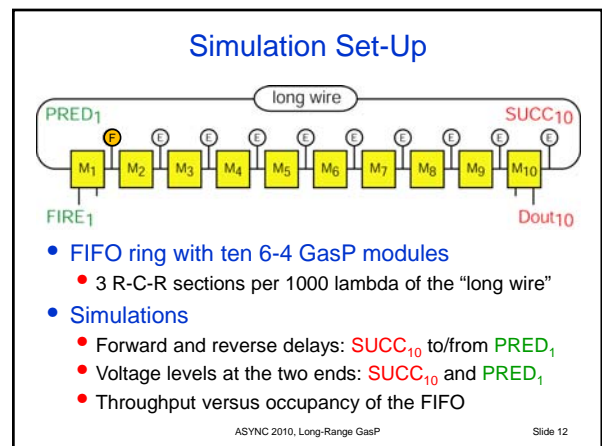
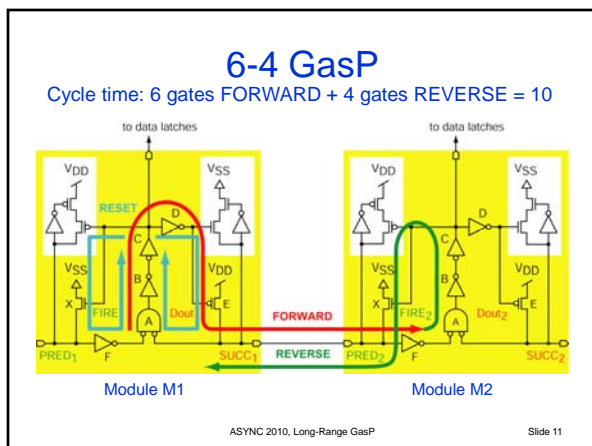
Scope:

- GasP is the study target
- But the results apply also to other single-track families

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- ### Outline
- GasP design
 - Simulation Experiments
 - Set-up
 - Delay-Voltage waveforms
 - Throughput results
 - Wire engineering
 - Summary
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Voltage and Delay Waveforms

Reminder:

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Voltage and Delay Waveforms

Reminder:

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Voltage and Delay Waveforms

Reminder:

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Throughput

100% Throughput = 4.2 GDI/sec in 90nm CMOS by TSMC
Long wires impose a BIG COST on throughput

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Wire Engineering

Wires are NOT FLAT – they're TALL + SKINNY

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Summary

Take-Away:

- GasP will work with very long single-track wires
 - It's CHARGE that matters, NOT TIME
 - Long wires impose a BIG COST on throughput
 - Plenty of margin to trade off length versus throughput
- True as well for ALL other single-track design

Implication:

- ENGINEER long single-track wires

PHIR MILENGE !

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AU REVOIR !

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