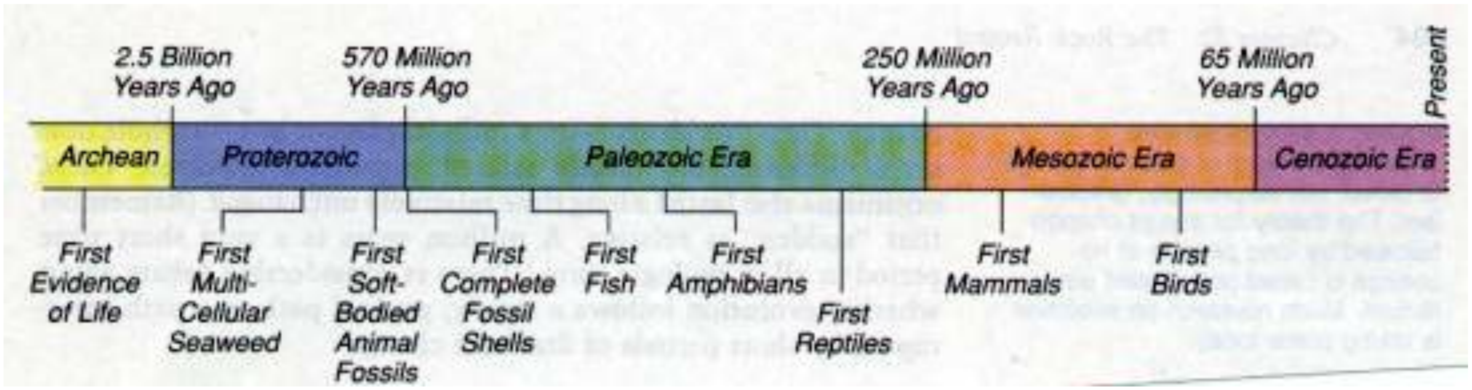
Unleashing software developers

May 2013

A call to action



- 25 years is too long to wait for
  - "Reasonable" FPGA development tools
  - "Powerful" FPGA development tools
  - Tools that enable reconfiguration and highly parallel designs usable by all developers

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Convergence

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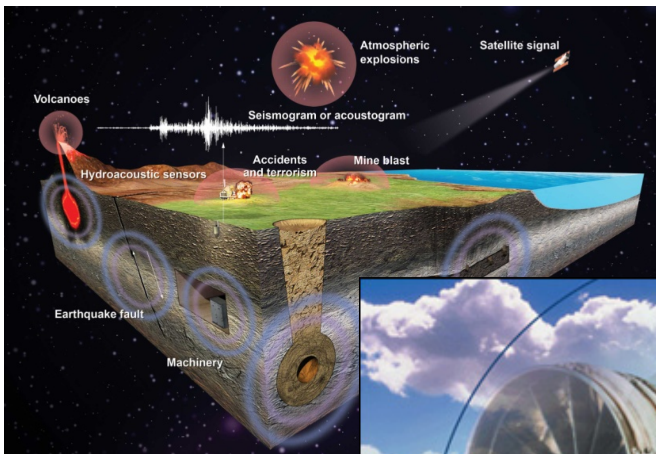
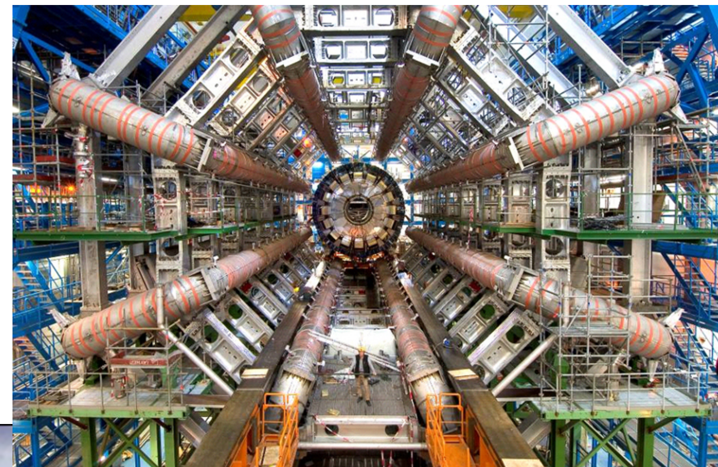
Operational Technology

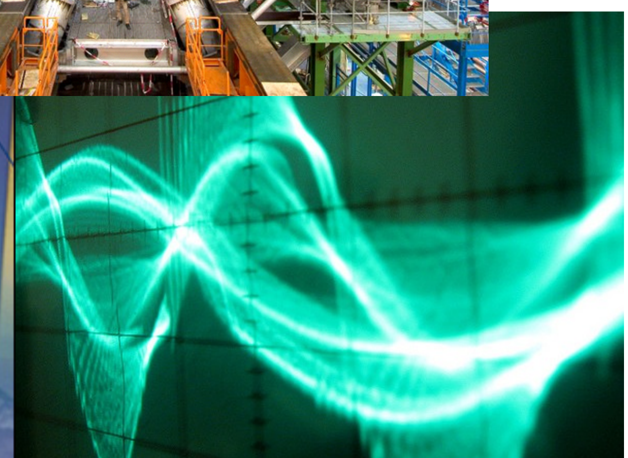
Operational Technology: Capture data in real time





CERN Hadron Collider
40TB in 1 sec.

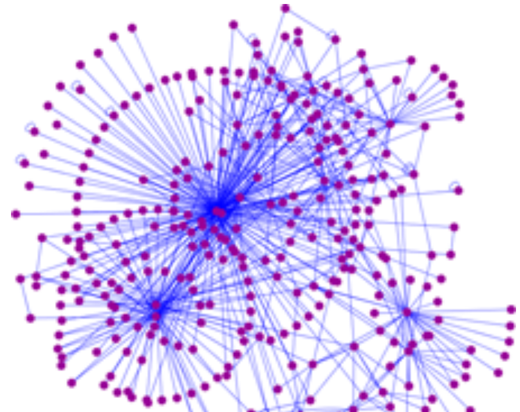
40TB in 2 hrs *
engines/plane *
27,000 flights/day

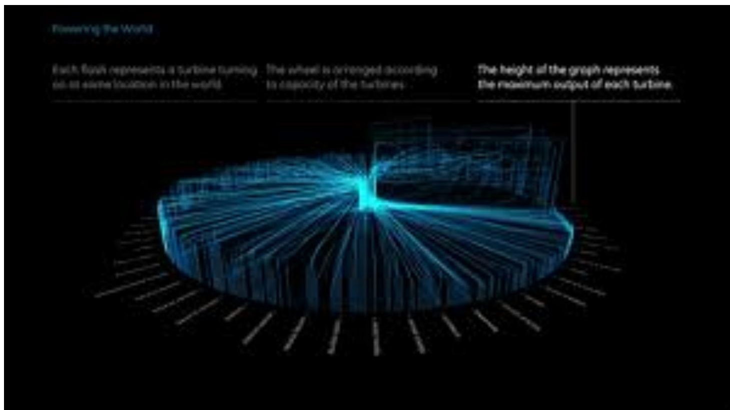


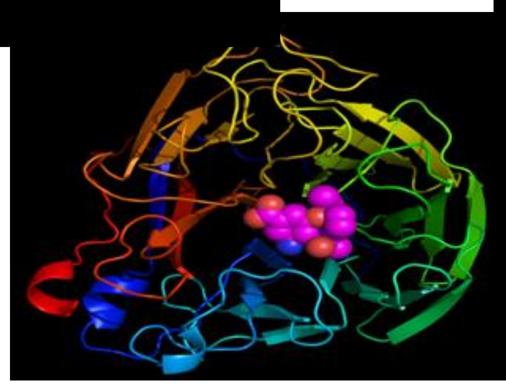
Unstructured data is so voluminous and fast it requires eHPC computing <u>at the edge</u>

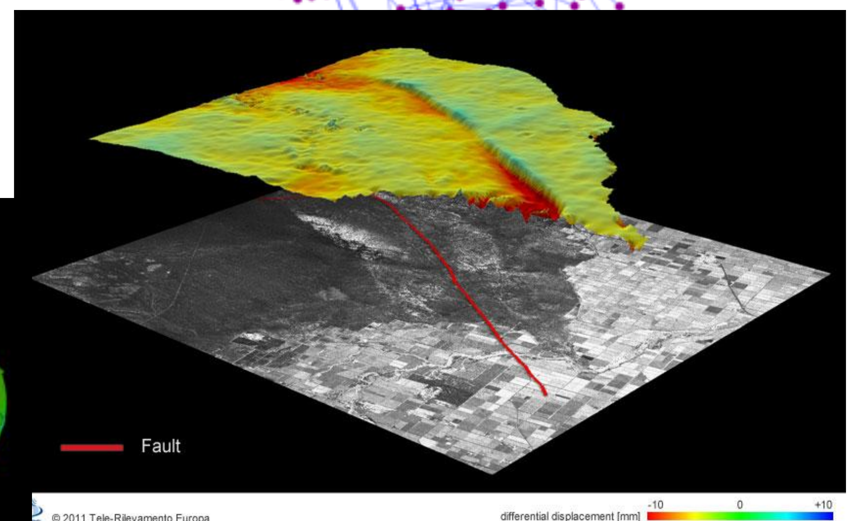
Information Technology

Informational Technology:
Turn that data into useful information





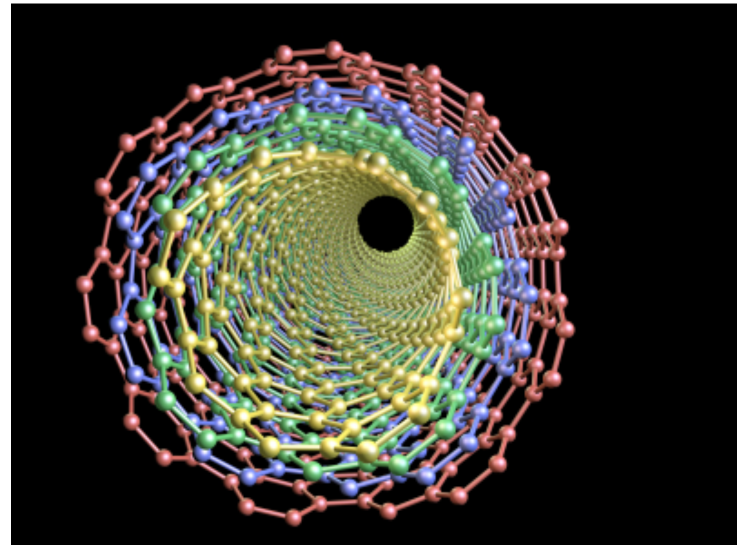




Complex data sets require HPC for information development

Business Technology

Business Technology:
Turn that information into reduced cost



Use HPC because - Time is Money

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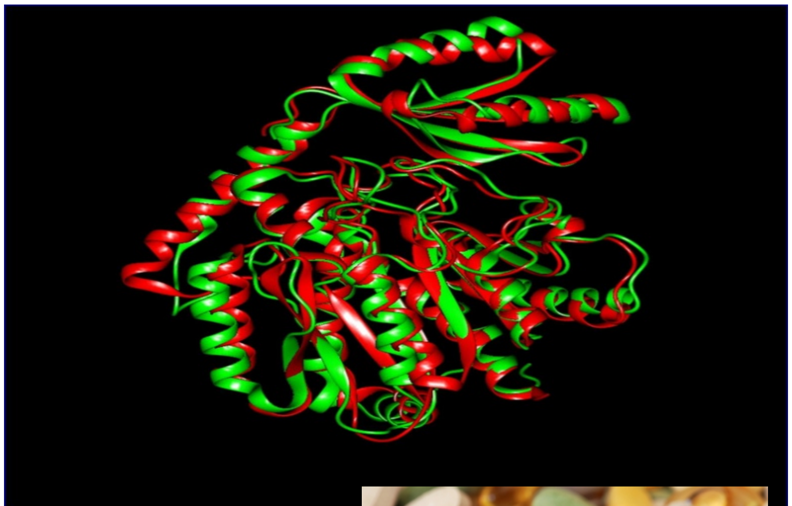
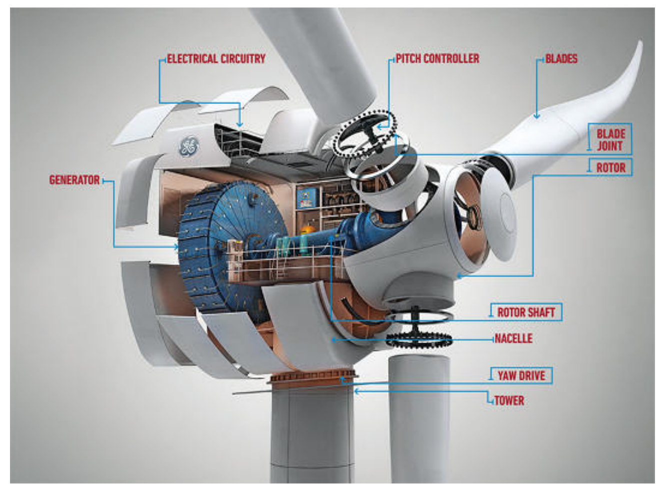
Business Technology

Business Technology:
Turn that information into less risk

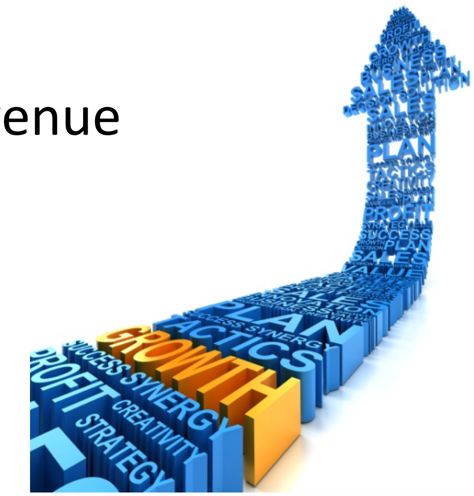




Use HPC because - Knowledge is Power

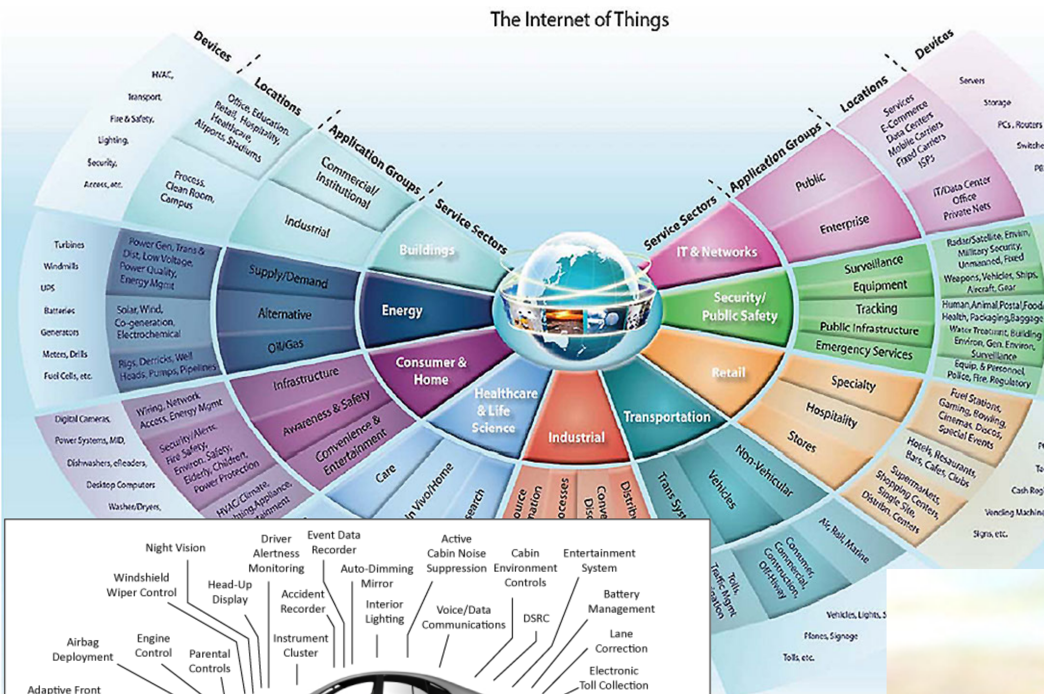
Business Technology

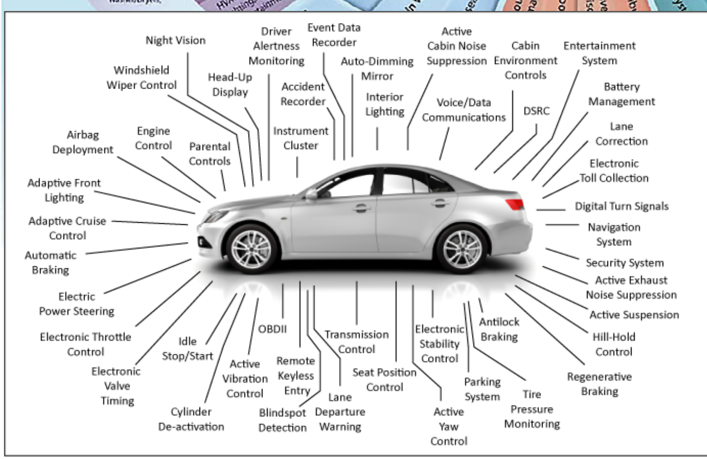
Business Technology:
Turn that information into revenue

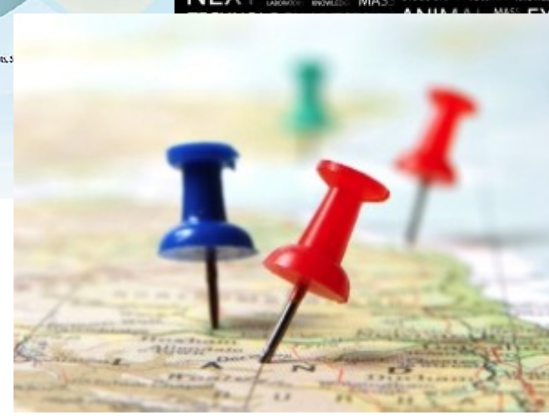


Use HPC because – Revenue drives everything

Inflection Point: Parallel Needs Across Markets







Pretty Pictures, Nice Story, But…

The real world comes with real problems

There is just way too much data – to collect

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A world of scale

- Billions
  - People
  - Internet of things
  - IC devices
- Peta-scale computing
- Peta-scale storage
- Sensors collecting in real-time a data flood

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Reconfigurable computing is missing

- From the real world
- From real problems and applications
- But the real world needs what it enables
  - Powerful computation
  - Efficiency
  - Robustness
  - Innovation

Today's barriers

- Tools
- Device capabilities
- Accessibility
- Software engineering role
- Compute models

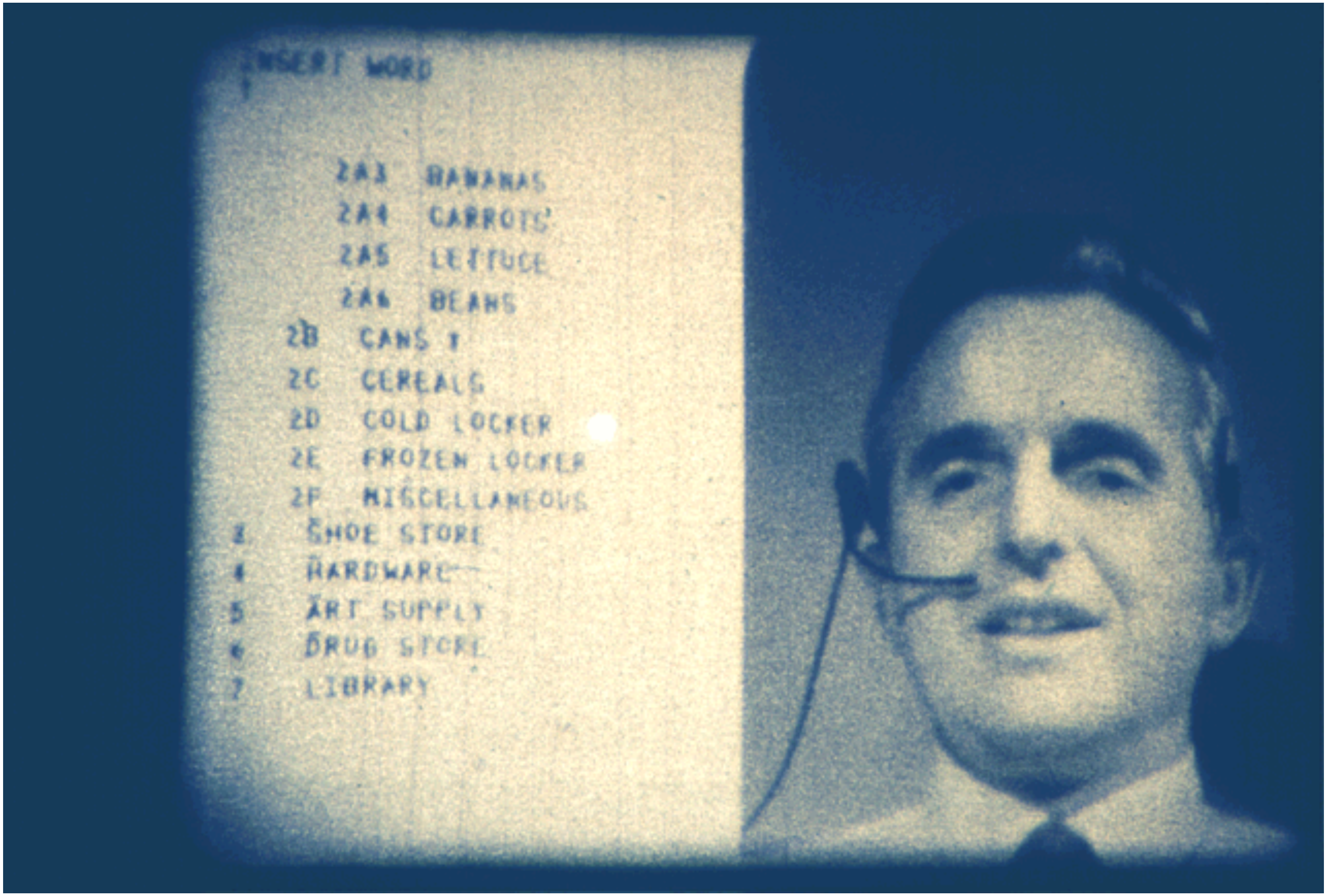
Today's Reconfigurable tools are too hard

- Fragmented into many tools
- File formats differ
- Binaries differ
- Hardware centric
- Lack cohesive computing model
- Difficult to discover
- Learn and use
- Incomplete

SW Developers to unleash

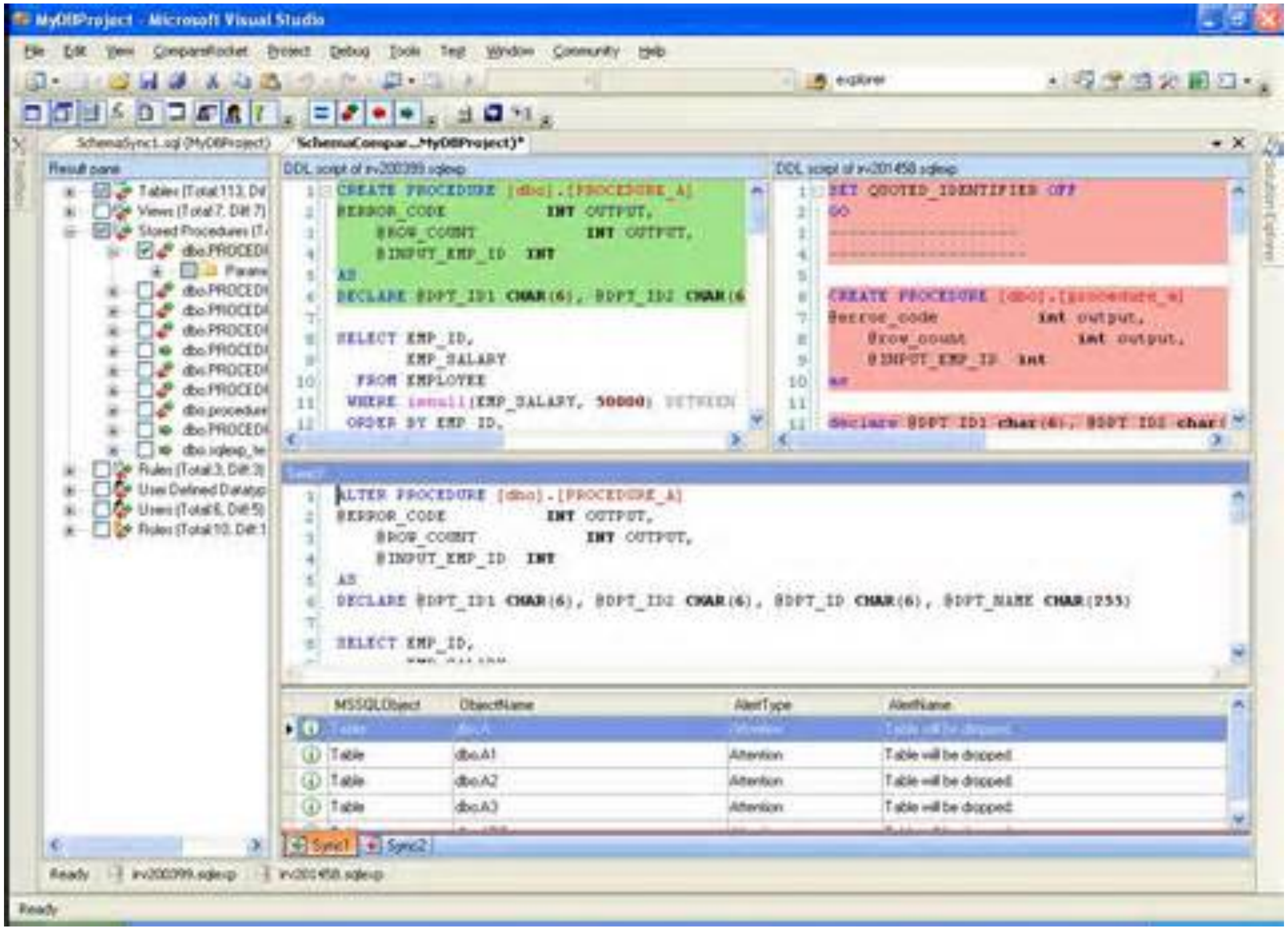
- More SW developers then HW developers
  - More then 100:1 difference
- SW drives most real world applications
  - Platforms
  - Adoption rates
  - Utility
  - Retention of users
- SW applications dominate
  - Think App stores


Think
BIG


INSERT WORD
2A3 BANANAS
2A4 CARROTS
2A5 LETTUCE
2A6 BEANS
2B CANS
2C CEREALS
2D COLD LOCKER
2E FROZEN LOCKER
2F MISCELLANEOUS
3 SHOE STORE
4 HARDWARE
5 ART SUPPLY
6 DRUG STORE
7 LIBRARY

Doug Engelbart

- SRI demo 1968
  - Interactive computing
  - Distributed computing
  - Real-time editing
  - Cut and paste
  - Mouse and chord to extend keyboard
  - Live multi-city video conferencing
  - Broadband


MyDBProject - Microsoft Visual Studio
File Edit View CompareRocket Project Debug Tools Test Window Community Help
Result pane
DDL script of rv200399.sqleep
DDL script of rv201458.sqleep
CREATE PROCEDURE [dbo].[PROCEDURE_A]
SET QUOTED_IDENTIFIER OFF
ALTER PROCEDURE [dbo].[PROCEDURE_A]
MSSQLObject
ObjectName
AlertType
AlertName
Table
dbo.A1
Attention
Table will be dropped
Sync1
Sync2
Ready

Andrew Singer

- THINK Pascal - 1986
  - First tool for Mac developers
  - Integrated Development Environment
  - Instantaneous compile (< 30 seconds)
  - Automated MAKE system
  - Debugging integrated with Development
    - Active debugging, trace, stop points, dynamic variables
  - Copied by all following GUI SW platforms
    - Apple, Microsoft, SUN, Eclipse, Google

What is powerful

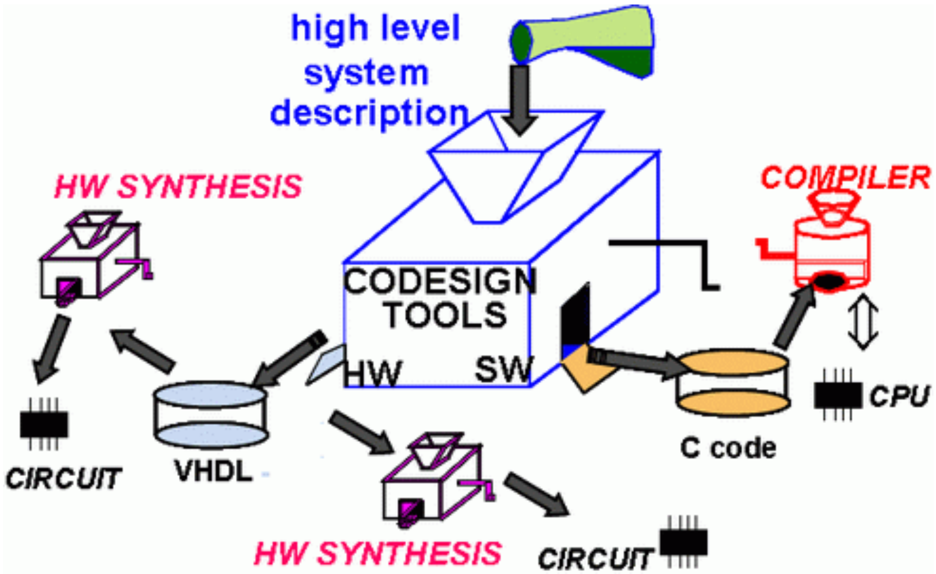
- Accelerate the ability to move from idea to implementation
  - Example Internet startup versus Hardware startup
- Allow all designs to scale across multiple devices and vendor devices
- Enable the developer to focus on the design not the implementation
- Enable true re-use (module, core, and app)

What is reasonable

- Tools that remove the burden from the developer of endless details
  - Timing closure
  - Area planning
  - Speed grade choice
- Fast compile
  - PAR in minutes
- Enable reconfiguration

Real world design

- Algorithm tools
  - MathWorks, Mathematica, Simulink, paper, spreadsheet, or drawing
- Hardware tools
- Software tools
- Complex environment
- Difficult verification
- Changes difficult
- Time Consuming
- Design limiting



Seeking One design environment

- HW and SW Unified flow
- Common code base
- Migrate from HW to SW with ease
- Migrate across device types with ease
- Reuse across device generations
- Unified verification and test
- Enable accelerate design discovery and implementation

Natural computing

- Emulates the biological world
- Change is embraced and used
- Diverse set of compute elements
- Simple and repeatable across system
- Scales from one to million
- Design reuse

Support Reconfigurable Categories

- Dynamic Reconfiguration
- Active Dynamic Reconfiguration
- Cooperating Dynamic Reconfiguration
- Evolvable Reconfiguration
- Cognitively Evolvable Reconfiguration

Dynamic Reconfiguration

- Runtime Dynamic
  - Time and space domains
- Function level
  - Data driven
  - Event driven
  - Function level granularity
- High burden on designer/architect
  - Limited real world use without effective tools

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Active Dynamic

- Across device boundaries
- Higher then function level
  - Modules, libraries, units
  - Can re-locate across devices
- Across system boundaries
  - Internet of Things
- Multiple actors initiate change
  - Events, time, data, device
- Enables robustness
  - Health monitors relocate prior to failure

Cooperating Dynamic

- Application level
  - Changes as Application sets change
  - Change as System environments change
- User driven actions
  - Initiate changes
  - Anticipate changes
  - Adapt to User patterns and modes

Evolvable

- Building blocks
  - Regular, repeating, simple, extendable
- Mutating
  - Introduces random change, chance and environmental activated
- Competing changes
- Survival of fittest
  - Evolve at design stage
  - Evolve in-situ

Cognitively Evolvable

- AI or Machine learning coupled
- Evolutionary monitor
  - Mange in-situ changes
  - Learning
  - Threshold monitors
  - Fitness monitors
  - System monitors

Summary

- Make this leap to enable SW developers
- Make this leap to enable all these modes of reconfigurable
- Then Reconfigurable moves into the mainstream
- And then we will see something that will amaze us all

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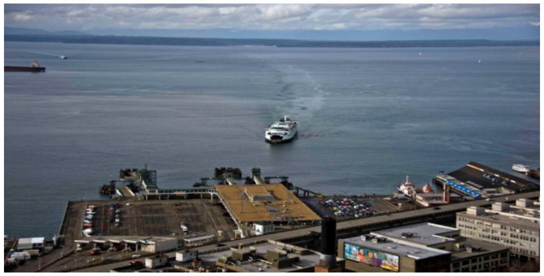

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