Microsoft

EXTREME COMPUTING GROUP

Defining the future.

Exascale Challenges

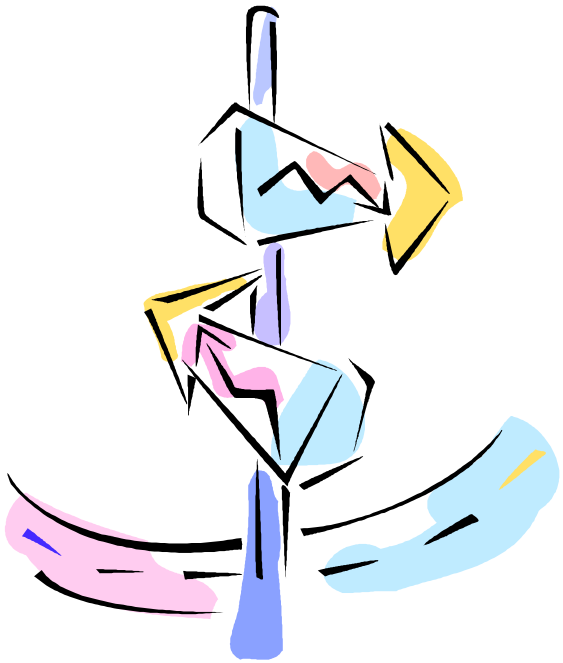
Dan Reed
Corporate Vice President
Extreme Computing Group &
Technology Strategy and Policy

reed@microsoft.com

www.hpcdan.org

Roadmap For The Next 20 Minutes

- The challenges of exascale … technical, geopolitical and social
- Technology inflection points … define our design points
- Open source implications …. and the inflection points
- Microsoft technical computing … investments, activities and models



Exascale Challenges

- Recognizing the ecosystem revolution
  - Punctuated change is happening *now*
- Choosing the right bounding boxes
  - Optimizing the important, not the familiar
- Embracing appropriate cost models
  - OPEX really matters (particularly power)
- Changing the infrastructure culture
  - When discovery is the true goal
- All the usual computing ones
  - Programmability, parallelism, resilience

Disruptive Technologies, Trends and Implications

Computing Consumerization
Many device world

Natural User Interfaces
Moving beyond GUIs

The Internet of Things (IoT)
Computing everywhere

Holistic Design
Rapidly evolving experiences

Milliwatts Matter
Not Megahertz

Software Services
COGS matter

Moore's Law
Multicore parallelism

Privacy and Security
Social norms, technical capabilities

Large Scale Data and Context

Computers Mediate Interactions With People and Data

Inventory remaining:
22 pints

Price reduction:
$2.99/pint thru Fri

New supplier added:
World Wide Importers

Low temps affecting
crop yield in Mexico

Update:
Customer loyalty program

Calories in whole
strawberries, per cup: 46

Customer review:
★★★

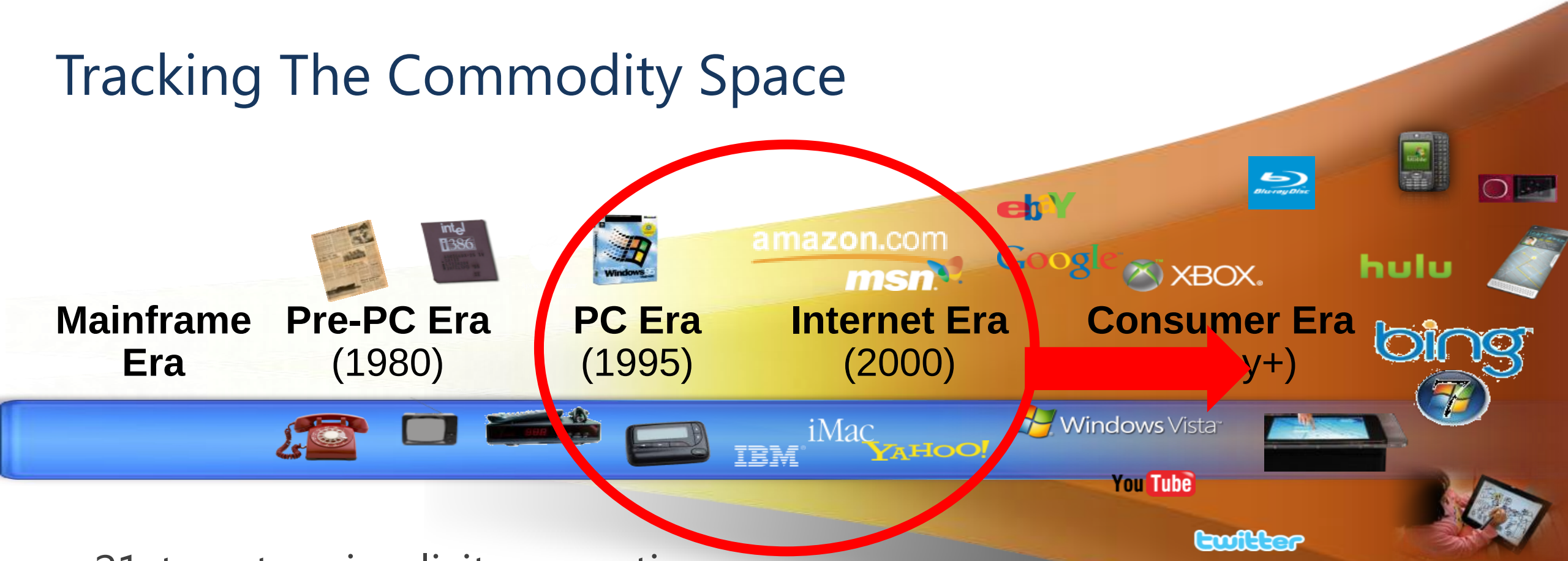
@jenna48: at the
grocery store – yum!

Epicurious mobile app:
strawberry recipes

@john2: Get strawberries
for tonight

Computing Everywhere – Mobility, Data and Augmented Reality

Tracking The Commodity Space



- 21st century implicit computing
  - Increasingly natural interfaces
  - Embedded intelligence
  - *SoCs – the new motherboard*
    - *Ecosystem diversification*

Exascale Software Leverage

- What made open source attractive in HPC?
  - Standard, commodity hardware ecosystem
  - Web services software ecosystem
  - Software development and reuse amortization
- Do those assumptions still hold?
  - Will exascale hardware be commodity?
    - If so, *which commodity*?
  - Will there be a non-HPC software ecosystem to leverage?
    - If so, what will it be?
  - Will there be a non-HPC community of developers?
    - If so, what code will be common and reusable?
- Plus IP protection and differentiation for vendors
  - How do they make money?

What's A Supercomputer? (With Exascale Implications)

Microsoft's Data Center Evolution And Economics

2005 | 2006 | 2007 | 2008 | 2009 | 2010

Data Center Co-Location Generation 1

Quincy and San Antonio Generation 2

Chicago and Dublin Generation 3

Modular Data Center Generation 4

Deployment Scale Unit

Server

Capacity

Rack

Density & Deployment

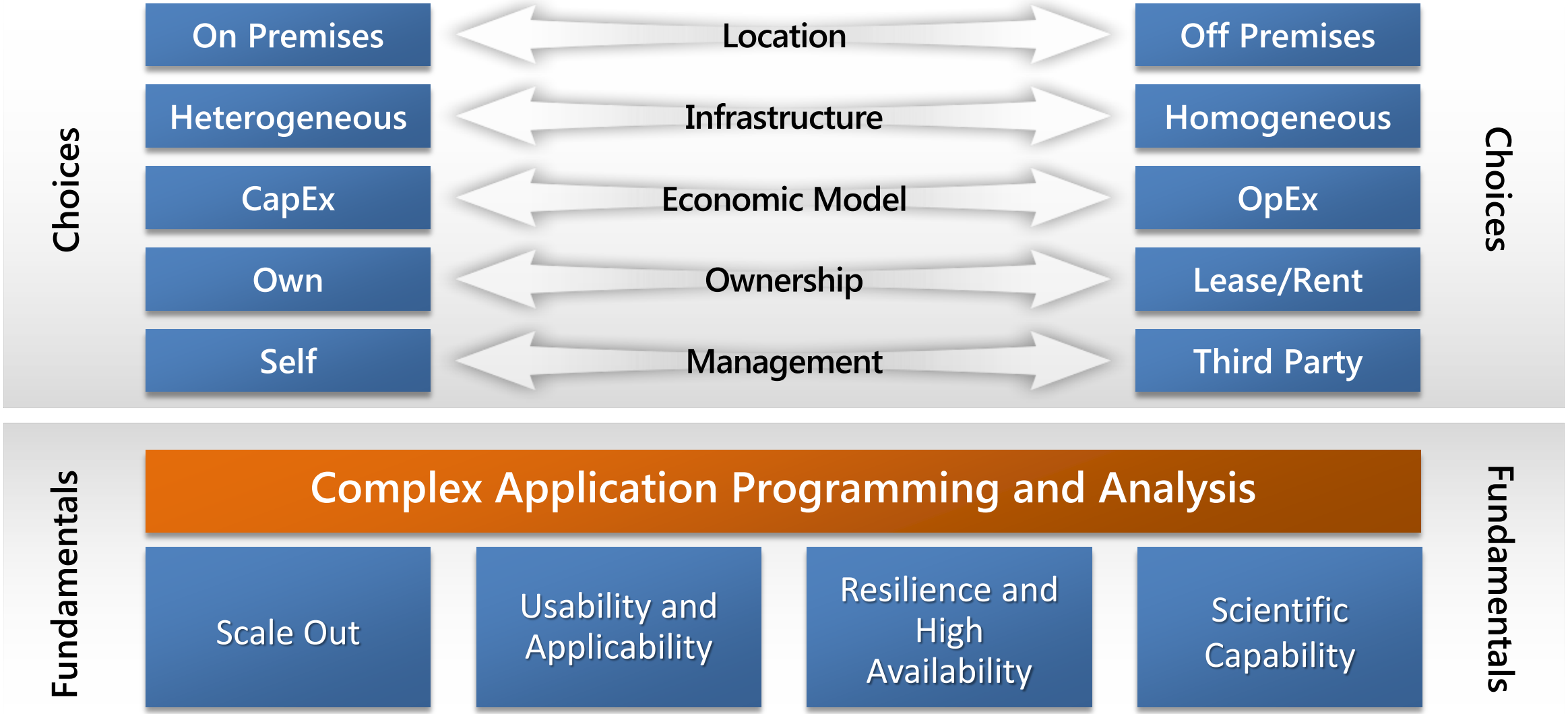
Containers

Scalability & Sustainability

IT PAC

Time to Market
Lower TCO

Rethinking The Choices



Democratizing Computing Mediated Research

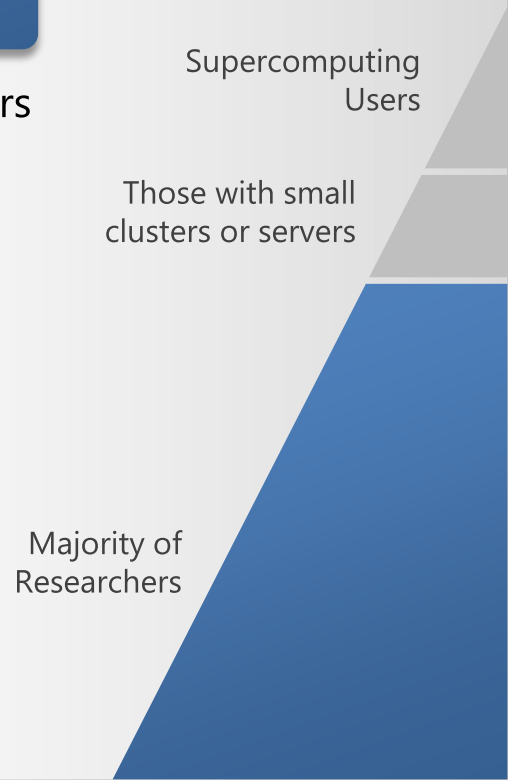
Today

Majority of Researchers

Use laptops and desktop computers

Overwhelmed by data

Doing analysis difficult; sharing even harder



Tomorrow

Paradigm Shift

Powerful tools

Building communities around research results

The ability to marshal needed resources on demand
Without caring or knowing how it gets done…

Accelerating discovery

Remember the boxing mantra: If you kill the body, the head will die

Microsoft's Global Cloud Research Engagement Initiative

Mission

- Broaden research capabilities, foster collaborative research communities and accelerate scientific discovery globally
- Provide massively scalable tools and services directly to users (from their desktops) which could transform how research is conducted, accelerating scientific exploration, discovery and results

Approach

- Build partnerships with government-sponsored research agencies and university consortia
- Offer cloud services to academic and research communities worldwide supported with a technical engagement team
- Provide code samples and templates for significant cloud application
- Provide tools to access the cloud and important cloud services from the desktop and laptop

Windows HPC Server

All On Premise

All in Cloud

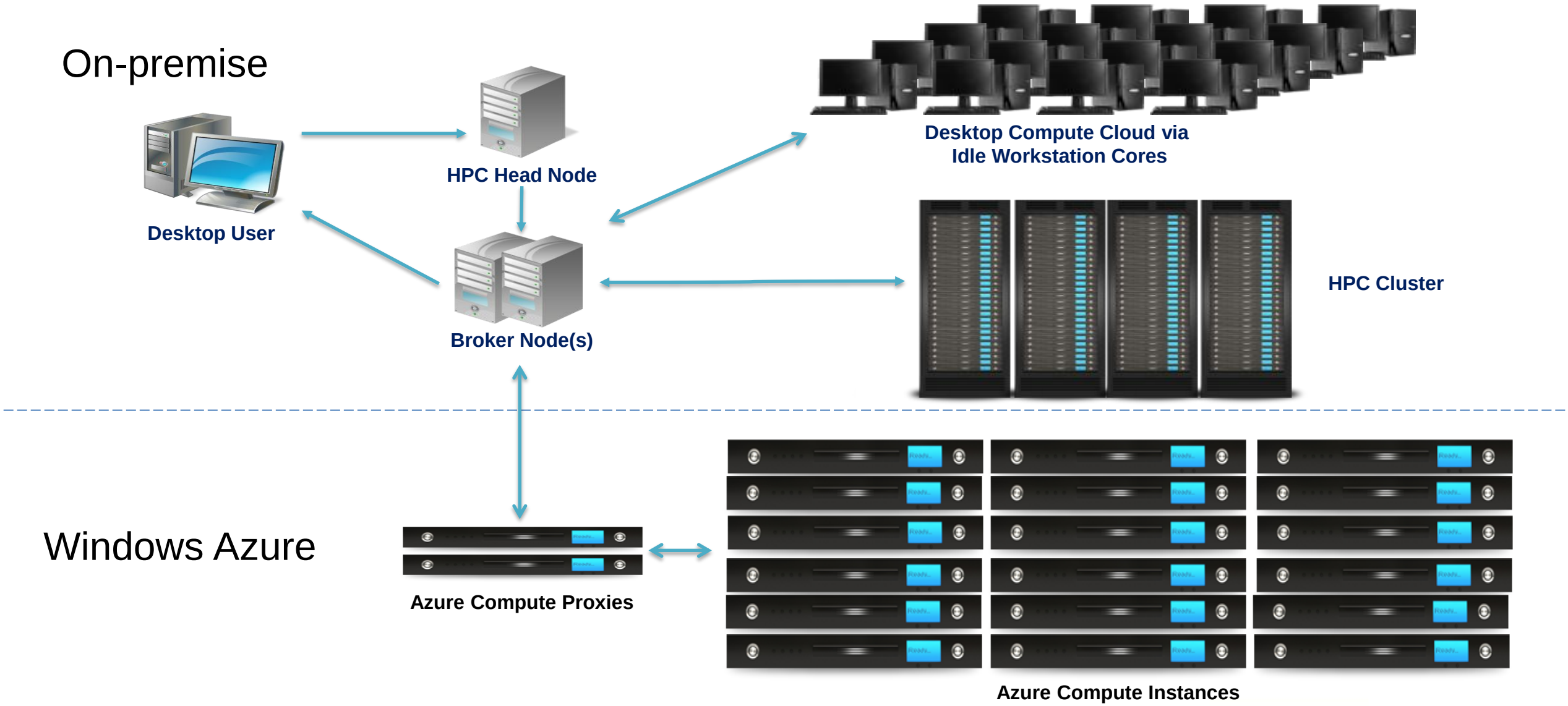
Mixed Cluster (Linux and Windows)

Burst on Demand

- Built on Windows Server 2008 R2
- Scalable for 1000+ nodes
- Customizable management elements
- Evolved SOA support
- Parallel development with VS 2010 & .NET 4.0
- HPC Services for Excel ® 2010
- Expanded capacity through Clusters of Workstations (CoWs)

Provide a complete, integrated, platform, tools and broad ecosystem to reduce the cost and complexity of HPC

Windows HPC and Cloud



Some Concluding Exascale Co-Design Thoughts

- Draw the right bounding box
  - It defines the problem you solve
- Metrics reward and punish
  - Choose carefully what you measure
- Hardware is cheap
  - Optimize for human creativity
- OPEX matters as much (or more) than CAPEX
  - Functional trumps aesthetic
- Engage multidisciplinary solutions
  - Mechanical, electrical, economic, social …
- Culture shapes behavior
  - Implicit versus explicit costs
- Leverage new ecosystems
  - Just as we have in the past