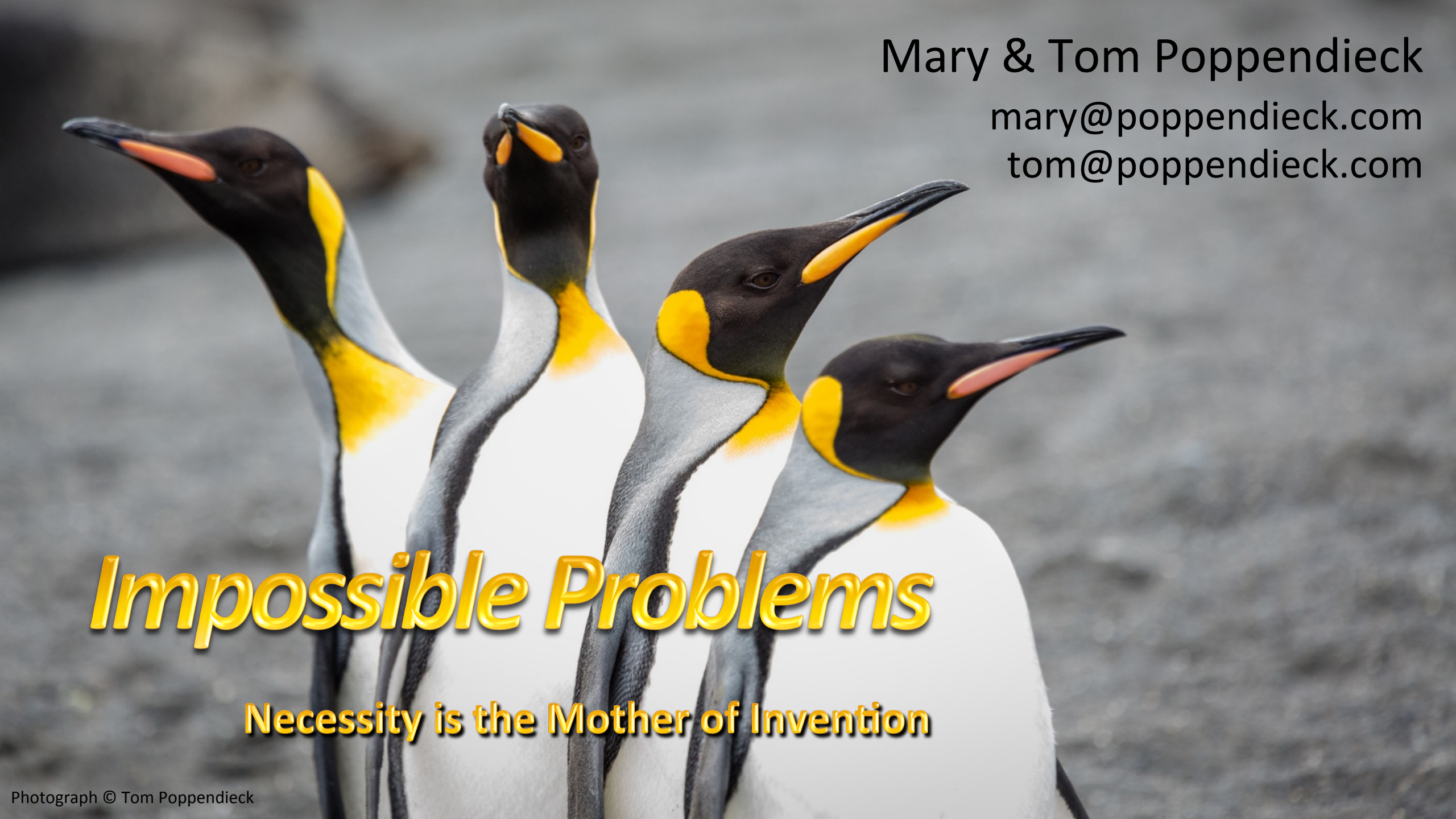

Mary & Tom Poppendieck
mary@poppendieck.com
tom@poppendieck.com

Impossible Problems

Necessity is the Mother of Invention

Photograph © Tom Poppendieck

2001: An Internet Scale Problem – 1.3 Billion Pages

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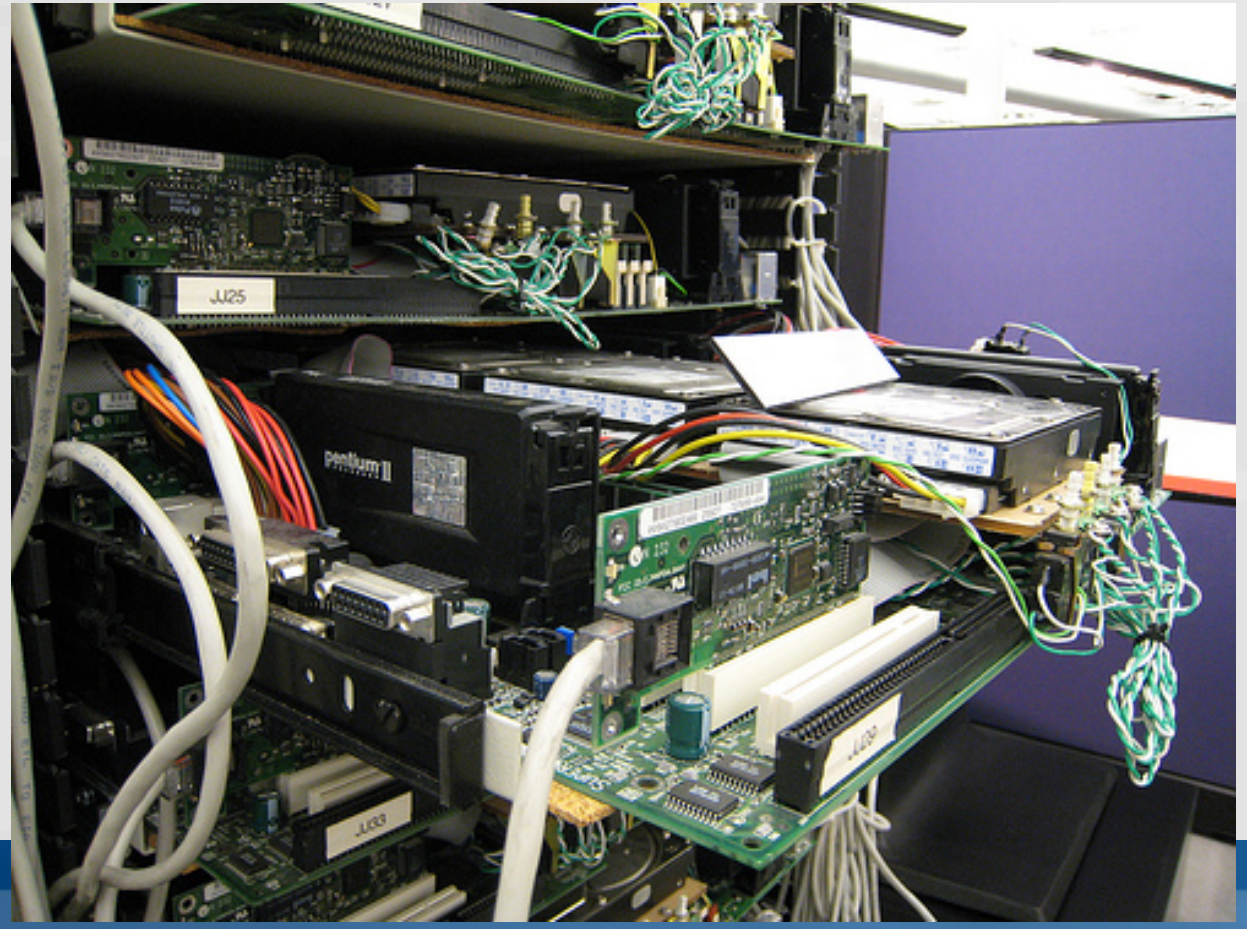
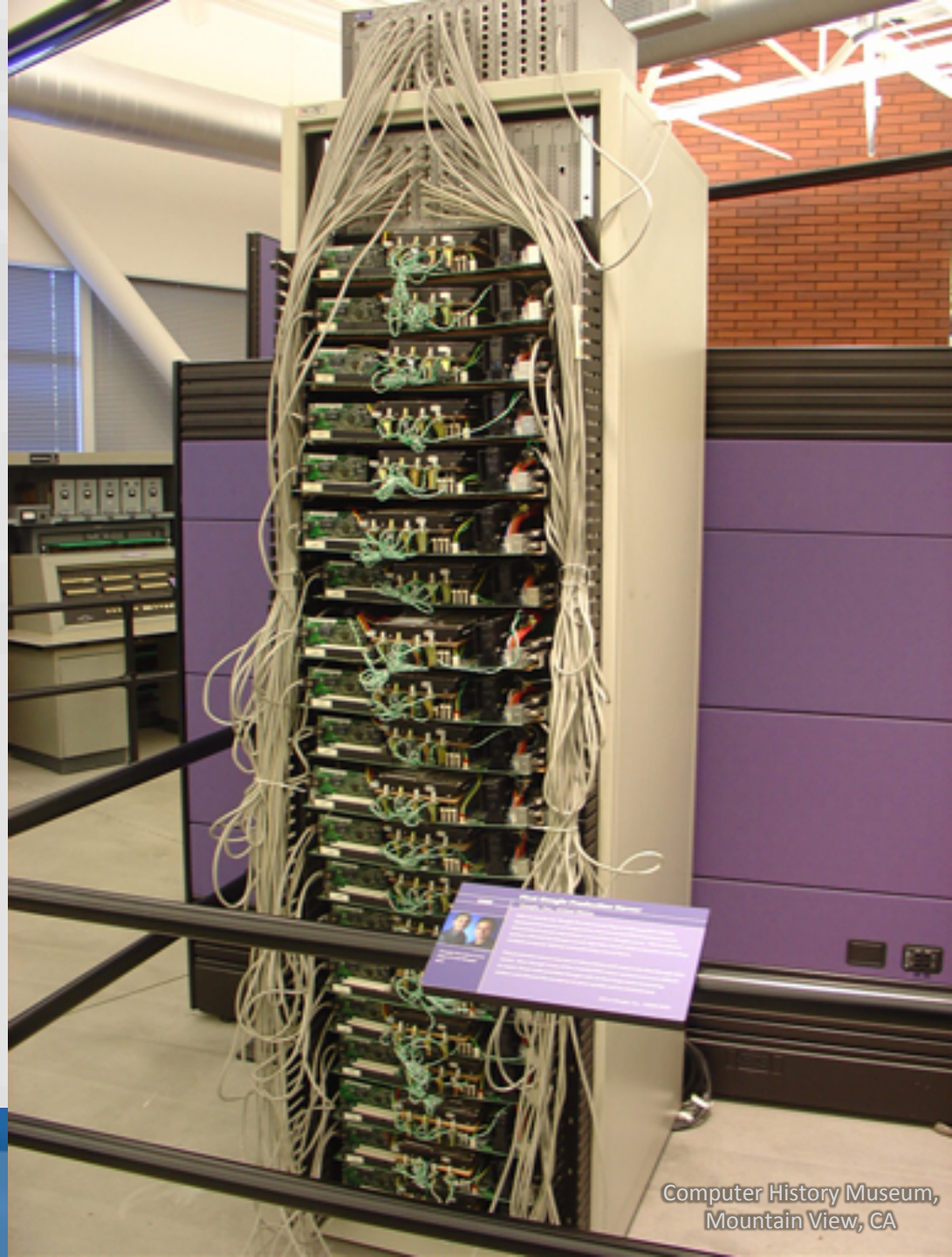
Scale is a Reliability Problem

Google Hardware ~ 1999





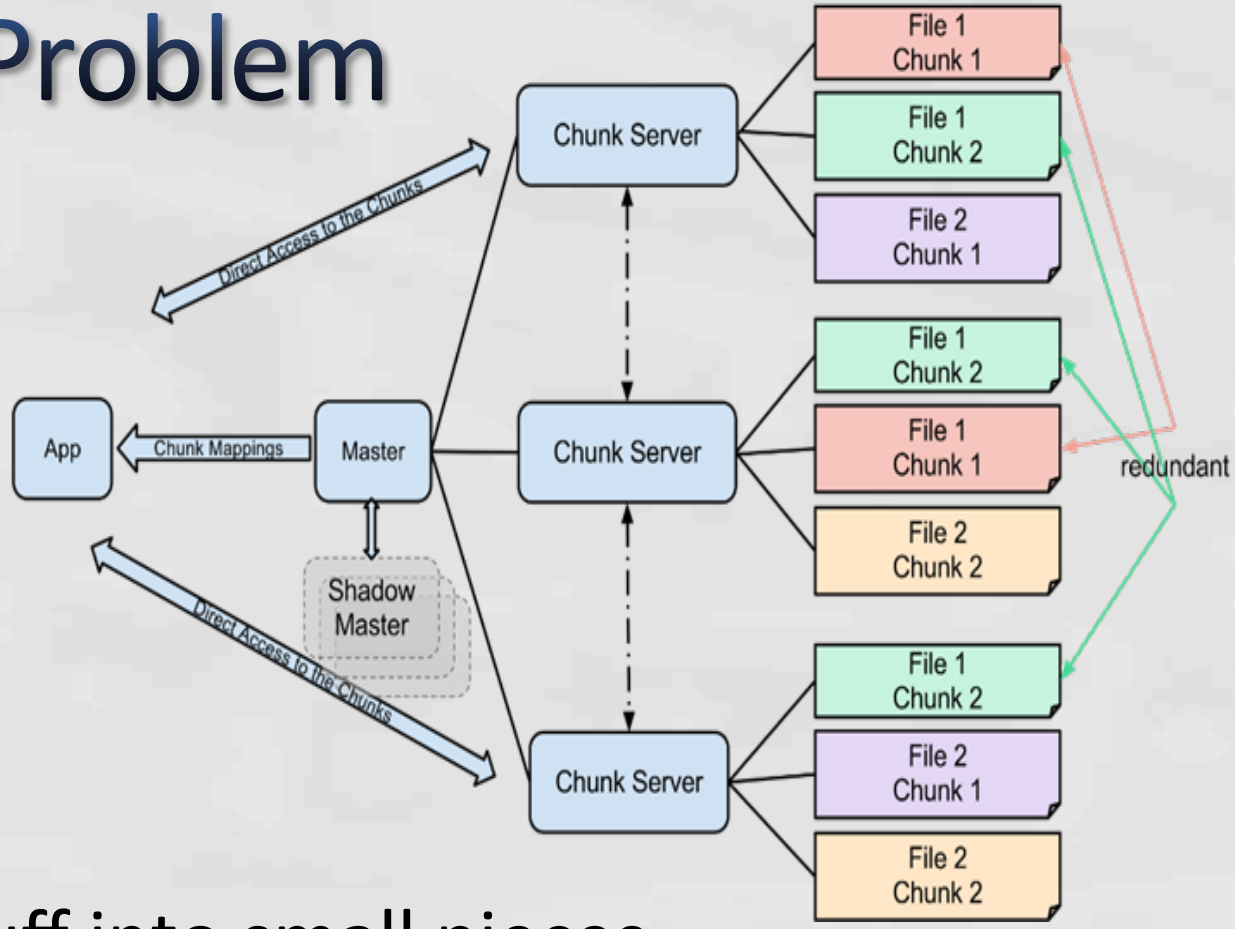
Scale is an Architecture Problem

Google's Problem:

- Search the entire Internet
- Instantly

Response:

- Revisit Queueing Theory
- You can't have all 3:
  - Speed
  - Utilization
  - Large Batches



- Break stuff into small pieces
  - hardware / files / data …
- Manage the pieces with software

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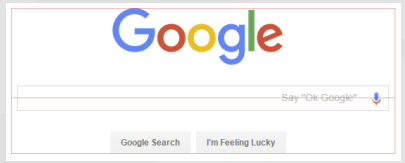
Solving the Architecture Problem

Break Impossible Problems – into Possible Problems

2003 Google File System Paper

2004 Google MapReduce Paper

Today – A Hyperscale Platform



The Birth of Big Data

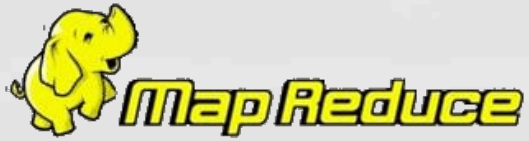
2001 

Doug Cutting, joined by Mike Cafarella

Web Crawler

2004

2005



Today – Base for most Big Data analysis

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Solving the Reliability Problem: Antifragile Systems

Artificially Suppressed Volatility

- Fragile Systems
- Hidden Buildup of Risk
- Catastrophic Failure

Colgan Air Flight 3407 – Stalled on autopilot.
Inattentive pilots reacted the wrong way.

Induced Failure

- Robust Systems
- Preparedness
- Contained Failure

Resilience Engineering: Learning to Embrace Failure
GameDay Exercises Case Study and Discussion
queue.acm.org/detail.cfm?id=2371297

Fault Tolerant is safer than Fault Free

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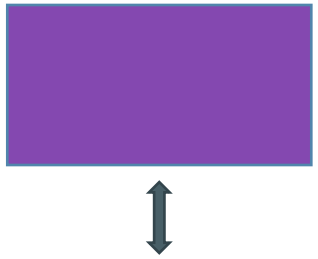
The Evolution of IT

1995

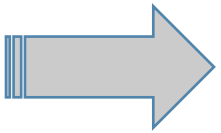
2015

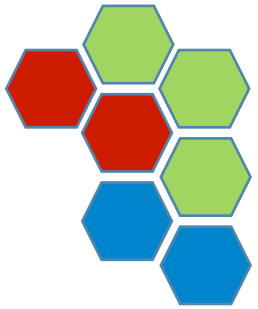
Thick, client-server app on thick client



Thin app on mobile, tablet

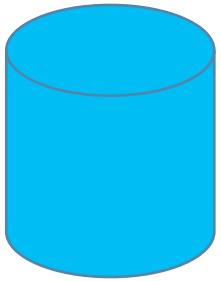
Well-defined stack:
- O/S
- Runtime
- Middleware





Assembled by developers using best available services

Monolithic Physical Infrastructure



Running on any available set of physical resources (public/private/ virtualized)

www.docker.io

Conventional Wisdom

1995

Business (Transaction) Software:

- Monolithic
- Slow to Change
- Central Database
- On a Single Server

Why One Server?

ACID = Reliable Database

- Atomicity (all or nothing)
- Consistency (valid state)
- Isolation (preserve sequence)
- Durability (fault tolerance)

Photograph © Tom Poppendieck

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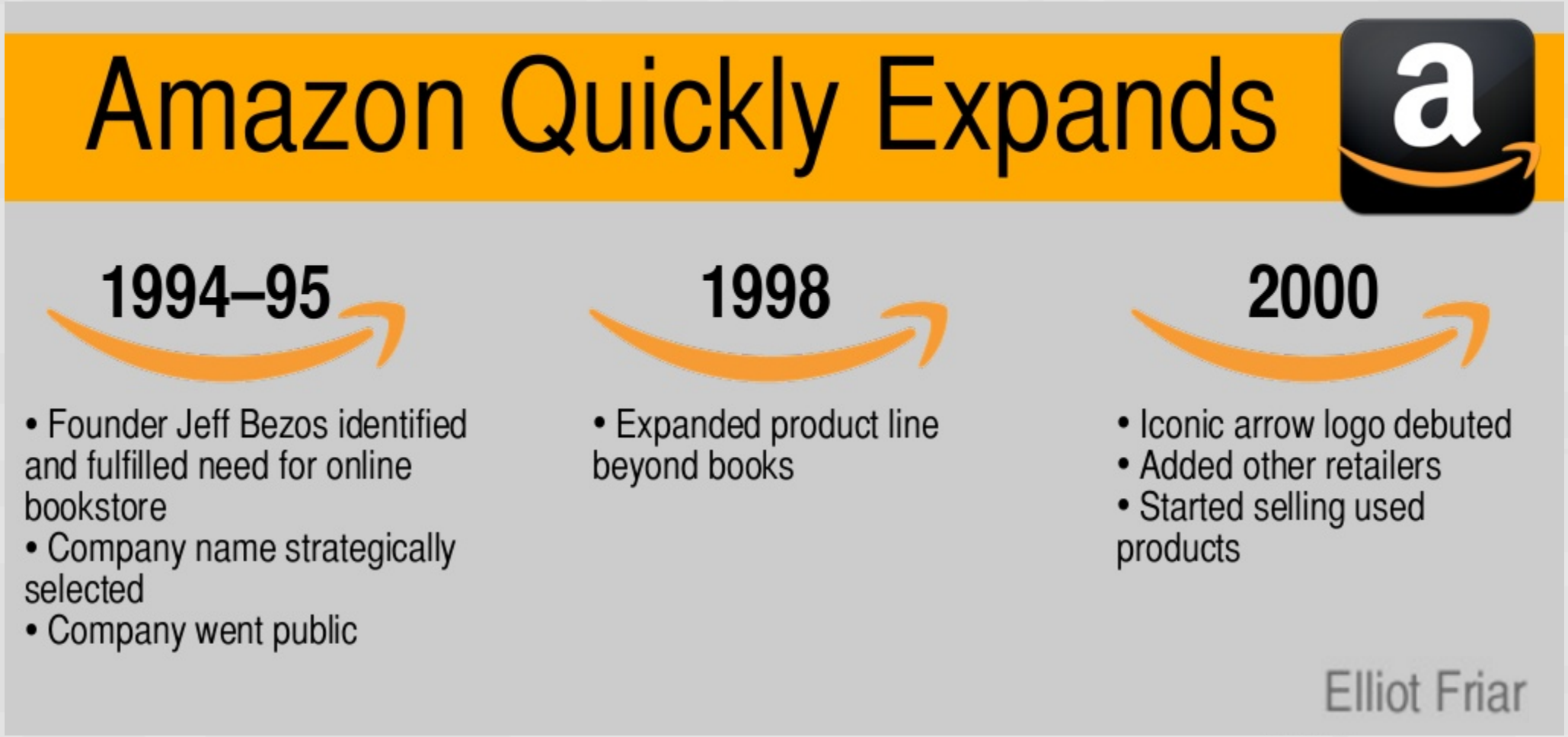
But One Server Did Not Work for Amazon



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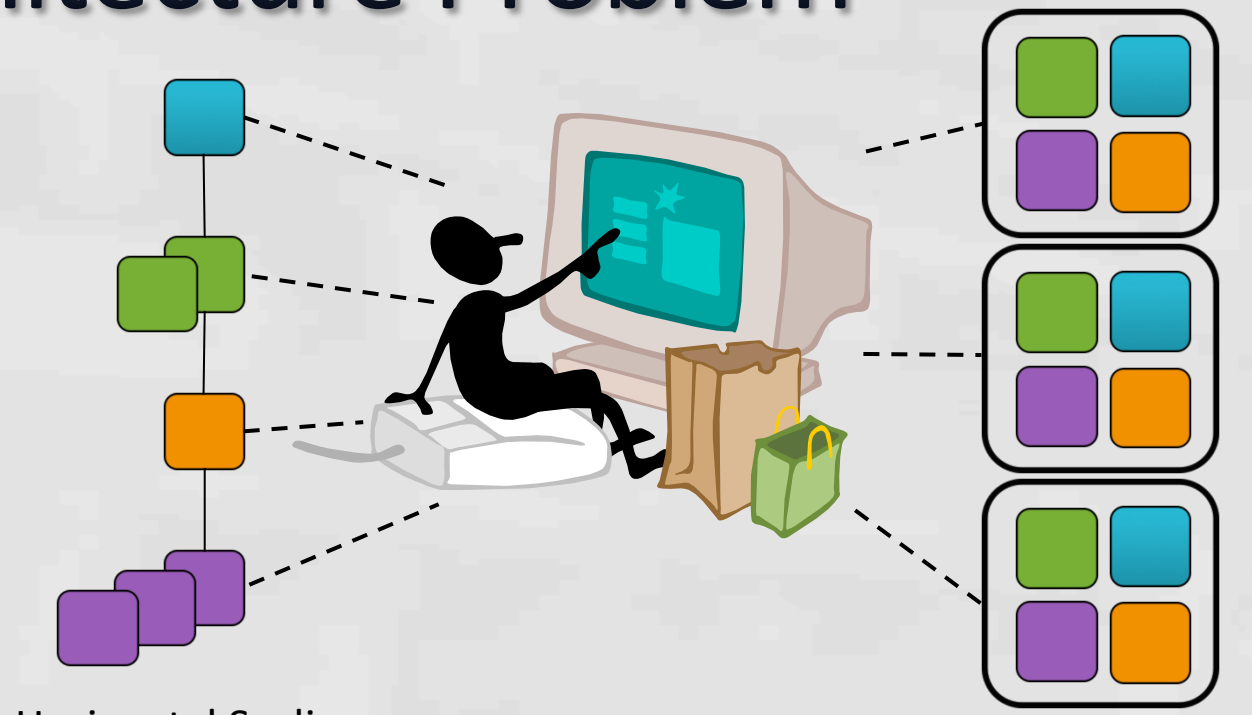
Scale is an Architecture Problem

Amazon Databases ~ 2001

- Handle a gazillion transactions
- All at once

Response:

- Revisit the CAP Theorem
- You can't have all 3:
  - Consistency
  - Access
  - Partitioning



Horizontal Scaling

Vertical Scaling

- Break transactions into services
  - Scale horizontally at the service level
- Each service owned by a "two pizza" team

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Solving the Architecture Problem

Impossible Problem:
Autonomous Service Teams – Independent Deployment

- Chris Pinkham (Infrastructure VP) Proposed self-service deployment for development teams
- Pinkham moved to South Africa
  - Asked to pursue project there
  - Assembled and led a team
  - Developed EC2 in 2 years

Innovation:
Sell the Solution

- Launched EC2 in 2006
  - Entirely new business model
  - Multi-billion dollar business

Necessity is the Mother of Invention

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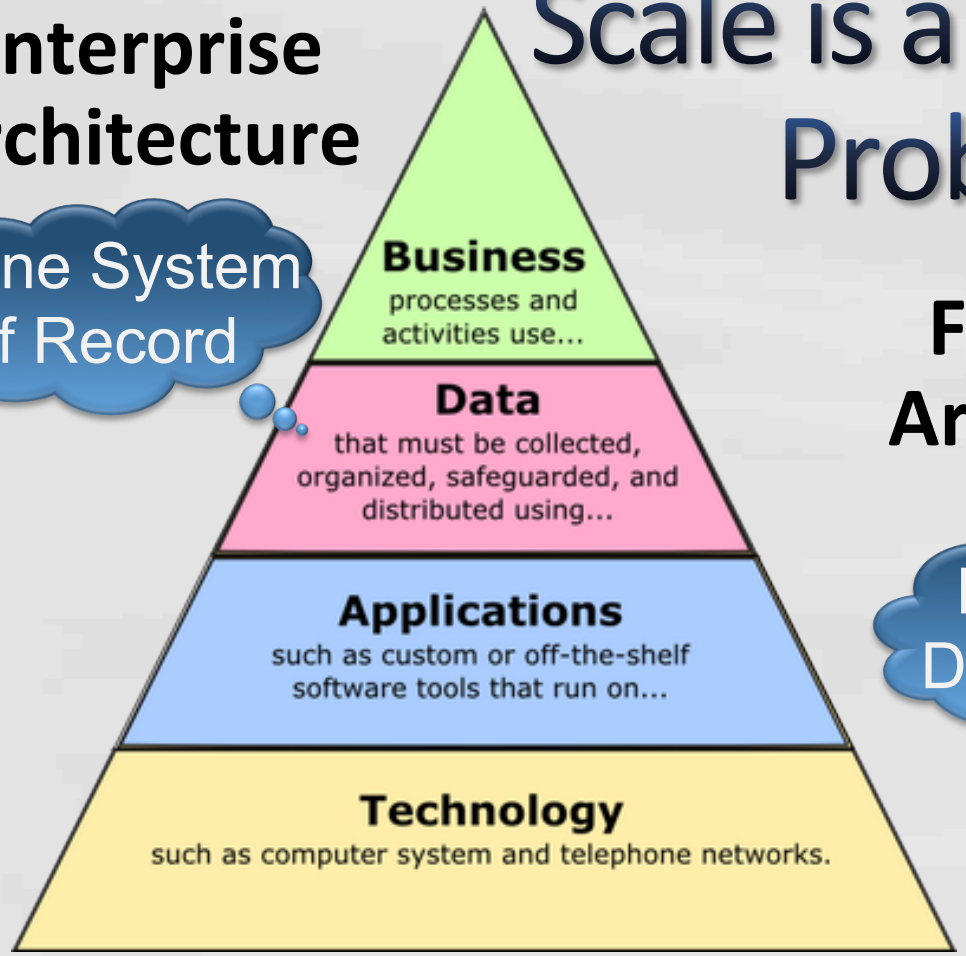
Scale is a Technical Problem

Enterprise Architecture

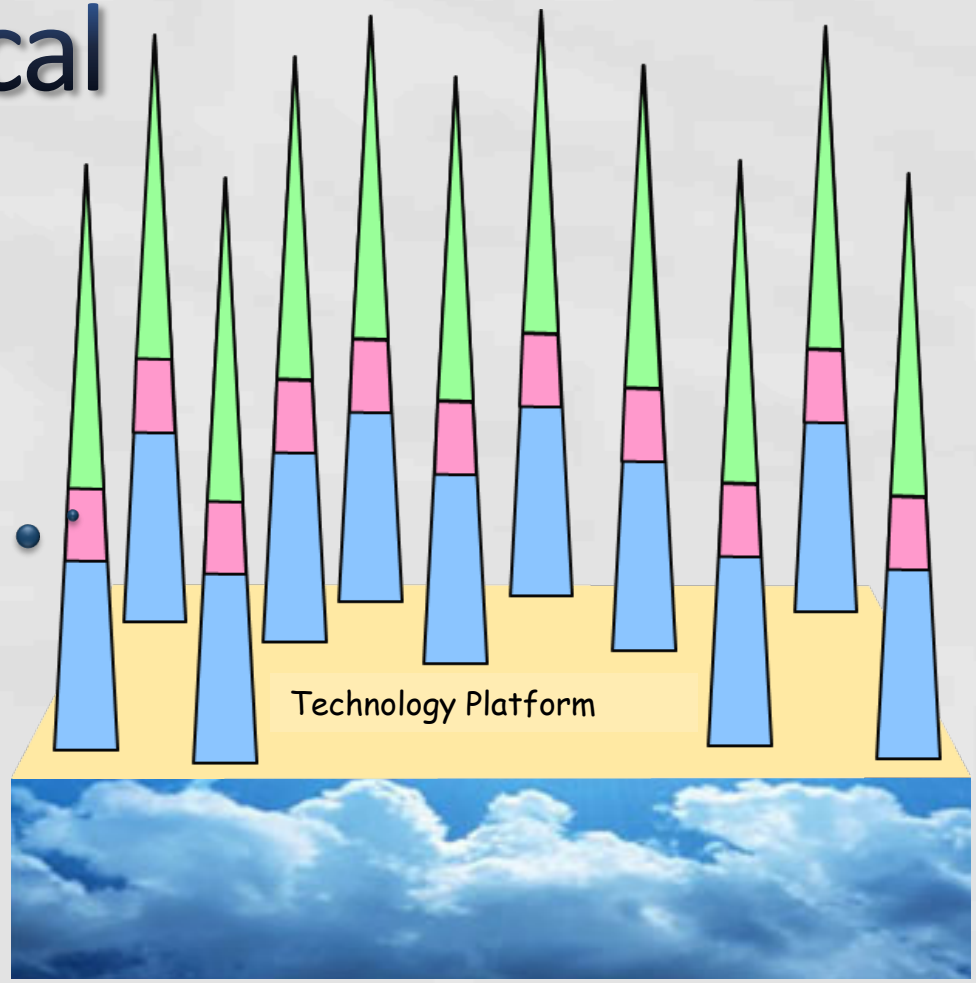
One System of Record



Monolith & Central Database ➠ Deep Dependencies ➠ High Friction

Federated Architecture

Distributed Data Stores



Microservices & Distributed Data ➠ Federation ➠ Low Friction

Innovation Mindset: Empathy Ambiguity Improvisation

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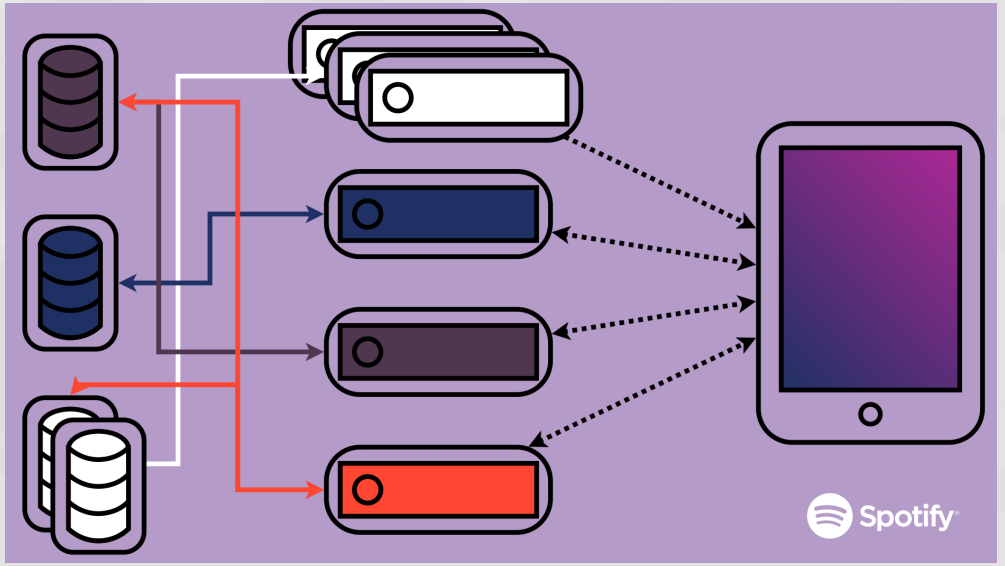
Federated Architecture

Microservices @ Spotify



Pros

- ☺ Easier to scale based on real world bottlenecks
- ☺ Easier to test (smaller)
- ☺ Easier to monitor (smaller)
- ☺ Can be versioned independently (for multiple devices)
- ☺ Easy to re-write rather than revise (at inflection points)
- ☺ Are less susceptible to large failures

Cons

- ☹ Harder to monitor (because there are so many)
- ☹ Need good documentation / discovery tools
- ☹ Creates increased latency (view aggregation service)

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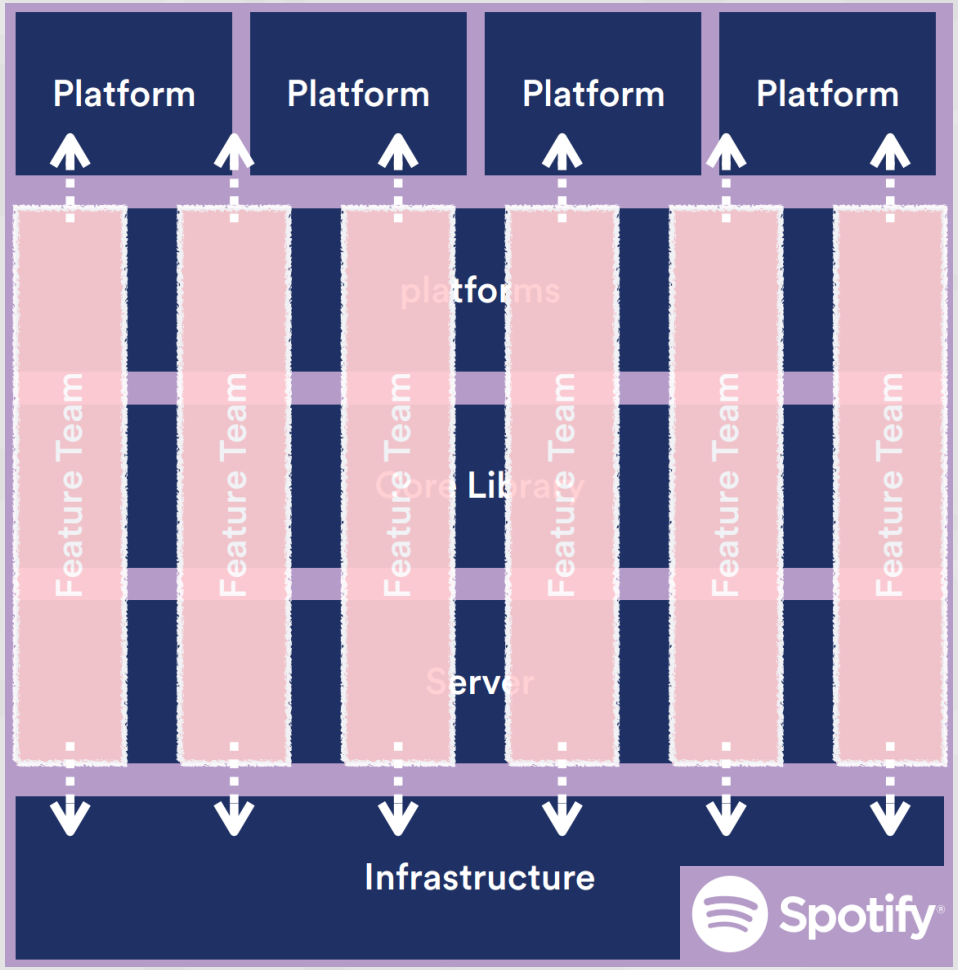
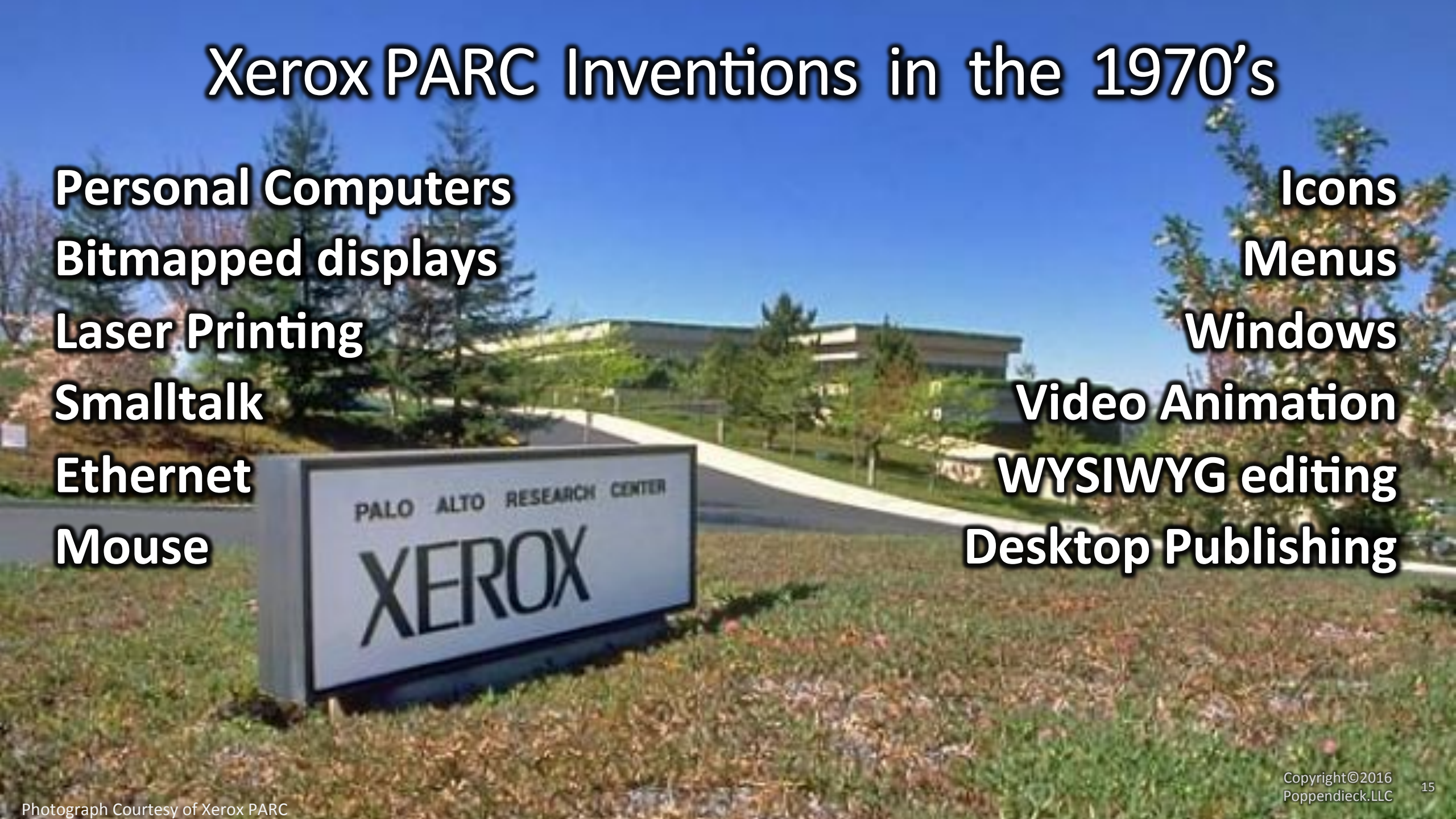
Federated Organization (Conway's Law)

- Autonomous Full Stack Teams
  - Back end Dev / Front end Dev / Testers / UI Designer / Product /
  - Full control over what they do
  - Few dependencies on other teams
  - Deploy & support their own code
- Each team has a mission
- Company sets top level priorities
- Teams choose what to do based on mission and priorities



Xerox PARC Inventions in the 1970's



- Personal Computers
- Bitmapped displays
- Laser Printing
- Smalltalk
- Ethernet
- Mouse
- Icons
- Menus
- Windows
- Video Animation
- WYSIWYG editing
- Desktop Publishing

Photograph Courtesy of Xerox PARC

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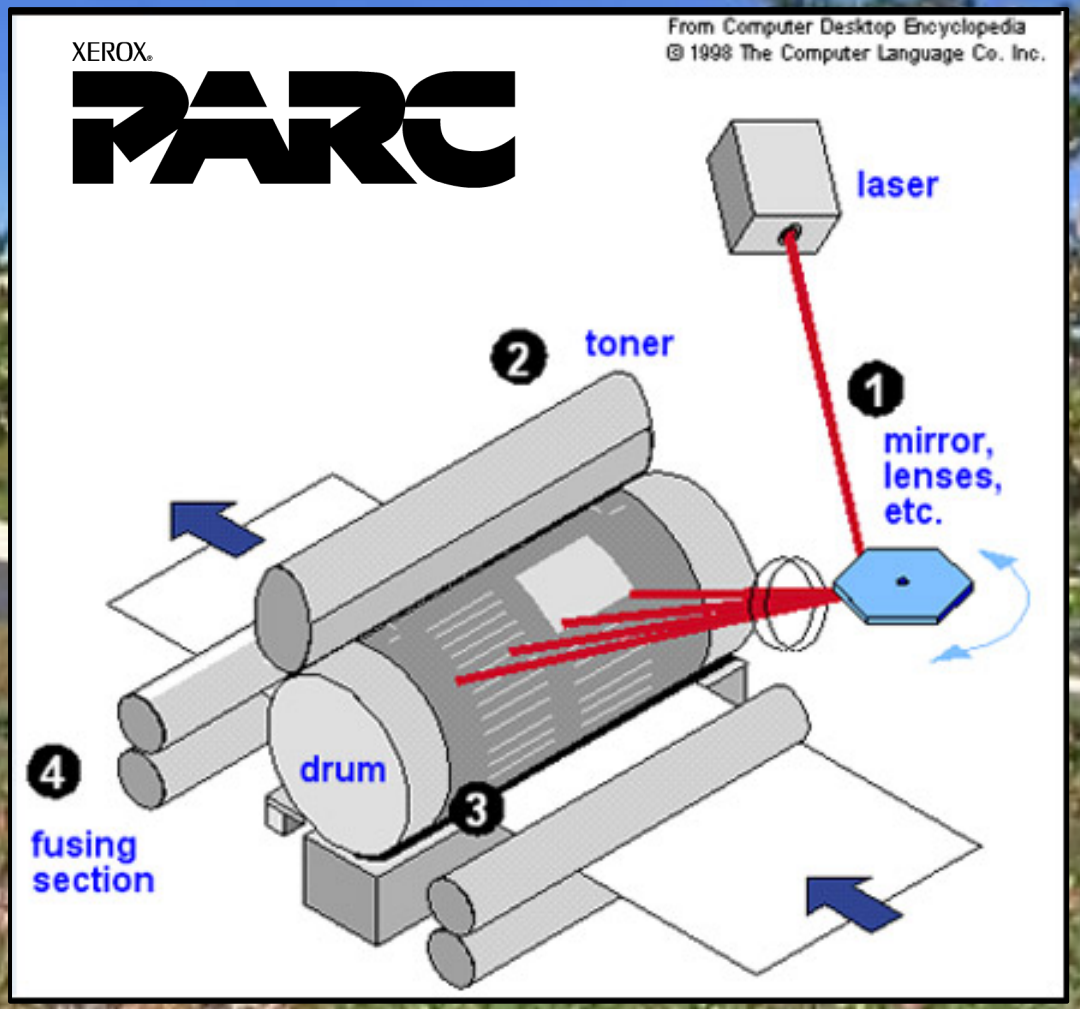
What Xerox Commercialized

Laser Printing, 1971

The laser printer, based on a modified xerographic copier, was invented at Xerox PARC by researcher Gary Starkweather, who had a fully functional networked printer system working by 1971. Laser printing eventually became a multibillion-dollar business for Xerox.



Photograph Courtesy of Xerox PARC

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Invention is Problem-Finding

-- Alan Kay

Invention

Frame: Exploration Centric

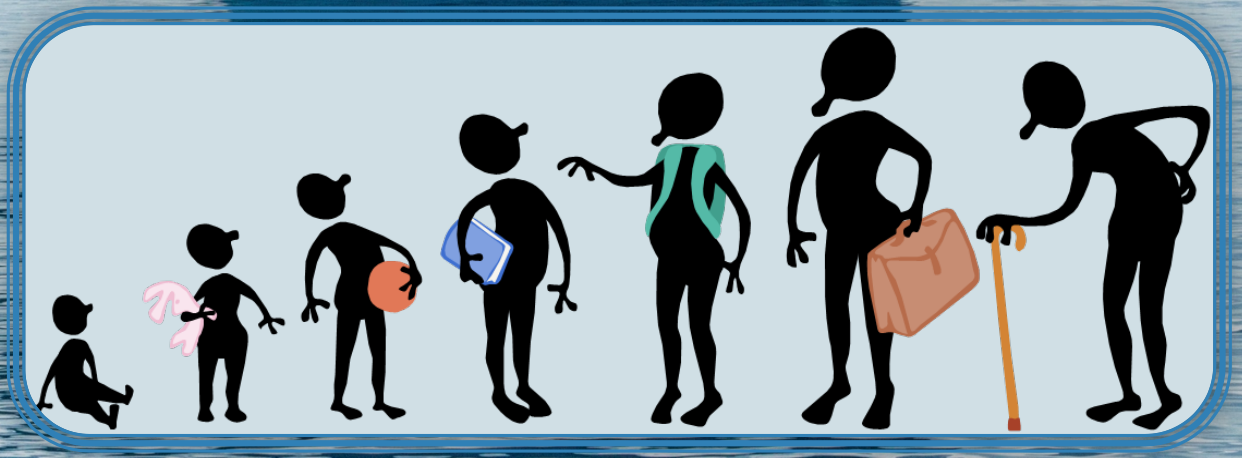
Photograph © Tom Poppendieck

Innovation is Problem-Solving

-- Alan Kay

Innovation

Frame: Customer Centric



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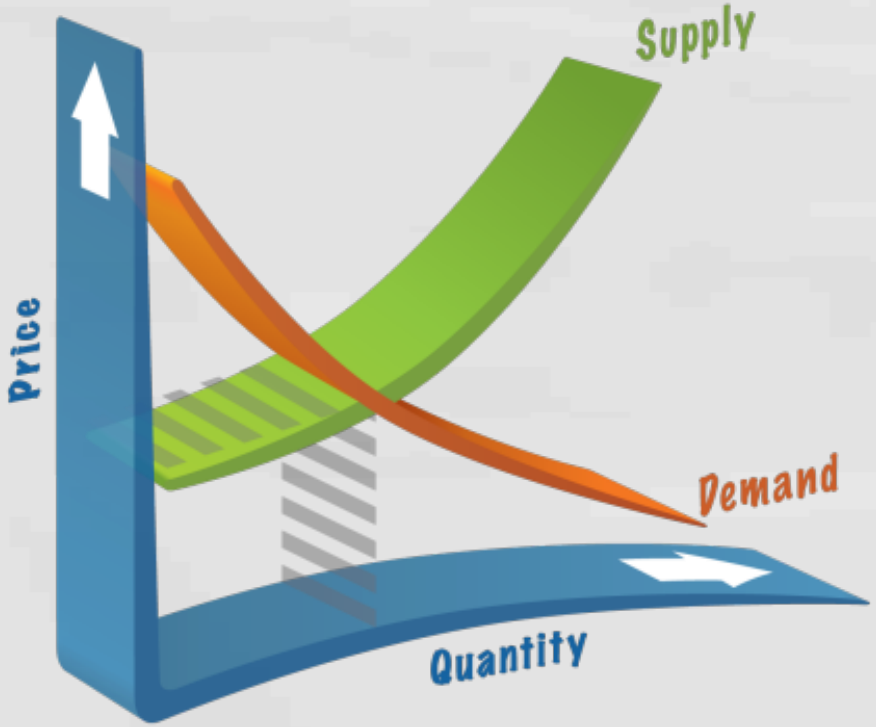
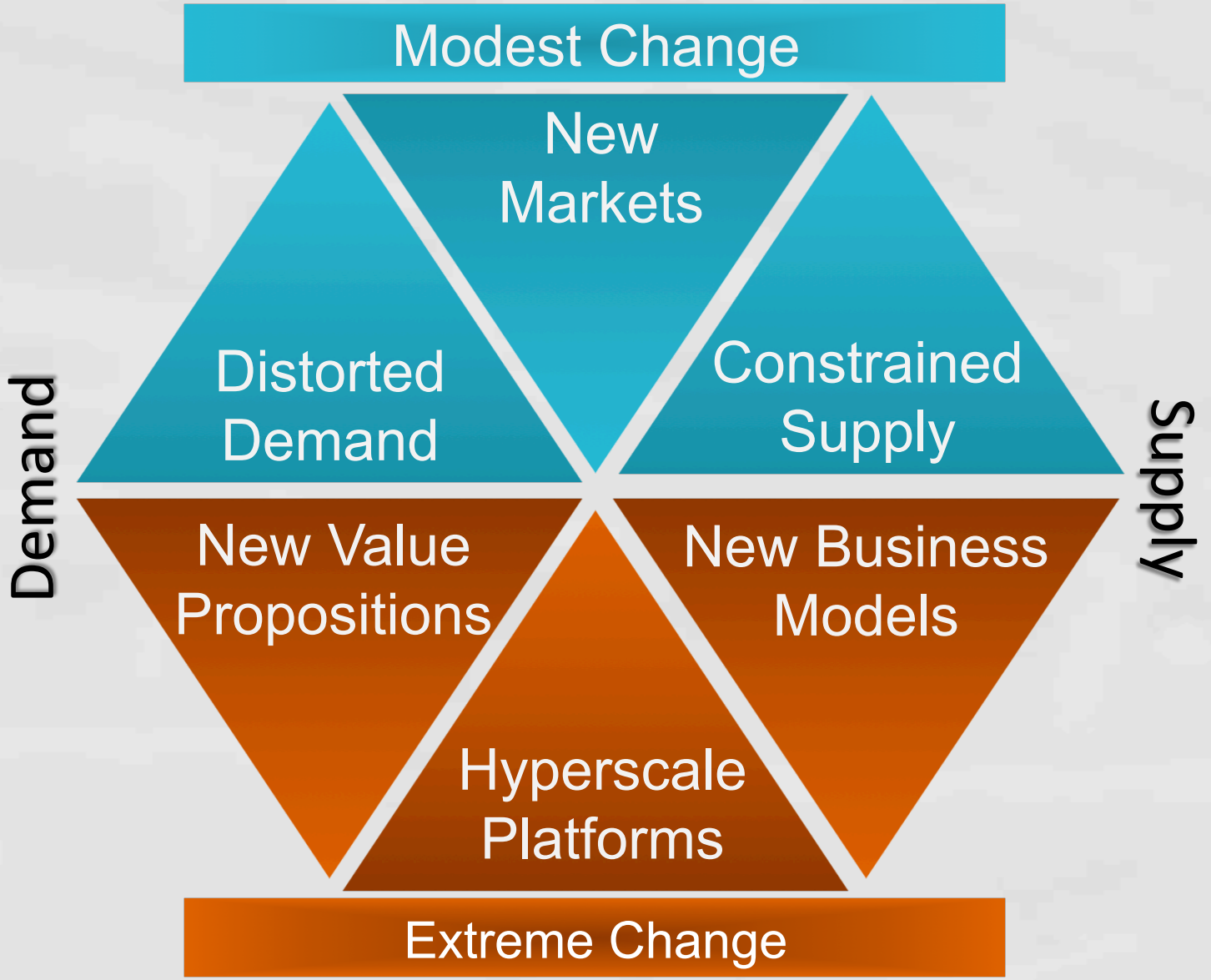
Innovation is an Economic Problem





http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-economic-essentials-of-digital-strategy

The Economic Essentials of Digital Strategy by Angus Dawson, Martin Hirt, and Jay Scanlan; McKinsey & Company

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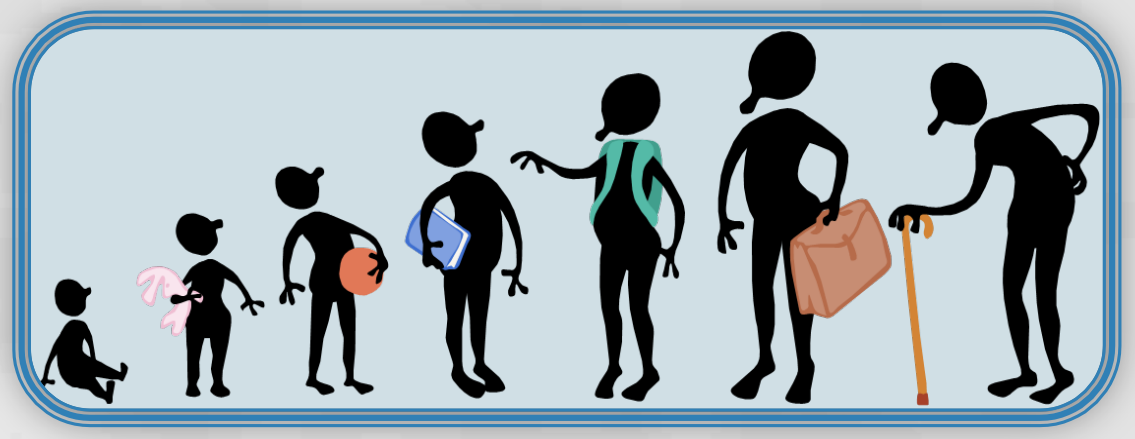
Solve for Annoyance



Make it easy and make it now.

Is Demand Distorted?

- Some customers cross-subsidize other customers.
- Lock-in contracts keep customers from changing vendors.
- Customers have to buy the whole thing for the one bit they want.

Address market demand by unbundling or tailoring.

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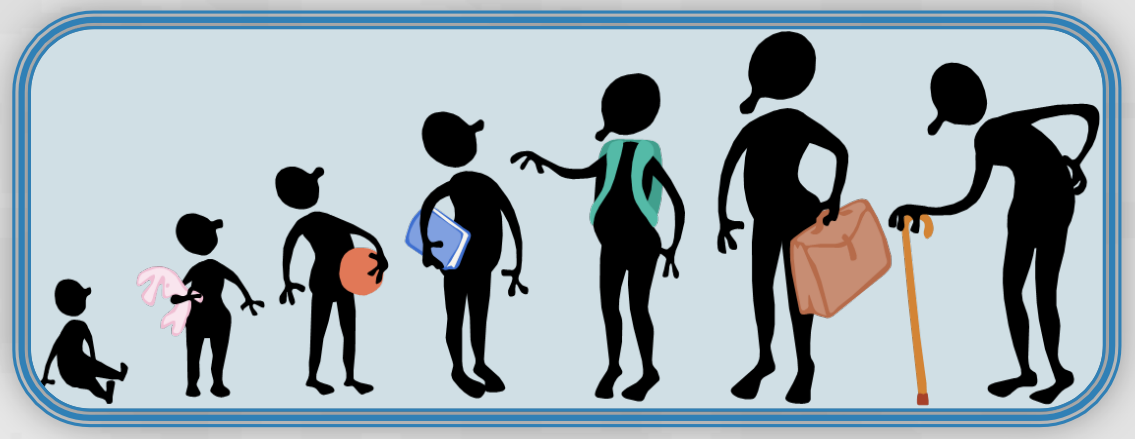
Solve for Access



Uncover Latent Supply.

Is Supply Constrained?

- Supply is inelastic and/or unaffordable.
- Customers use only a small part of the product.
- Supply could be recycled, but no means exist to do so.

Make capacity more readily available, in smaller increments.

airbnb zipcar MITOPENCOURSEWARE MASSACHUSETTS INSTITUTE OF TECHNOLOGY YouTube

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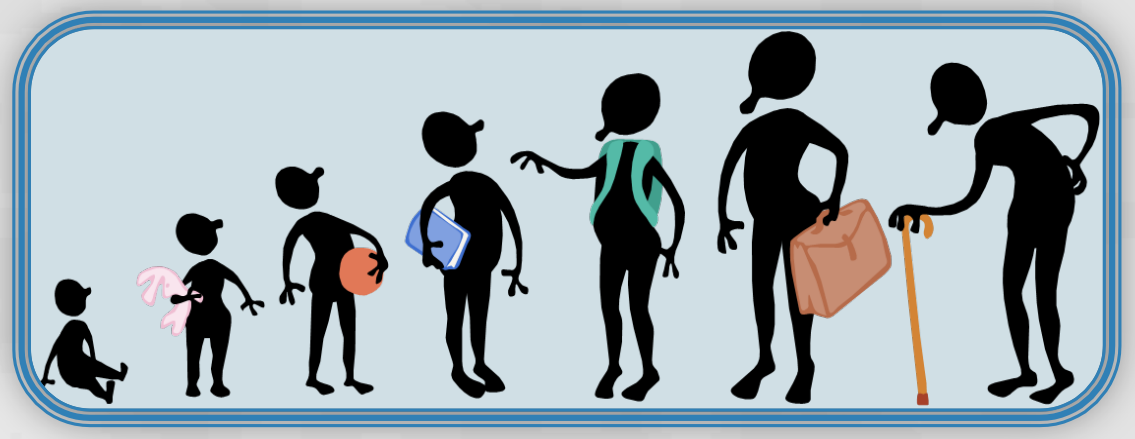
Solve for Friction



Find the Friction.

People have 3 friction budgets*

Time

- Don't waste my time.

Money

- Don't take my stuff.

Angst

- Don't make me think.

TaskRabbit

tripadvisor®

* Simon Goodall and Jim Emerson - Friction Lab, SxSW 2015

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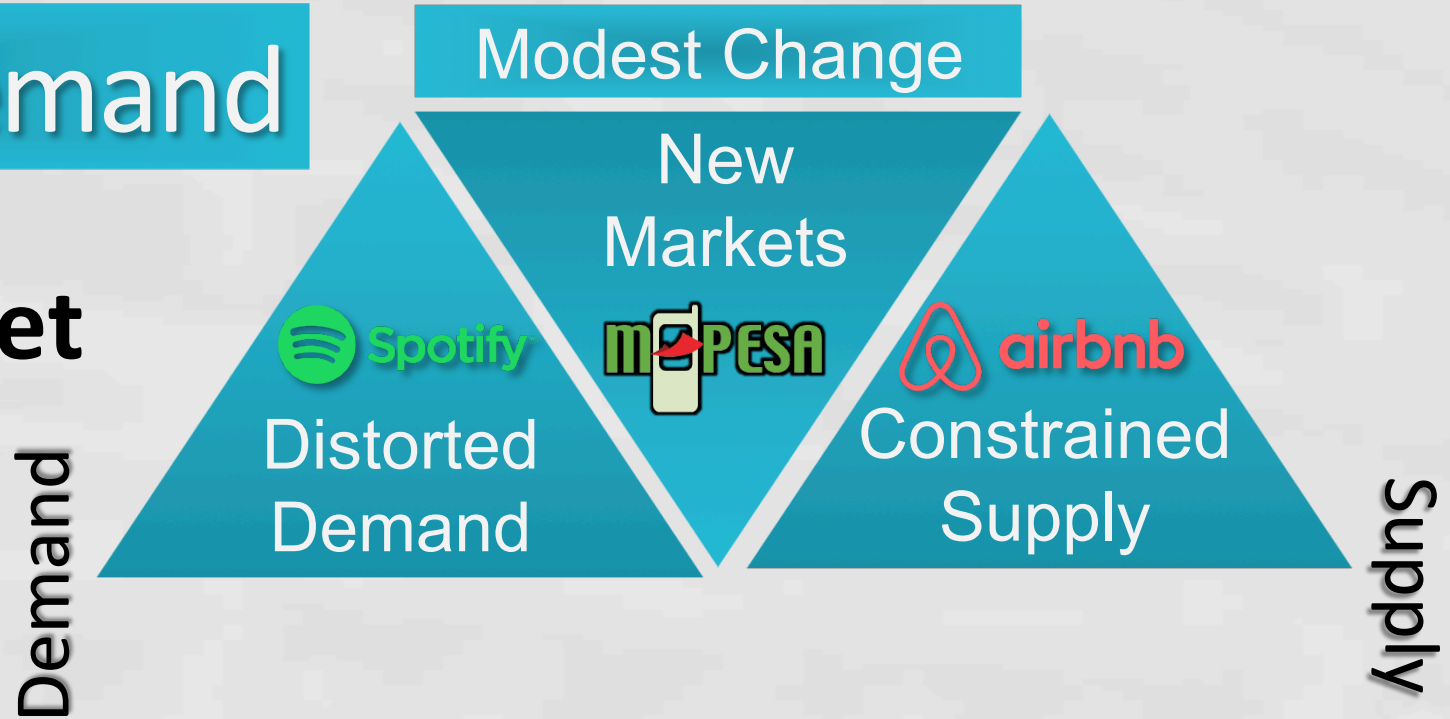
Modify Supply & Demand

The Innovation Mindset

Customer Centric

- Empathy
- Ambiguity
- Improvisation
- Full Stack Teams



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The Economic Essentials of Digital Strategy by Angus Dawson, Martin Hirt, and Jay Scanlan; McKinsey & Company

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Principal Designer / Chief Engineer

Example: Doug Dietz, Principal Designer, GE Healthcare

- Doug's Baby

- 80% of Children ages 3-7 required sedation

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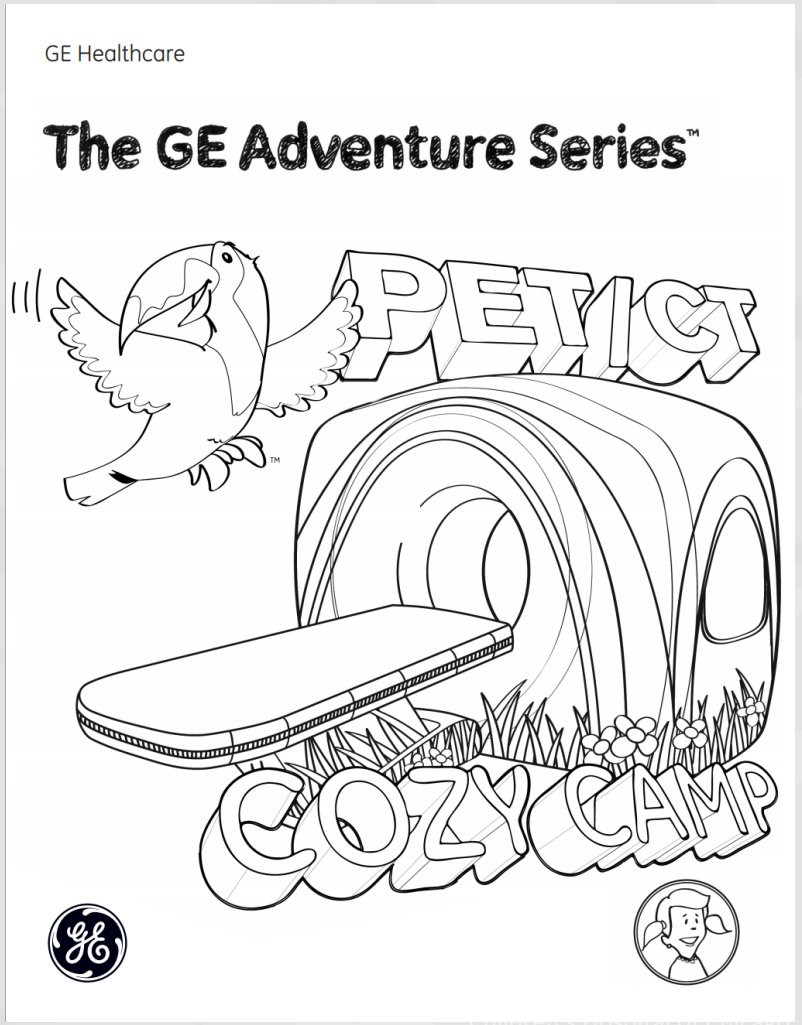
A New Standard for Children's Health Care

Children's Hospital of Pittsburgh of UPMC



Children's Hospital of Chicago

Innovation Mindset: Empathy 👀 Ambiguity 👀 Improvisation

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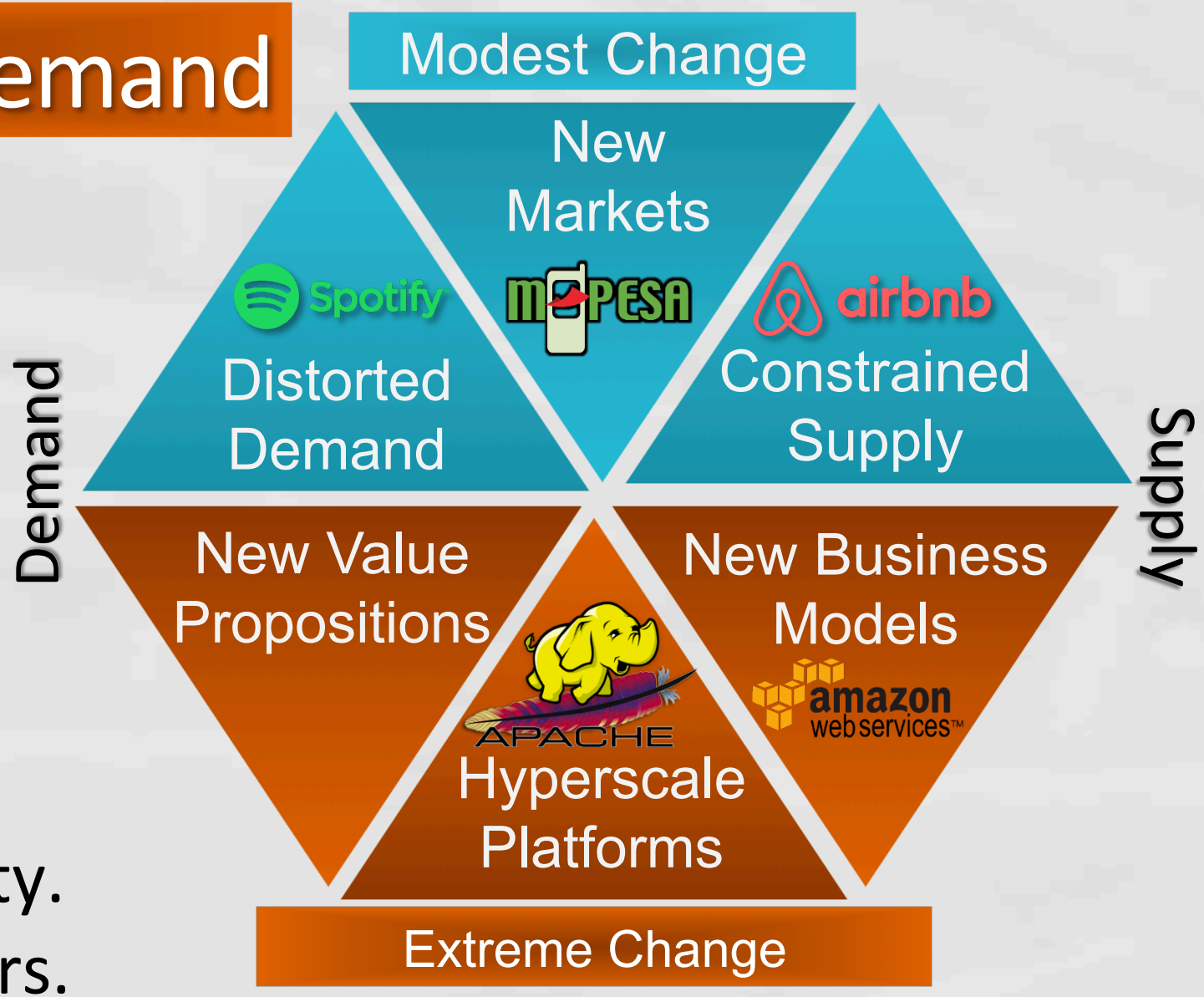
Reinvent Supply & Demand

Supply Side:
Change cost structure by automating, virtualizing, or disintermediating.

Bring the Sides Together:
Create Communities

Demand Side:
Add information, social content, and/or connectivity.

Do more work for customers.



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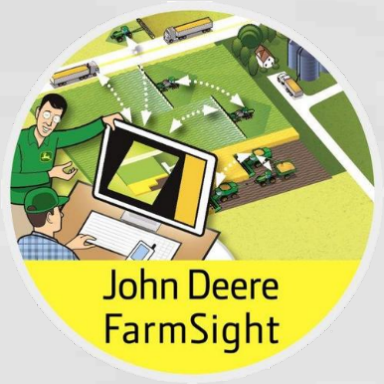
Impossible Problems Need Complete Solutions



JoySmart℠ Solutions

Predix

Modest Change

Demand

Supply

New Markets

Spotify

M-PESA

airbnb

Distorted Demand

Constrained Supply

New Value Propositions

John Deere FarmSight

Predix

APACHE

Hyperscale Platforms

New Business Models

amazon web services™

Extreme Change

http://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-economic-essentials-of-digital-strategy

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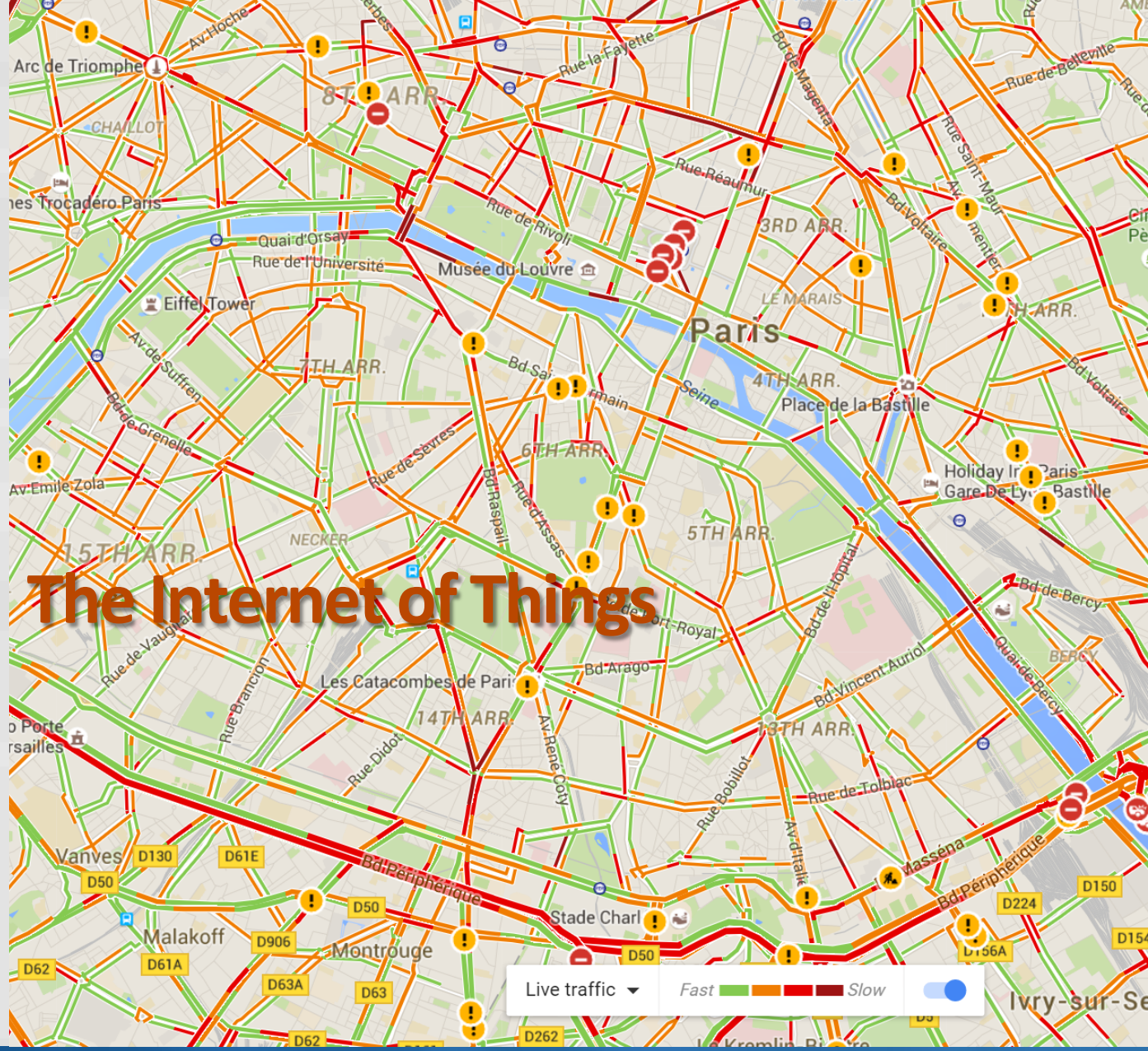
Provide New Value

How the World might use The Internet of Things

- Traffic/Transit Information
- Self-driving Vehicles
- Home Automation/Security
- Elderly Home Monitoring
- Remote Medical Care
- Immersive Visualization
- Use Your Imagination!



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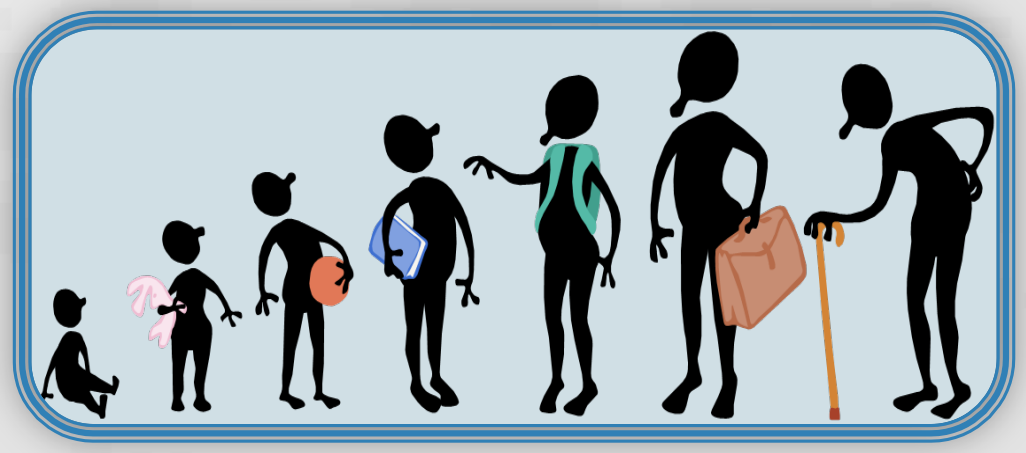
Innovation is Optional – so is Survival.

- Invention is necessary but not sufficient for Innovation.
- New business models and new platforms are very difficult.
- The easiest places to start are:
  - Distorted Demand
  - Constrained Supply



- For the biggest opportunities:
  - Solve your industry's biggest problem.
  - Do more work – the whole job – for customers.
- Use emerging technology to solve tough real world problems.

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Mary & Tom Poppendieck
mary@poppendieck.com
tom@poppendieck.com

Thank You!

Innovation is Optional – So is Survival.

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