Making IT Rain with Cloud Computing

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IT Chief Technology Officer

and

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Missions Cloud Expert

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"One must learn by doing the thing;
for though you think you know it, you have no certainty until you try." - Sophocles

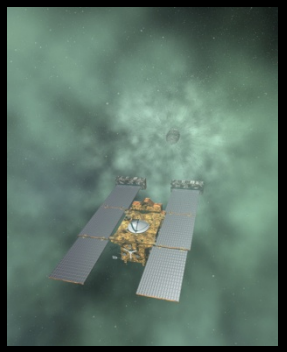
JPL is part of both NASA and Caltech

- JPL is a Federally Funded Research and Development Center (FFRDC) Managed by CalTech for NASA
- NASA's lead center for robotic exploration of the solar system. Have 19 spacecraft and 9 instruments across the solar system and beyond
- $1.7B contract per year, ~ 5,000 employees; 177 acre facility located in Pasadena, CA, with 670K sq.ft of office space and 900K sq.ft. of labs

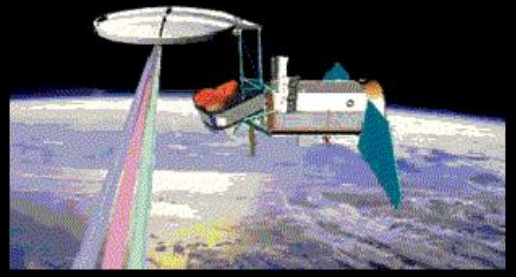
- Manages worldwide Deep Space Network
  - 3 Locations - Goldstone CA, Madrid Spain, Canberra Australia
  - Spacecraft Command & Control - Recording scientific data
- 50+ years experience in spacecraft design, production, operation
- JPL spacecraft have visited all planets in our solar system except Pluto!

Upcoming Mars & Solar System Exploration Events

EPOXI
Comet
Flyby

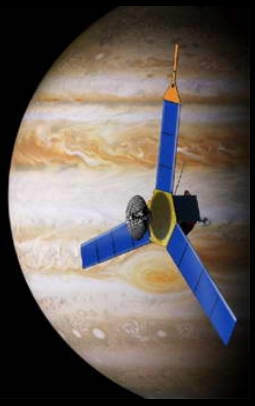


Stardust-
NExT
Comet
Flyby
February
2011



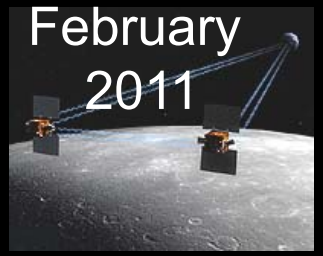
Aquarius

April 2011

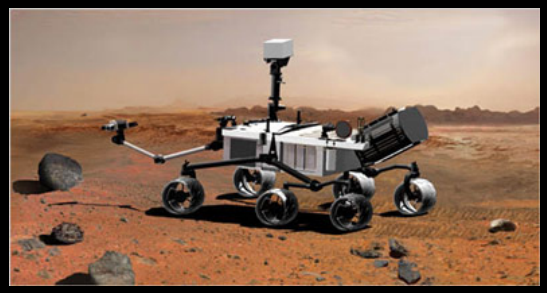


Juno
August
2011

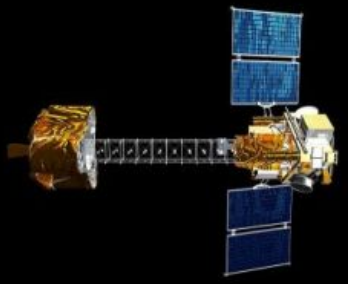
Dawn Vesta
Arrival
August 2011
(Ceres, February



GRAIL
September
2011

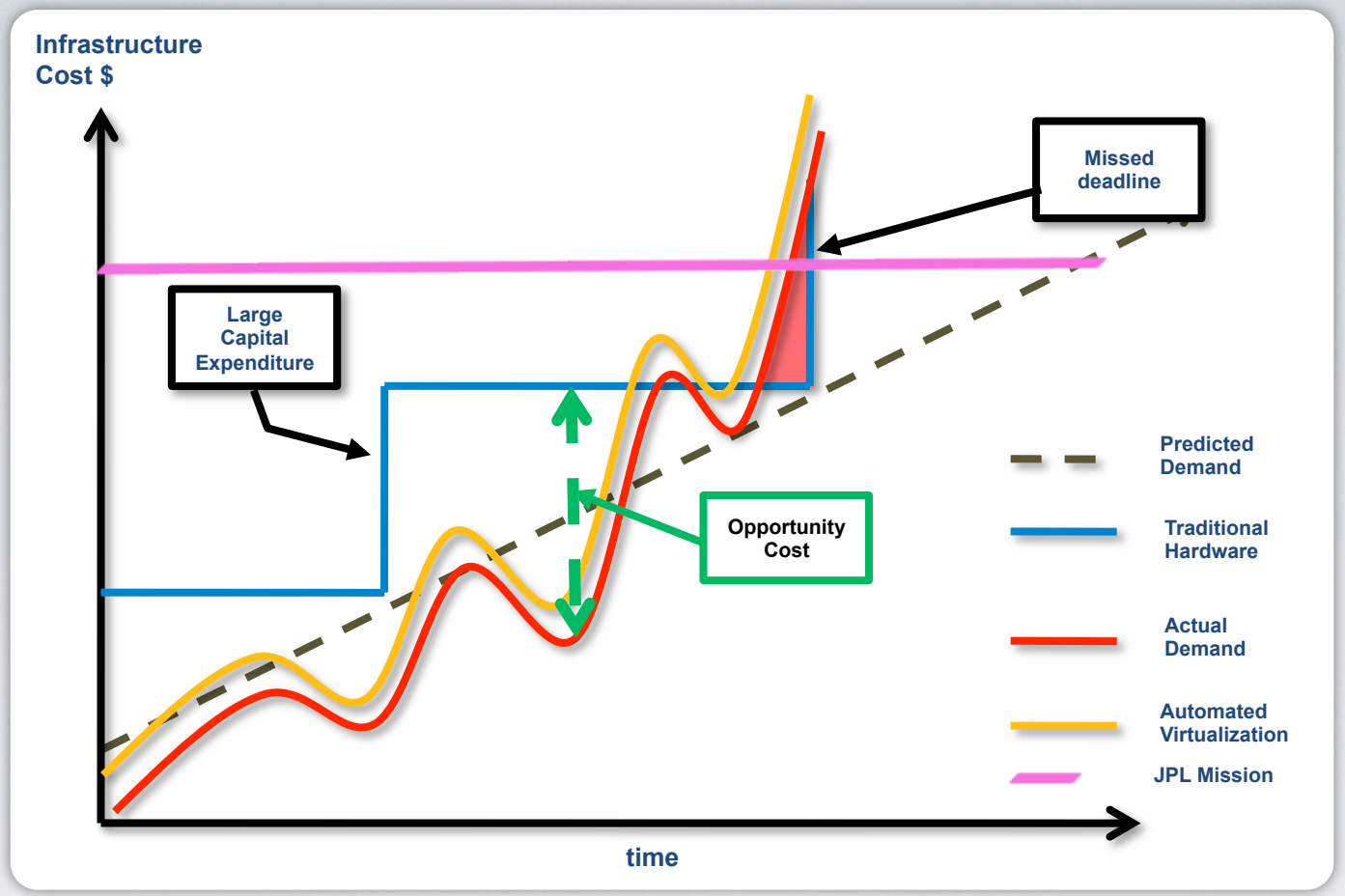


Mars Science
Laboratory
November 2011



NuSTAR
January
2012

PEARL STREET STATION



Mission Operations Computers

JPL OCIO

Enterprise Information Technology

Traditional Approach to Infrastructure

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	[redacted]s, Joseph C (1731-Affiliate)	RE: New Maestro Blade	August 6, 2009
	[redacted]s, Joseph C (1731-Affiliate)	RE: New Maestro Blade	August 6, 2009
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	Khawaja S Shams	Re: New Maestro Blade	August 5, 2009
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!!	[redacted] Bryan (315H)	Re: New Maestro Blade	August 5, 2009
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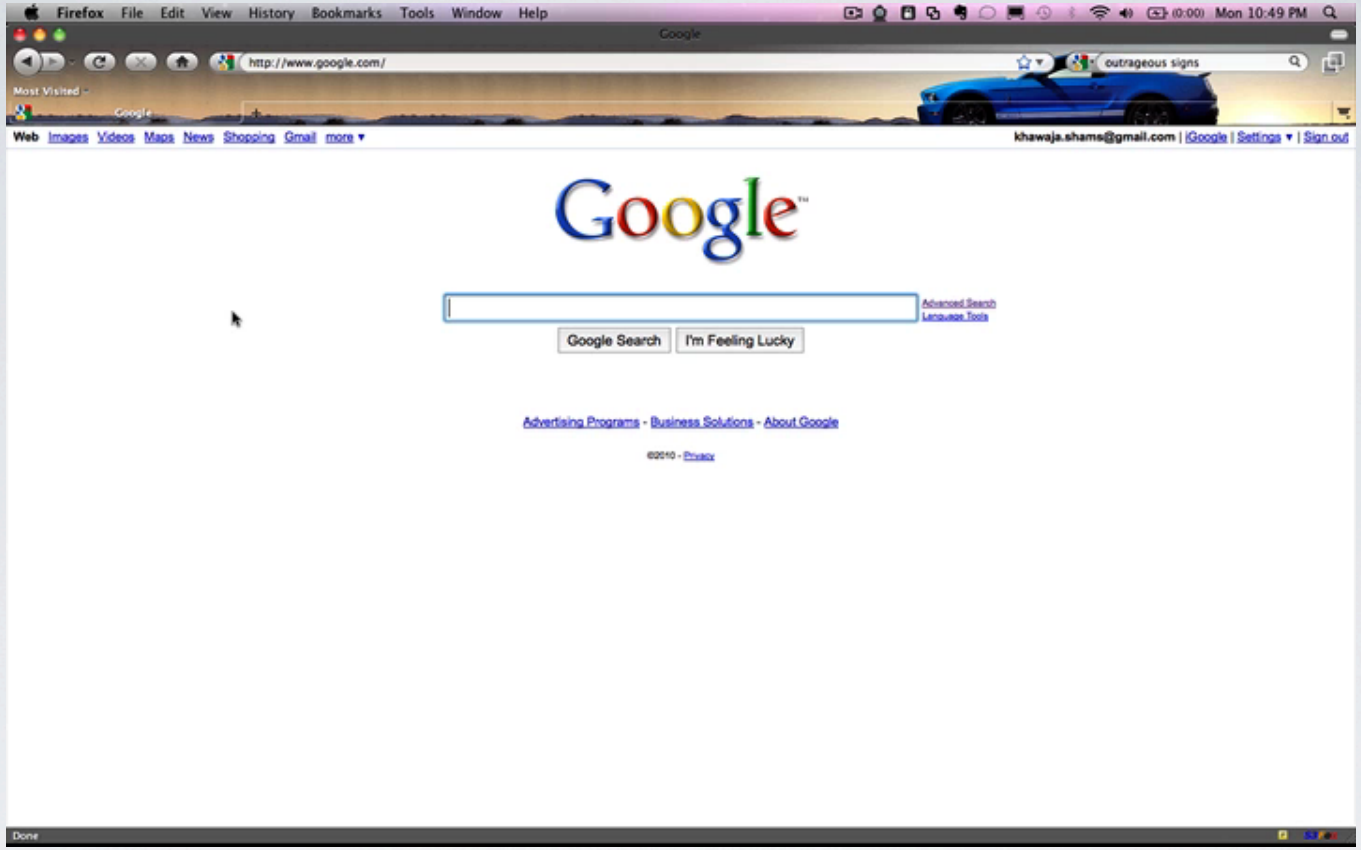
	[redacted]i (173G)	RE: New Maestro Blade	July 28, 2009
!!	[redacted], Douglas S (1733)	[redacted]	July 28, 2009
	Jeff Norris	Re: Confirming configuration of new MAESTRO...	July 28, 2009

Replace Every Procurement Screen with a Provisioning Screen.
Jim Rinaldi - CIO JPL

What Compute Capacity means to JPLers



Here comes the rain…

JPL's approach to Cloud Computing

But how?

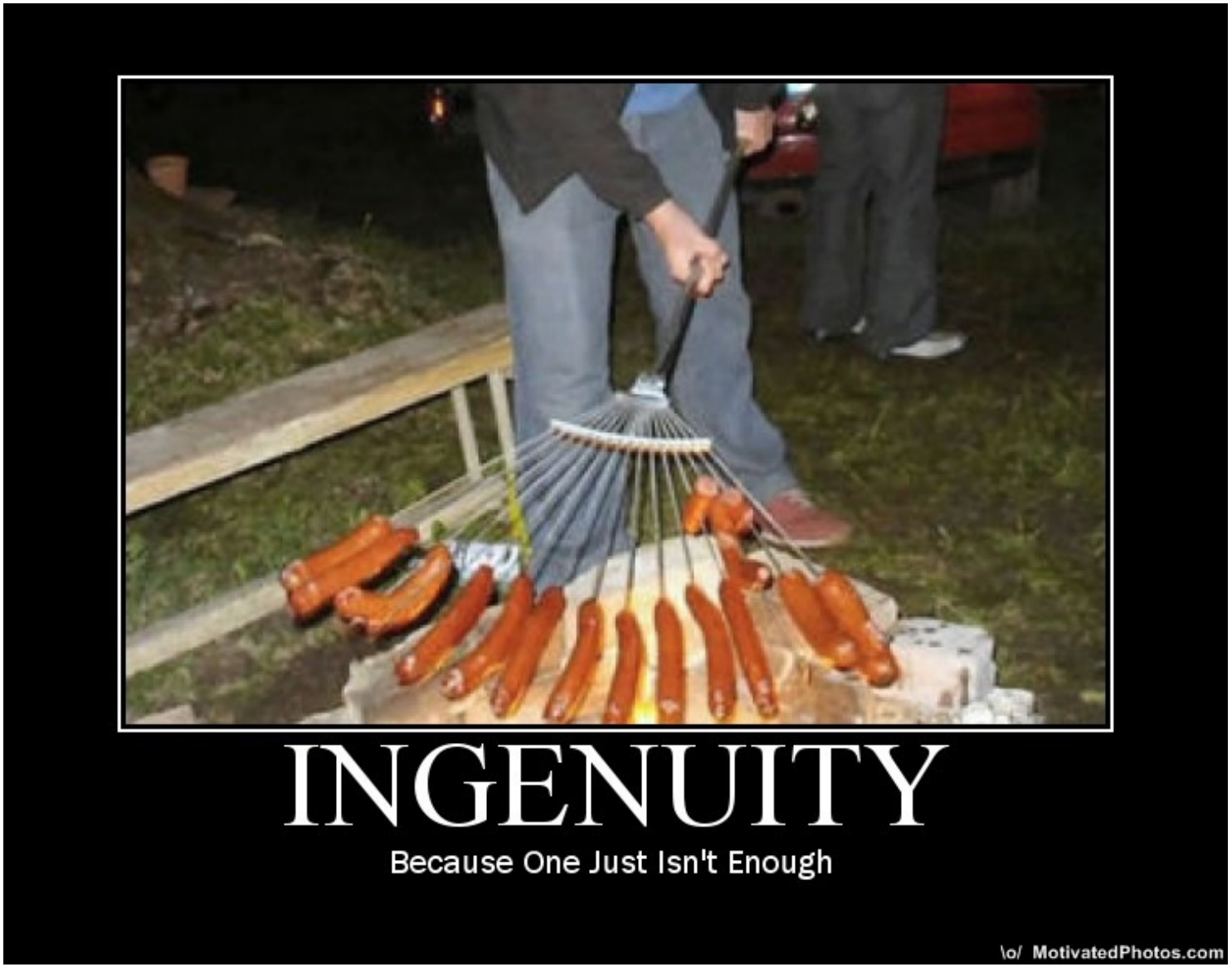
- **Focus on real business problems**
- Early hands-on prototypes of enabling capabilities in every promising cloud
- Avoid analysis paralysis, but be safe
- Educate, communicate, influence, elaborate
- **Keep it real**
- Pro-active partnering

Let’s Move to the Cloud!

Contract Negotiations!

First to Sign!

Fostering the IT Consumers' Ingenuity



IT ➔ "Innovating Together"

JPL Partners

terremark

CSC

LOCKHEED MARTIN
We never forget who we're working for™

UNIVA UD

Eucalyptus Systems™

appscale
open source Google App Engine

NASA NEBULA Cloud Computing Platform alpha

amazon web services™

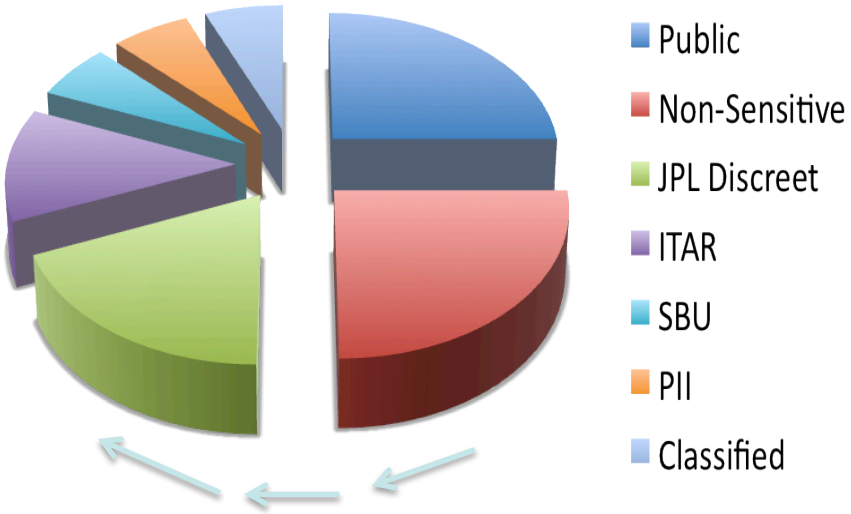
Google

Microsoft®

Cloud Computing Concepts

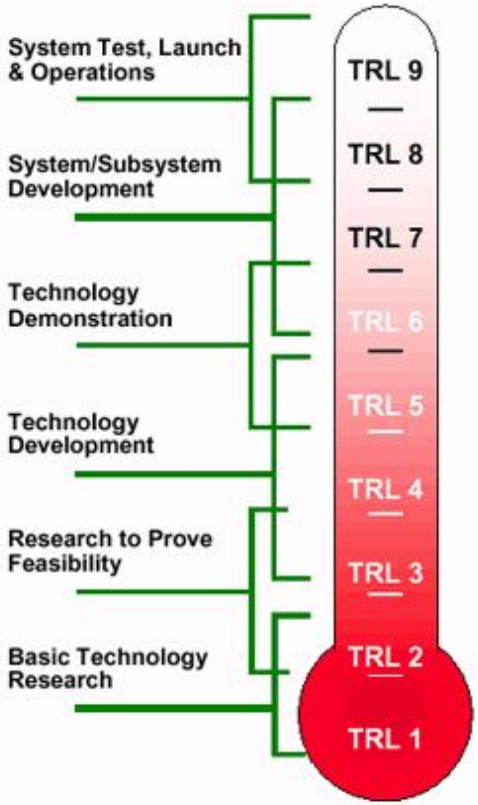
1. Cloud Application Suitability Model (CASM)

2. Wheel of Security



Public and Non-Sensitive data can be accessed in the Cloud today

3. Cloud Readiness Levels (CRL) (Institution, Apps, Dev)



NASA Technology Readiness Level

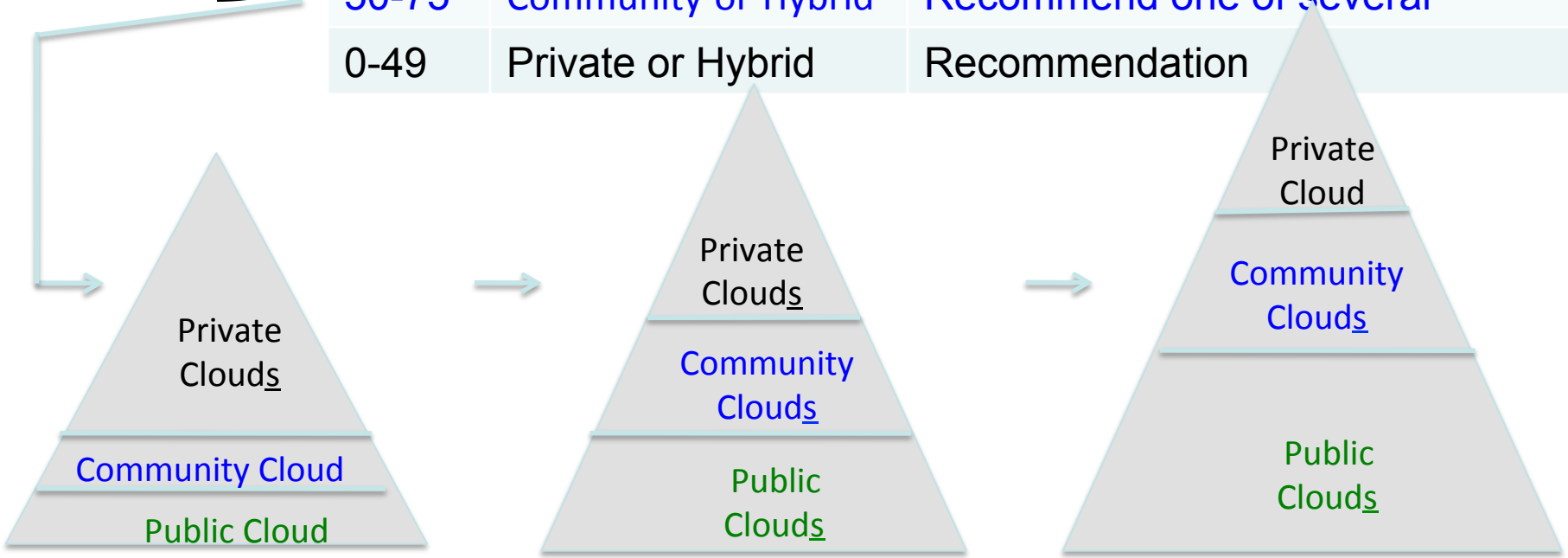
http://en.wikipedia.org/wiki/File:NASA_TRL_Meter.jpg

4. Cloud Oriented Architecture (ClOA)

Cloud App Suitability Model determines application location

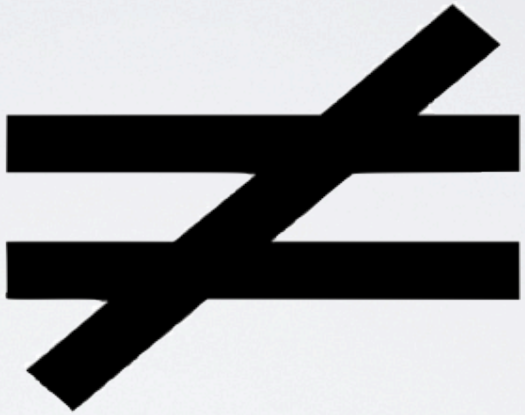
App Req'ts:
Security, ITAR, app type, bandwidth, uptime, etc

Score	Cloud Type	Testing ➔ Need for a "Cloud Broker"
76-100	Public	Recommends one of several
50-75	Community or Hybrid	Recommend one of several
0-49	Private or Hybrid	Recommendation

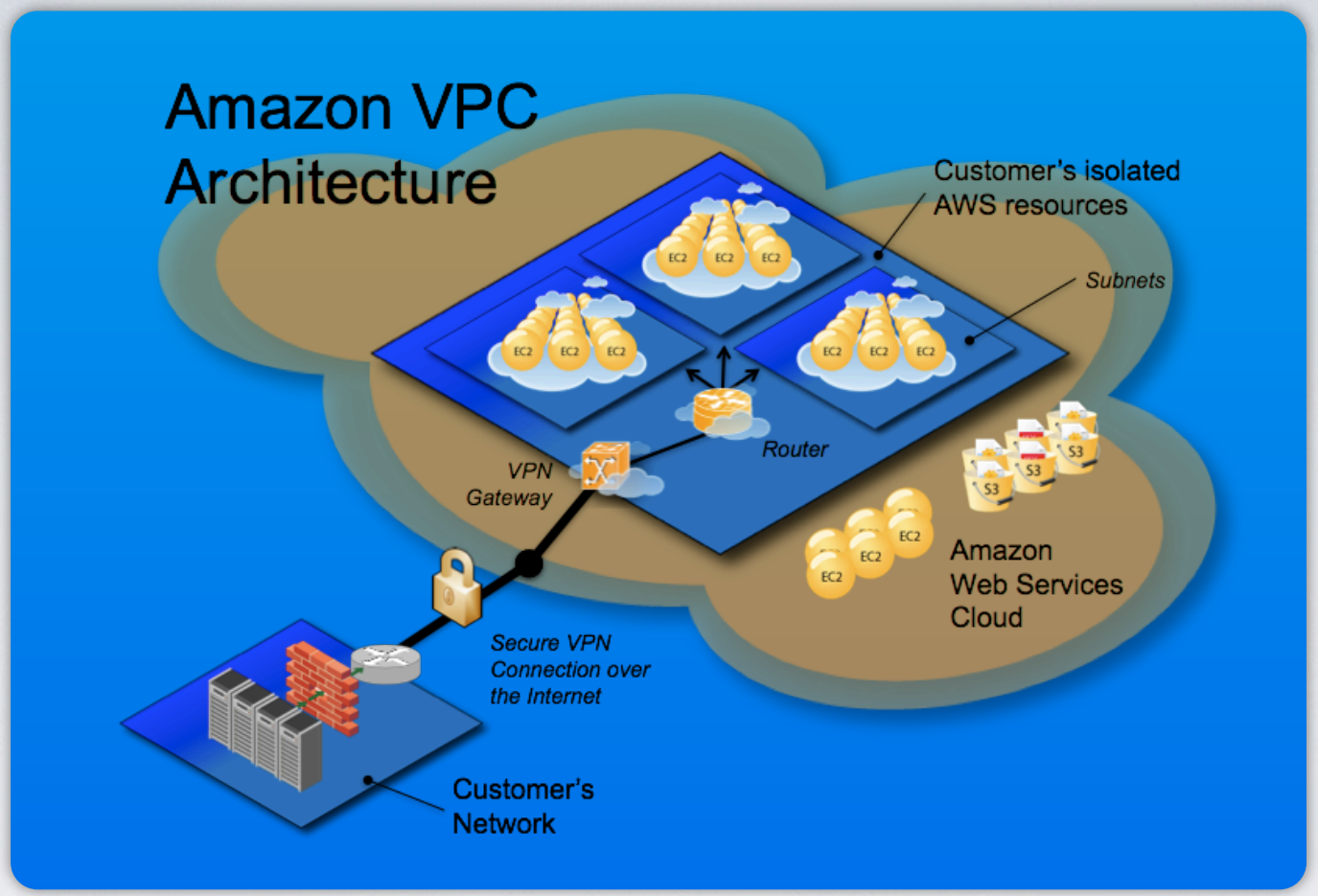


➔ *We'll become faster, cheaper, greener, more flexible, and a partner of choice*

Data in Cloud



Public Data



Virtual Private Cloud

JPL Cloud Uses: Outreach for Citizen Scientists

BeaMartian.jpl.nasa.gov

Reaches MS Cloud developers / citizen scientists of all ages

JPL Cloud Uses: Crowd Sourcing for E4 Rover

- At EclipseCon 2010, a competition to drive a "Mars rover"
- Innovative concepts. Great programs. Exciting and fun
- It was all in Amazon's Cloud (no JPL computing resources)

e4 Rover Mars Challenge

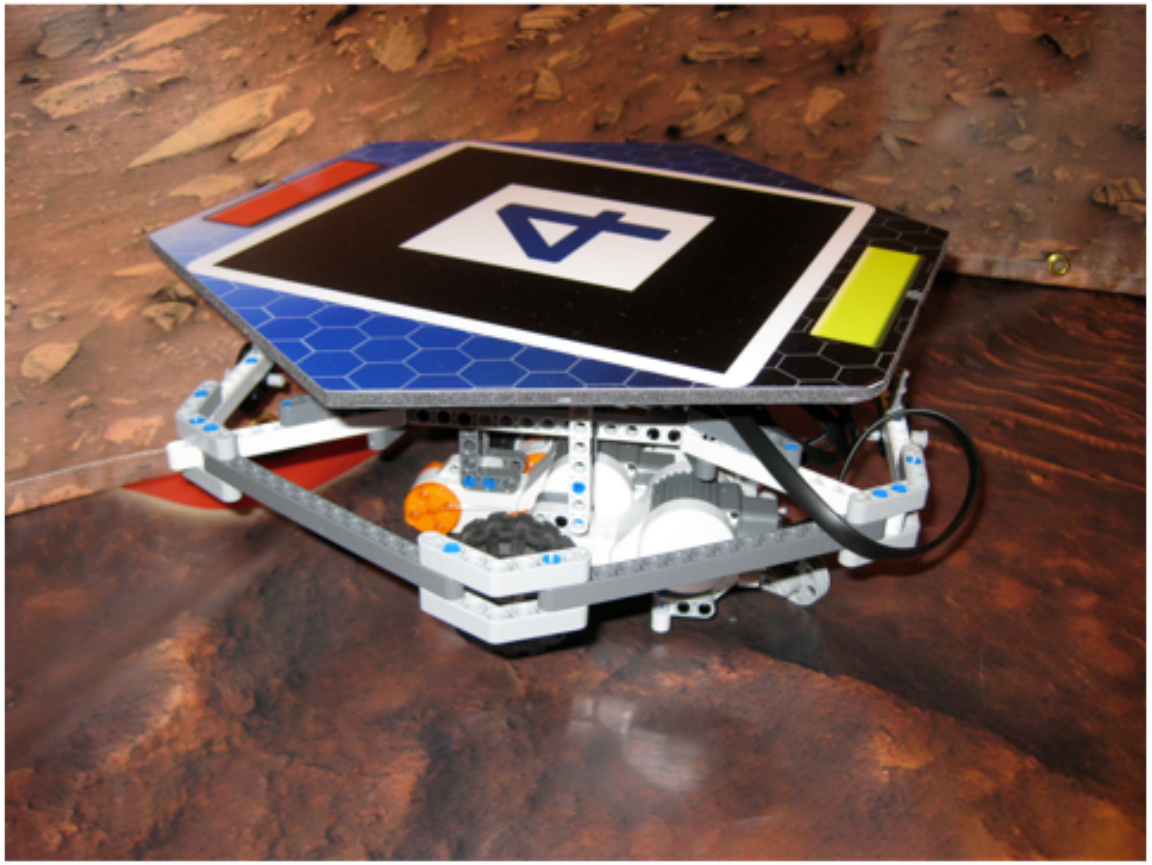
mindstorms

Slashdot

Mashable

POPSCI

NASA

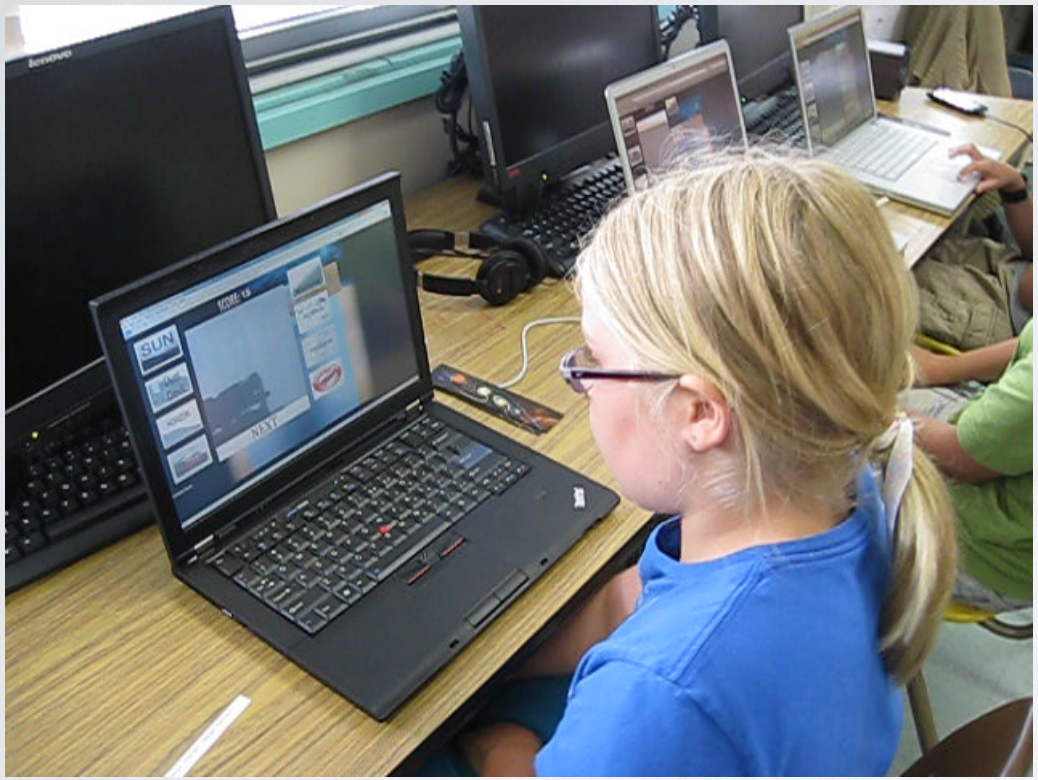


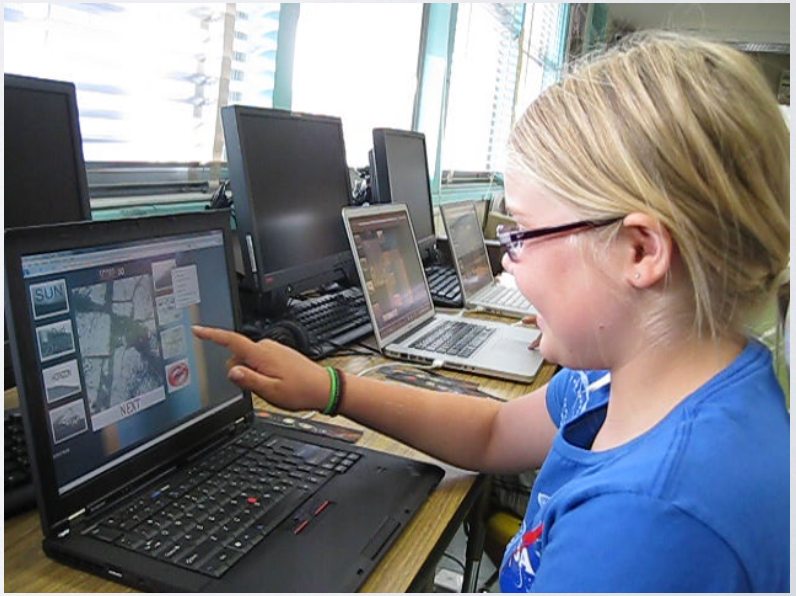
Mars-2-Earth

UCSD

JPL
Jet Propulsion Laboratory
California Institute of Technology

Mars-2-Earth

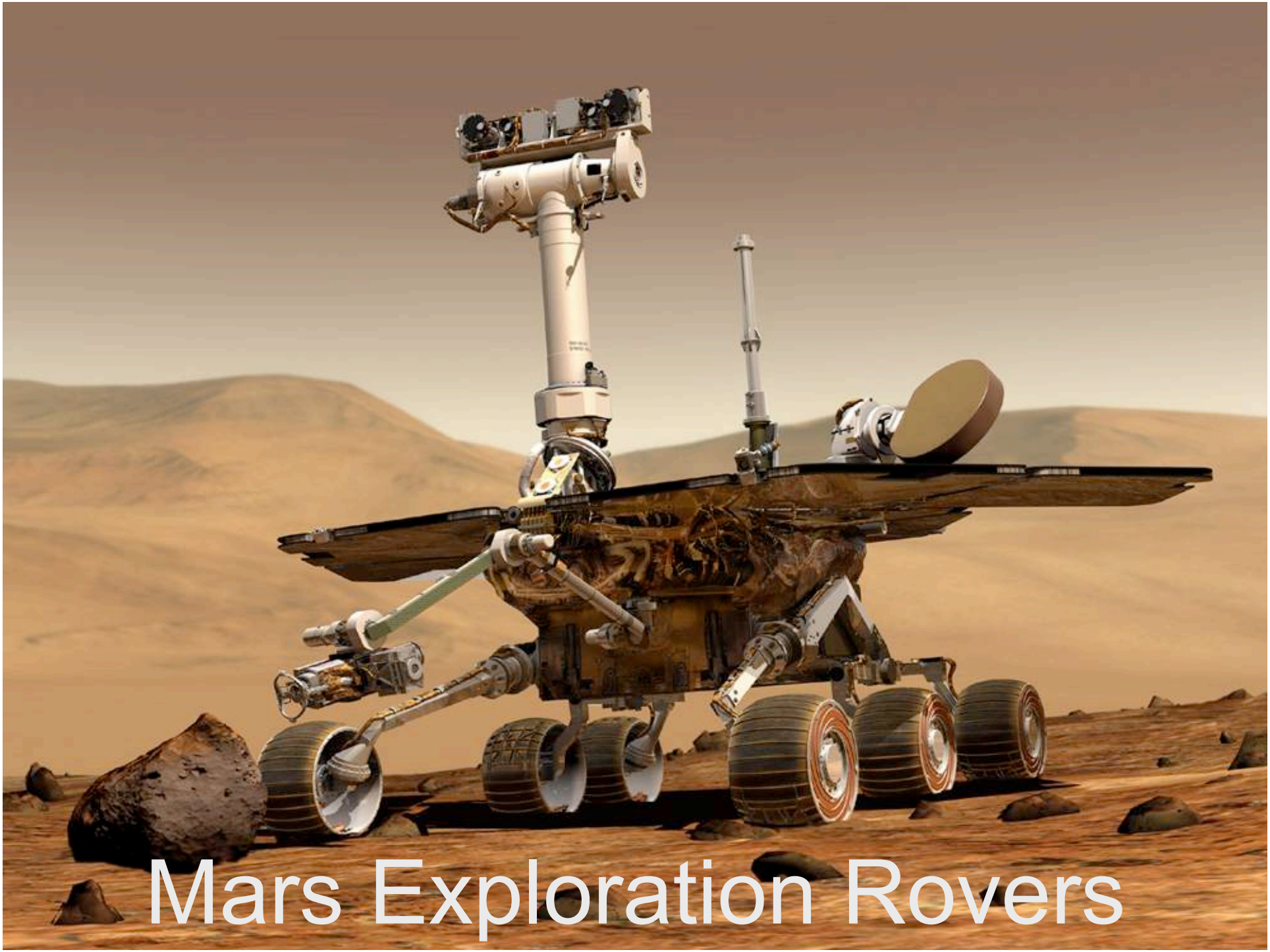




UCSD

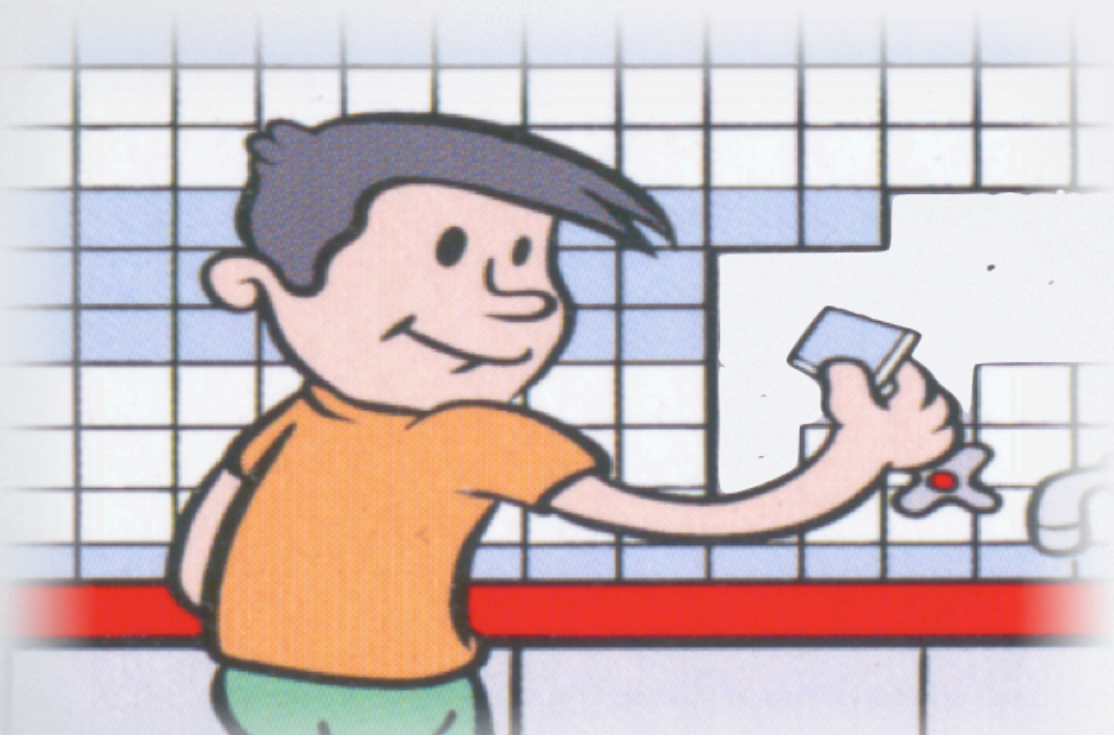
JPL
Jet Propulsion Laboratory
California Institute of Technology

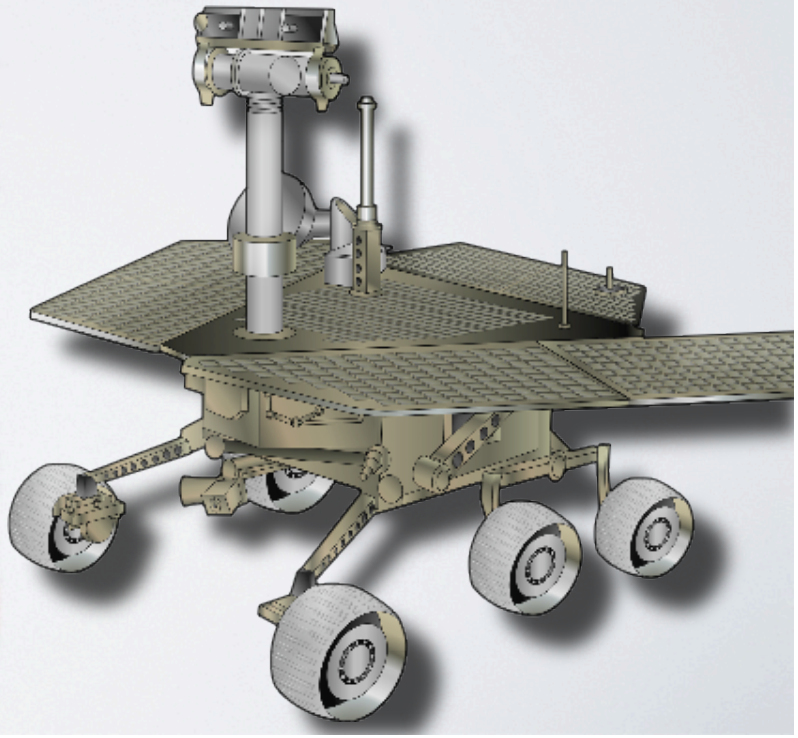
JPL Cloud Uses: Amazon HPC usage for Athlete


Mars Exploration Rovers

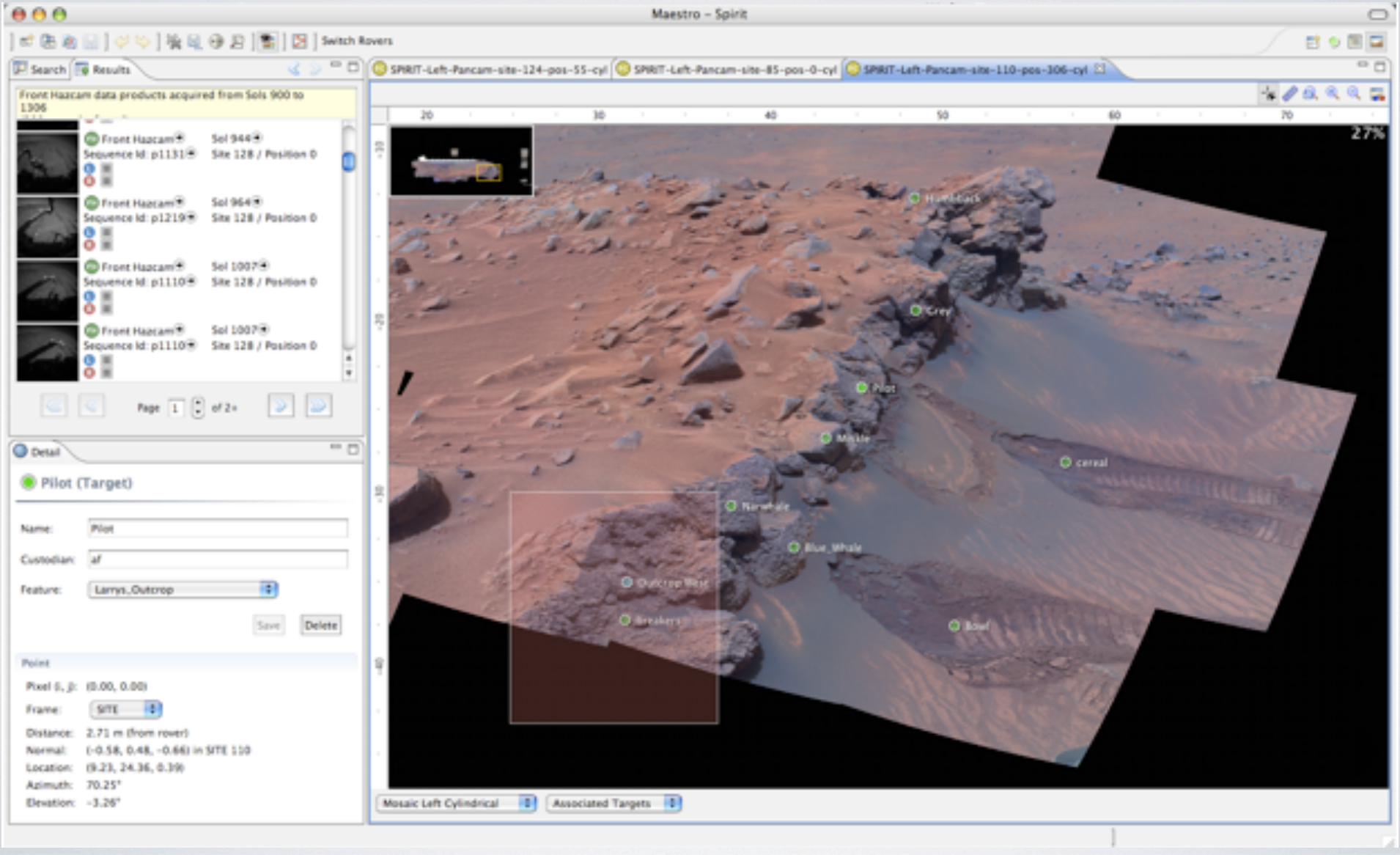
MER Image Processing

Embarrassingly parallel application
Process and deliver from Cloud
Streamlined image processing through Cloud Computing
Better situational awareness, better science, better safety





Maestro for MER



OPS Lab
Operations Planning Software Laboratory

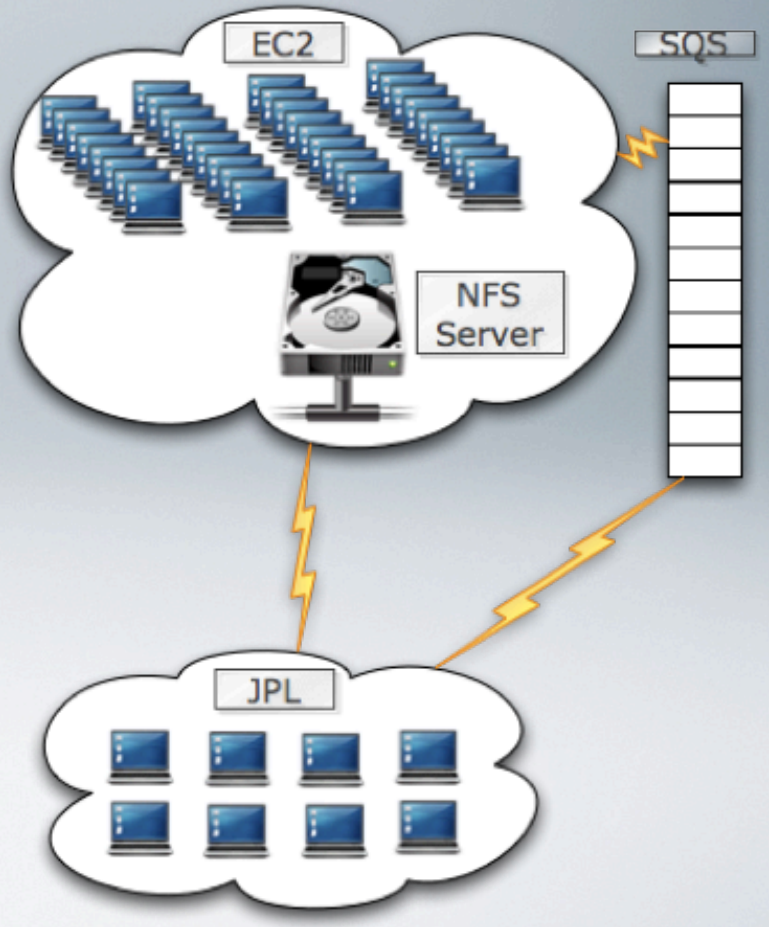
POLYPHONY

IMAGE PROCESSING ON CLOUD

~ Quarter Million Images
Quarter of a *day*
<$200

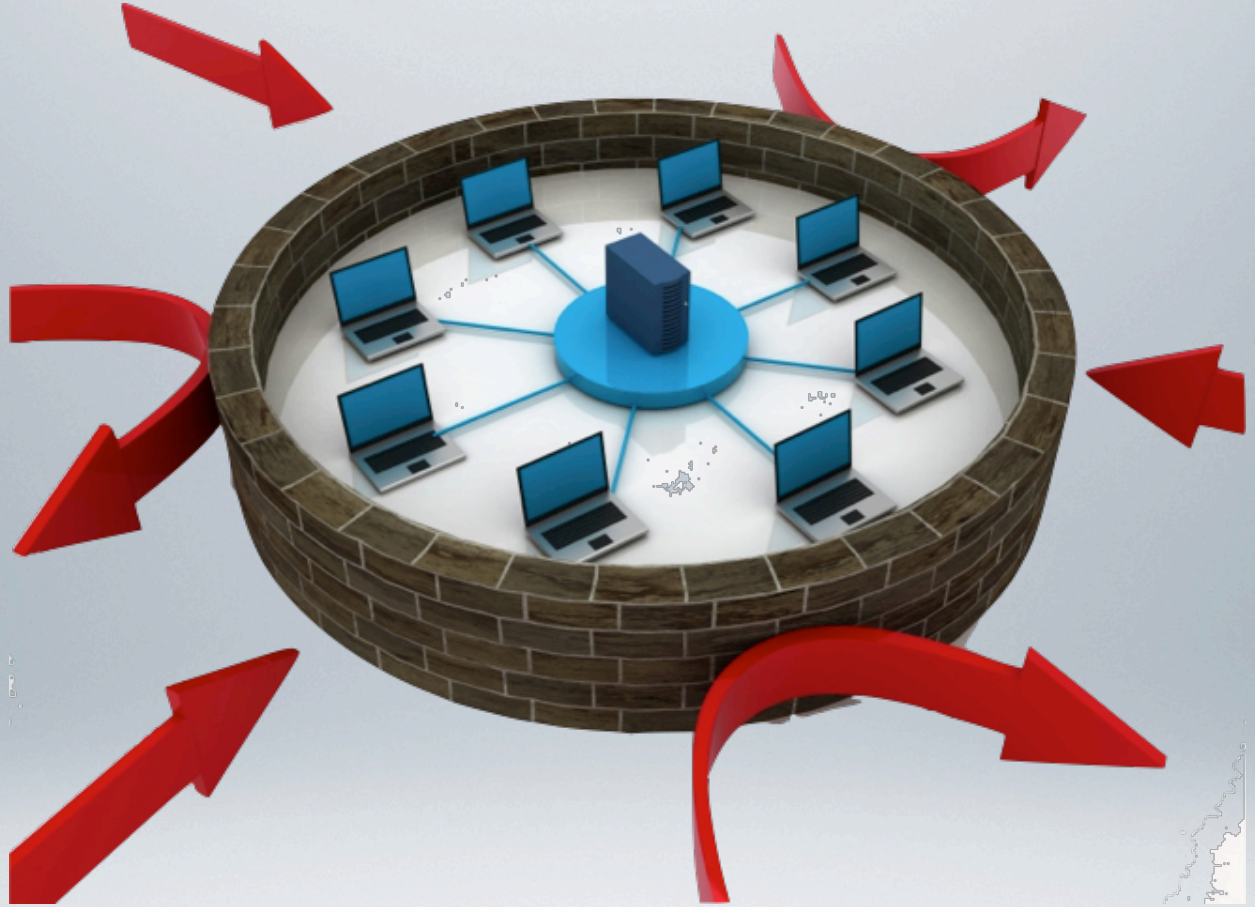
Weeks ⊘ Days

Polyphony Architectural Diagram



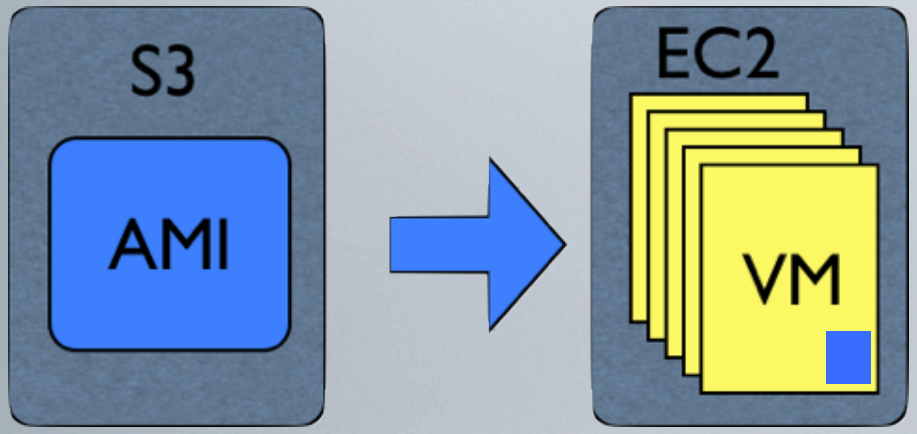
Physical Control

Who Do We Already Trust?



Can Clouds Be Safer?

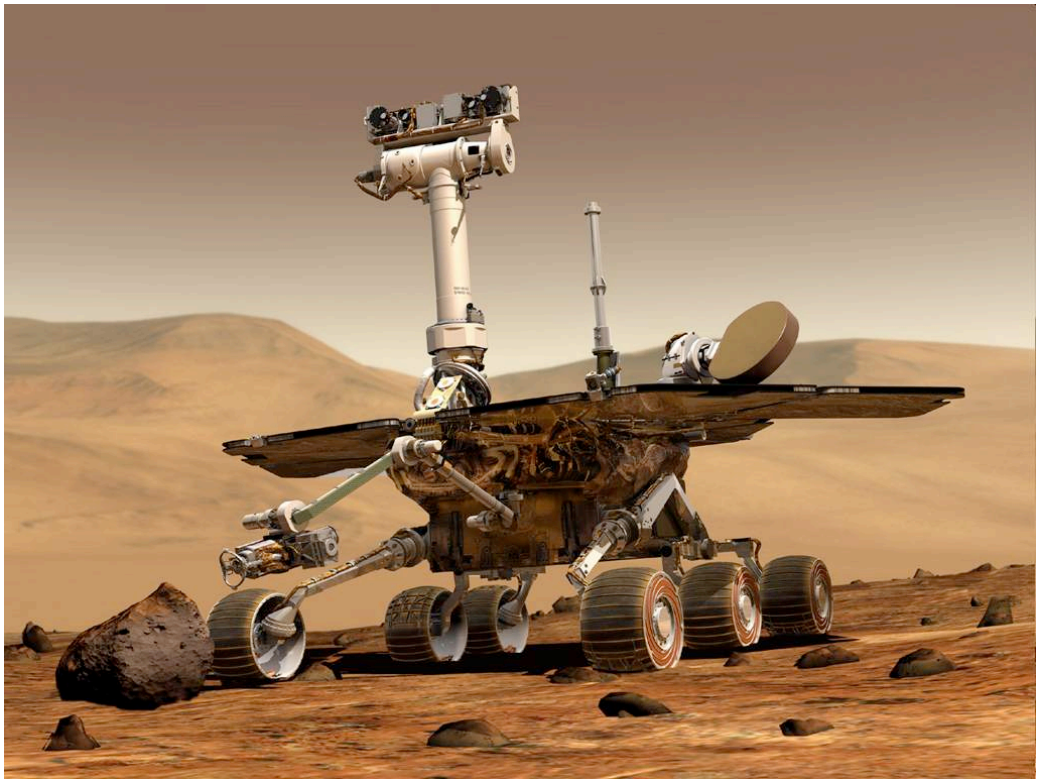
Security through Uniformity



JPL Cloud Uses: Observed Mission Benefits

A few examples of prototyped benefits so far:

- From weeks to hours to process Saturn images
- 15% more time for scientists world wide on Mars rovers
- From days to hours to model computations (e.g. DSN)
- Can reduce ops costs
- Can reduce risk
- Can speed experiments
- Augments JPL resources
- **Partnering pays off!**



JPL Cloud Strategy: What's next

➔ **Cloud is THE enabler… if we continue to Keep it Real**

JPL Cloud Strategy: What's next for JPL and Clouds

- We transition from understanding the Cloud to working in the Cloud to partnering in the Cloud
- The Cloud enables everything … if we let it (e.g. PC 3.0)
- Specialized Clouds become the Operating System
- JPL will advance the Cloud Readiness Levels (CRL) and Cloud Oriented Architecture (COA)
- Transition Cloud from Pilot to Operational mode
- Spin the Wheel of Security and evaluate more Use Cases
- Automate the Cloud Application Suitability Model (CASM)
- Continue to keep it real and benefit from employees' and partners' ingenious usage of Clouds

Take full advantage of the Pervasive Cloud

Can we live without making IT rain?

What can YOU do about Cloud computing?

- Get started now with low sensitivity data
- Focus on new capabilities
- Prototype under the radar screen
- Communicate it as a business initiative (ROA)
- Partner with everyone
- Use the 3-floor elevator test
- Create a cross-functional leadership team focused on the concept (legal, procurement, security, facilities, business leaders, IT)
- Expect license agreement to take time
- **Keep it real**