CONNECT OPENVMS Bootcamp 2010

Using OpenVMS Technologies to Build an Agile Computing Base

From Experiment to Production without Interruption

Robert Gezelter, CSA, CSE

As a courtesy to your fellow attendees:

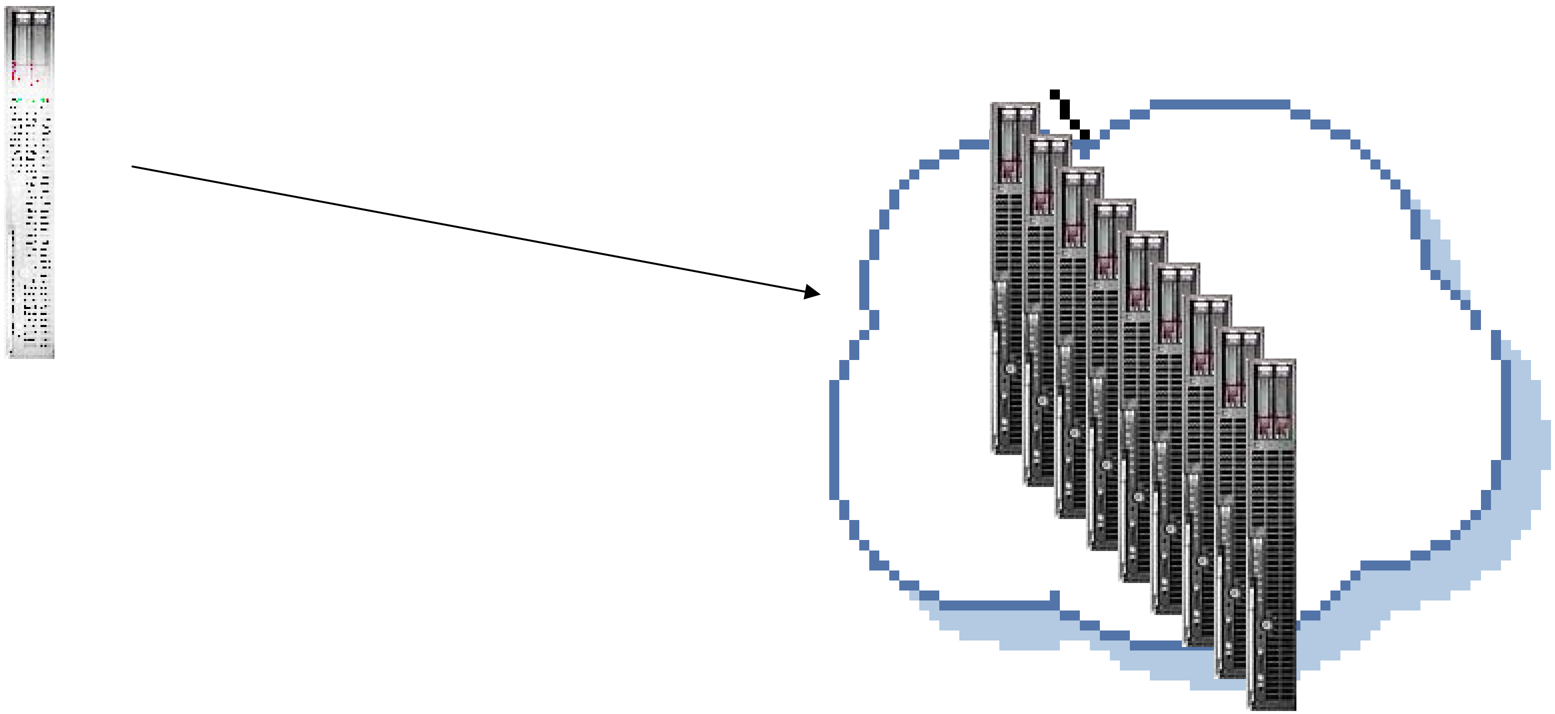
Please take this opportunity to check that ***ALL*** portable electronic devices are on the silent or vibrate settings.

If you need to answer a call, please leave the room to avoid disturbing your fellow attendees.

This is a ***NOT*** a Non-Disclosure Session.

This session, and the material therein may be referenced and reproduced without limitation, provided that proper credit is given and the copyright notice is retained unaltered.

The goal – Seamless operation from Experiment through Production



Do you use “cloud computing”?

- Scalability
- Configuration independence
- Maintainability
- Upgradeability
- Transparent failover

Maintainability

Scalability

Upgradeability

Configuration Independence

Transparent Failover

“ility’s” are results; not causes

- Specific engineering create results
- Most “cloud” presentations omit what creates the results
- Many “cloud” computing models are nothing more than “virtualized” versions of non-cloud platforms (e.g., Windows™, Linux)
- Virtualization does not solve problems (e.g., virtual machine migration)

Is “cloud computing” new?

- The term is of recent origin
- Computing independent of being “in front of the machine” is by no means new
  - SaaS
  - ASP
  - Remote Access (1970’s)
  - Timesharing (Project MAC, circa 1963)

Six blind men and an elephant

- What you feel depends on where you are
- Perspectives are only a single point or slice

From Martha Adelaide Holton & Charles Madison Curry (1914), *Holton-Curry readers*, Rand McNally & Co. (Chicago), p. 108

Often, what appears different is merely a question of perspective

- Not unlike the elephant
- Circles, ellipses, parabolas, hyperbolas, and other curves are all “conics”
- “conics” are all slices of a cone
- Analyses are all related
- Understand the general case, all of the special cases are solved

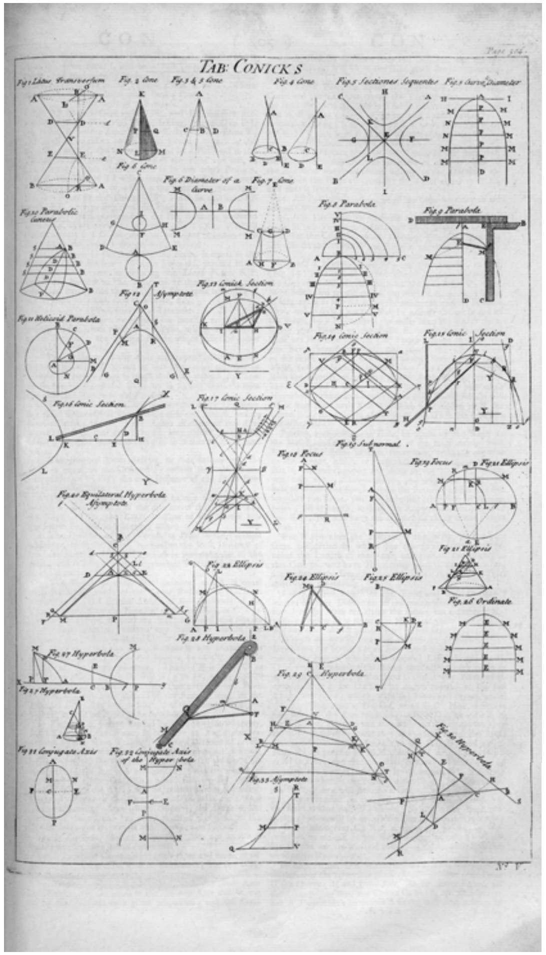


Table of Conics, *Cyclopaedia* (1728), volume 1, pp 304

Difference between clairvoyance and reality

- Controlled and uncontrolled changes are fundamentally different
- Example: Processor upgrade
  - Known in advance
  - At “Time and Place chosen”
  - Can always be aborted

Difference between clairvoyance and reality (cont'd)

- Example – Uncontrolled
  - "Time and task not of my choosing" (?) – Chester Nimitz, Admiral, USN, Spring 1942
  - No advance warning
  - No reschedule
  - No inherent fallback
  - Case in point: World Trade Center, 9/11; Blade-out in a jet turbine; Spring 2004 HPTF NE US power outage

The difference – In short

The difference can be summarized as that between a ordinary switch and a circuit breaker

- Switches work when thrown
- Circuit breakers work either when:
  - Manually
  - Automatically (when an overload occurs)
- Circuit breakers are more embracive than switches

Back to computing: An example – Virtual machine migration vs. OpenVMS Clusters

- Comparing apples to oranges
- Virtual machine migration is a "switch"
- OpenVMS cluster failover is a "circuit breaker"
- Virtual migration is useful ***WITHIN*** the context of an OpenVMS cluster; it is not a substitute

Combining existing fundamental facilities in new ways

- OpenVMS clusters
  - Shared locking domain
    - Shared system volumes
  - Logical names
  - Rolling reboot
- Volume Shadowing for OpenVMS (aka HBVS)
- HP Virtual Machines (and other virtualization products from Stromasys and Migration Specialties)

Each of these technologies is independent

- These technologies are independent
- In concert, they create an extremely malleable environment
- This flexibility allows us to transition the hosting and capacity of a cluster in any way we choose

The fourth dimension: Time

- Hindsight is always 20/20 (if not better)
- Foresight, somewhat less so
- Capacity projects are fallible; both high/low

Employ technology to remove shortfalls

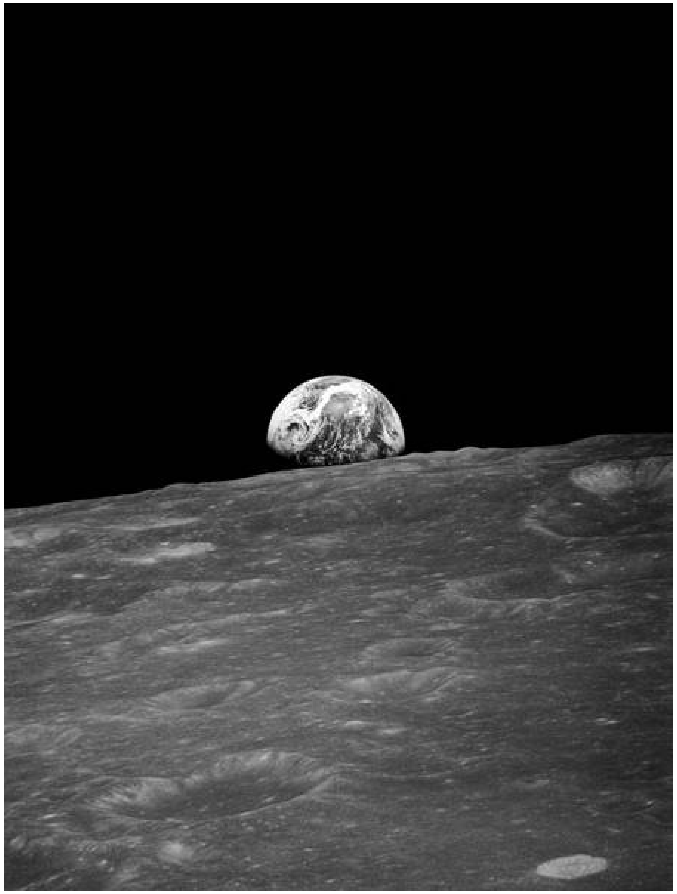
- OpenVMS clusters address capacity up/down
- Volume Shadowing for OpenVMS allows us to change storage platforms
- Virtual machines allow:
  - Fractional provisioning
  - +(fractional second) Ready Reserve capacity
- Dynamic Volume expansion allows expansion of file volumes
- Logical names hide hardware dependencies

Not new technologies: Change Perspective

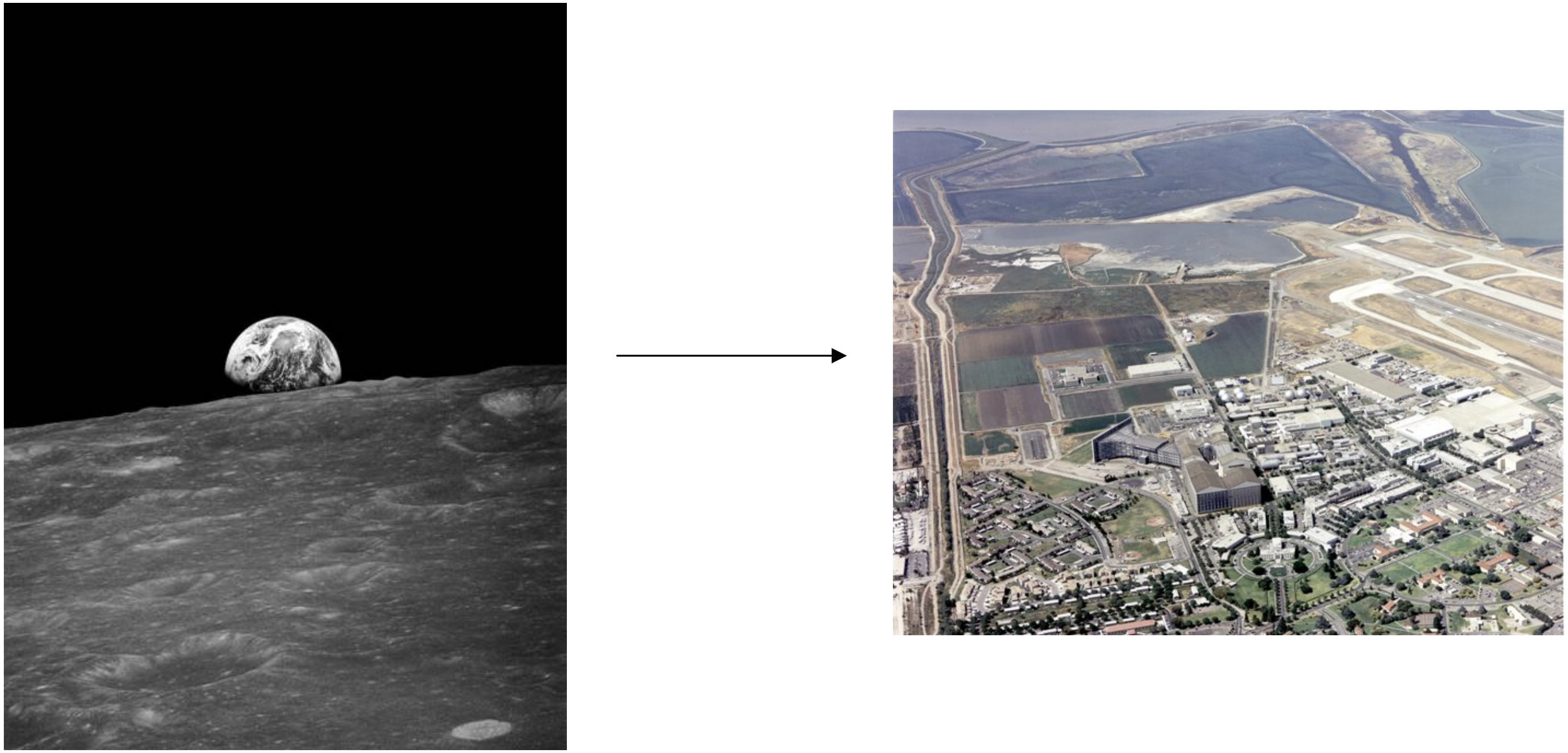
- “short sightedness” is a common hazard
- Manuals often reinforce with “on point” examples
- The general case is often under explained and thus under appreciated

Technologies from a high perspective

- “Not seeing the forest for the trees”
- A more global perspective aids comprehension

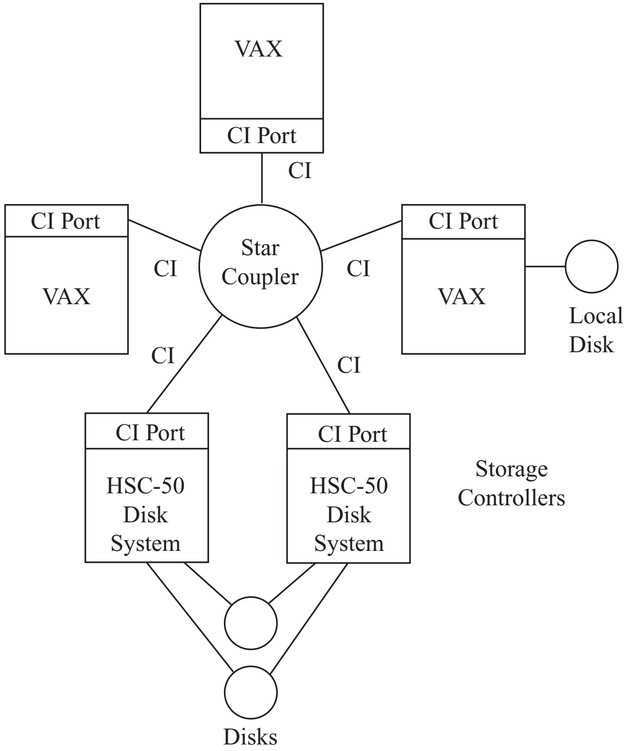


Then look at point cases as one point in a long-term continuum



In this vein, revisit OpenVMS clustering

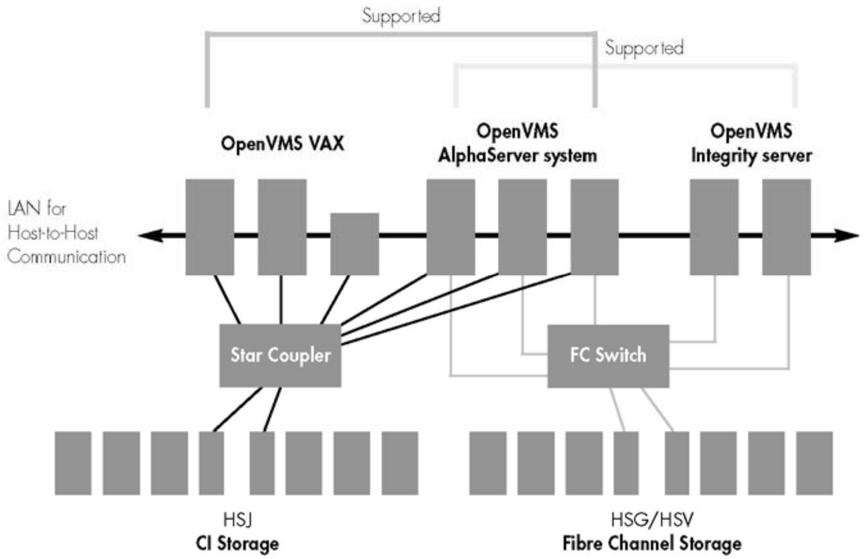
- Classic VAX cluster (Kronenberg, Levy, Strecker, 1986)
- Certainly valid
- Not the entire concept
- Does not illustrate the potential of the "OpenVMS cluster gestalt"



From Kronenberg, Levy, & Strecker, (1986)
VAXcluster: A closely-coupled distributed system
ACM Transactions on Computer Systems 4(2)

Current OpenVMS Clusters

- Even today's examples are far too restrictive
- Cluster nodes remain hardware tied
- This is an unneeded and incorrect belief



Both classic and present are snapshots

- Both are individual moments in time
- Over time
  - a cluster node may be small, large, or non-existant
  - Over time, nodes matter
  - Nodes are independent of their hardware

Monday	Fractional VM
Tuesday	BL 860
Wednesday	<none>
Thursday	Fractional VM
…	<none>
Monday + n	Superdome

An OpenVMS cluster node is ***NOT*** a :

- CPU, blade, box, or virtual partition
- System disk (or root thereof)

If a node is not a machine, what is it?

A member belonging to an OpenVMS cluster is identified by its Cluster ID (**`SCSSYSTEMID`**) and Cluster Node name (**`SCSNAME`**). At any given point in time, a member can exist on at most one "processor" with communications to the OpenVMS cluster. The current host processor may be real or virtual.

An active OpenVMS cluster member has a:

- Host processor(s)
- A system volume or shadow set
- A specific system root on the system volume (**`SYS$SPECIFIC`**)
- Files specific to that root
- Files specific to that node (note the difference with the preceding)

Types of nodes in an OpenVMS cluster

- Core nodes (voting)
- Satellite nodes (non-voting)

Both types of nodes may be individually virtualized at various times.

New logical name needed: **SYS$NODE_SPECIFIC**

- New root on system volumes: **[NODE_SPECIFIC]** (Gezelter, 2009)
- Each member has a directory below this root (e.g., **[NODE_SPECIFIC.ALPHA]**
- Add logical name definition early in startup process by entering definition file in user side of **STARTUP** database (**STARTUP$STARTUP_LAYERED**)
- Inserted in **SYS$**... search lists behind **SYS$SPECIFIC** and before **SYS$COMMON**

New logical name needed: **SYS$SITE_SPECIFIC**

- Logical names specific to local site (Gezelter, 2004)
- May have separate directory tree, e.g. **[SITE.<location>]**
- Add logical name definition early in startup process by entering definition file in user side of **STARTUP** database (**STARTUP$STARTUP_LAYERED**)
- Inserted in **LNM$FILE_DEV** ahead of **SYS$COMMON** and behind **SYS$NODE_SPECIFIC**

Each OpenVMS cluster node has several alternative boot roots

- Base node definition information (**SCSNAME**, **SCSSYSTEMID**, DECnet node address, etc.) in **SYS$NODE_SPECIFIC**
- Individual boot roots hold system parameter file
- Writeable logs
- Possibly page file (could be in **SYS$NODE_SPECIFIC** or elsewhere)
- Possibly dump file (could be in **SYS$NODE_SPECIFIC** or elsewhere)

Why separate node specific and boot roots?

- Production version
- Test version
- Previous production version
- Experimental version
- Different hardware scenarios (e.g., blade, virtual, rx2660, AlphaServer DS10)

Separate roots – Example

Cluster member **GREEN** has:

- node specific files in **[NODE_SPECIFIC.GREEN]**
- Port Production BL860c boot root of **SYS1**
- Starboard Production BL860c boot root of **SYS11**
- Emergency rx2660 boot root of **SYS21**
- Test BL860c boot root of **SYS31**
- Experimental boot root of **SYS41**
- Etc …

Specific boot roots invoke Node-specific files

- **STARTUP** series command files (e.g., **LAT$SYSTARTUP.COM**)
- **AUTOGEN** files
- Test within “Experimental Boot root”, promote to “Production” roots or Node-specific directories
- Similarly, promote from Node-specific to **SYS$COMMON** as appropriate

About system volumes

- Characterizing OpenVMS as a “single system image” cluster understates the case
- “single system images” (e.g., shared system disk) is a possibility; but it is only one of many
- “a copy of the system that may be used by zero or more nodes at any point in time” may be a more appropriate description
- At least one (preferably more) per architecture per cluster at any moment in time

System volumes are similar to boot roots

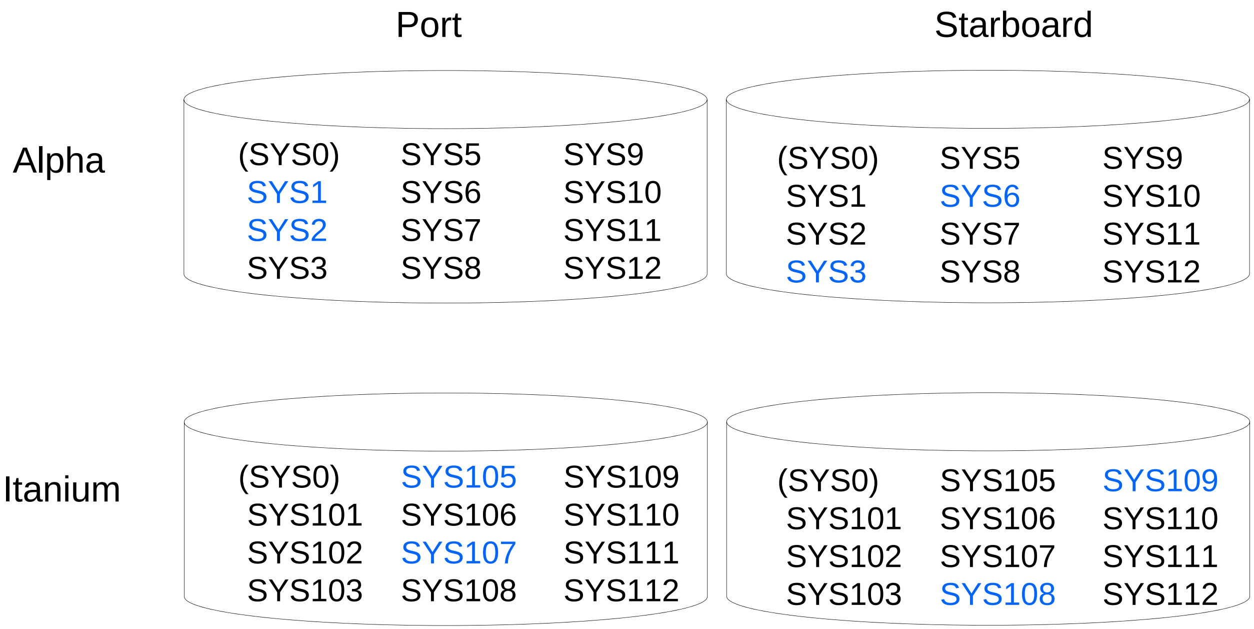
Per architecture:

- Port/Starboard Production (or more depending on load) copies
- Test copies for upgrading
- Previous copies for fallback
- Experimental copies as needed
- Master copy

Treat system volumes same as applications

- Clone masters for “Production” copies
- For “Upgrades” or “Installations”
  - Clone master creating test system volume
  - Perform update/installation
  - Following test; promote Test to master
  - Create one/more new Production clones
  - Phase in use of new Production clones; phase out previous set of Production clones

Steady state:



Port — Alpha

(SYS0)	SYS5	SYS9
SYS1	SYS6	SYS10
SYS2	SYS7	SYS11
SYS3	SYS8	SYS12

Starboard — Alpha

(SYS0)	SYS5	SYS9
SYS1	SYS6	SYS10
SYS2	SYS7	SYS11
SYS3	SYS8	SYS12

Port — Itanium

(SYS0)	SYS105	SYS109
SYS101	SYS106	SYS110
SYS102	SYS107	SYS111
SYS103	SYS108	SYS112

Starboard — Itanium

(SYS0)	SYS105	SYS109
SYS101	SYS106	SYS110
SYS102	SYS107	SYS111
SYS103	SYS108	SYS112

Active System Root
Inactive System Root

From *Evolving OpenVMS Environments* (Gezelter, 2009) presented at the 2009 HP Technology Forum, Las Vegas, NV (June 17,2009)

About cluster members:

OpenVMS clusters are often incorrectly described as being a "***n***-node cluster". A better phrasing would be "normally a ***n***-node cluster".

Why?

- Sporadically operating test nodes
- Scheduled expansion (daily) nodes (e.g., "Wildfile')
- Pre-configured expansion nodes (often non-voting)

Surge capacity (“call up the reserves”):

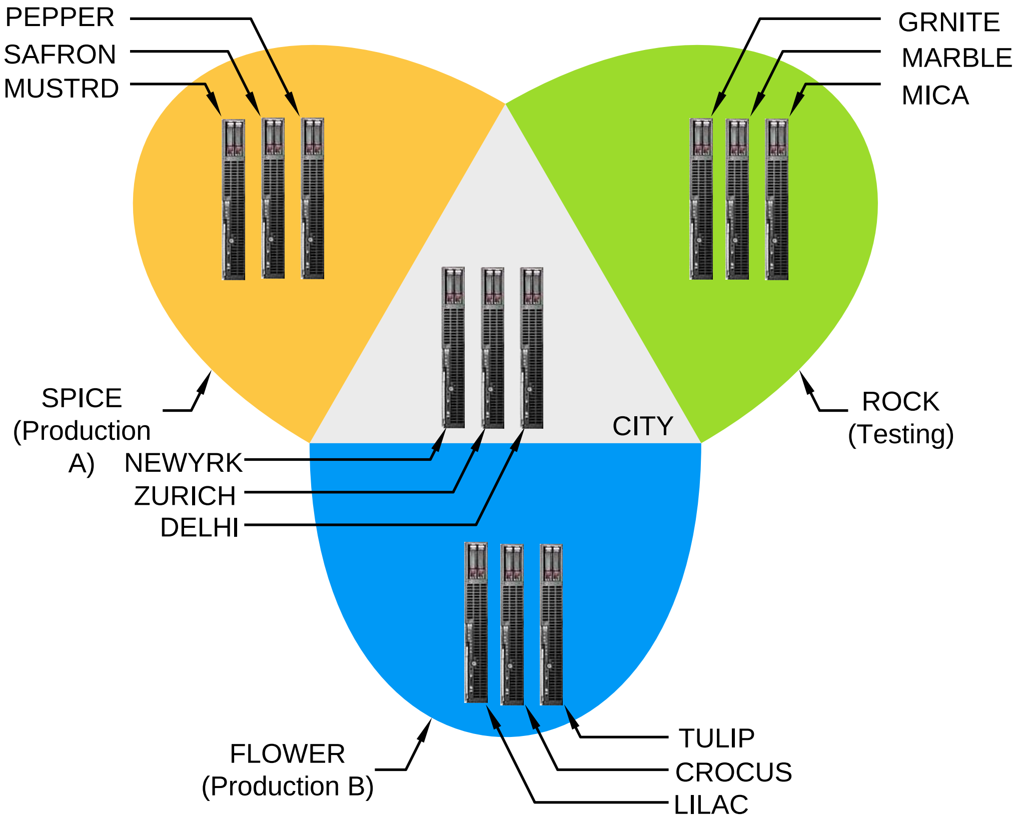
- Pre-defined satellite “worker” nodes
- May be physical (e.g., blade, test system, quality assurance systems, training systems)

“Oh &^%**&$#; get 10,000 (or more) VUPS online now!!!!!

- Remember those pre-configured reserve production roots?
- Consider:
  - Virtualizing test/quality/assurance/training systems
  - Creating a nominally, high priority reserve production cluster member instance in a different VM on the same physical host hardware.
  - 90+% return of capacity in under one second; reduced impact on normal users (test, QA, students)

Hardware assets become a “pool”:

- Assets are fungible
- Reallocate as needed
- Virtual slices can be quickly pre-empted



From *Evolving OpenVMS Environments* (Gezelter, 2009) presented at the 2009 HP Technology Forum, Las Vegas, NV (June 17,2009)

This is not theoretical

- This is all completely legal OpenVMS
- Nothing has been done which has not been supported
- Fall forward; not fall back
- Shortened downtime
- Agility ≡ pre-provisioned and prepared
- This is an “OpenVMS” private cloud with all of the attributes of a virtually hosted servers on other platforms

Back to the original problem – Prototype to Production without Interruption

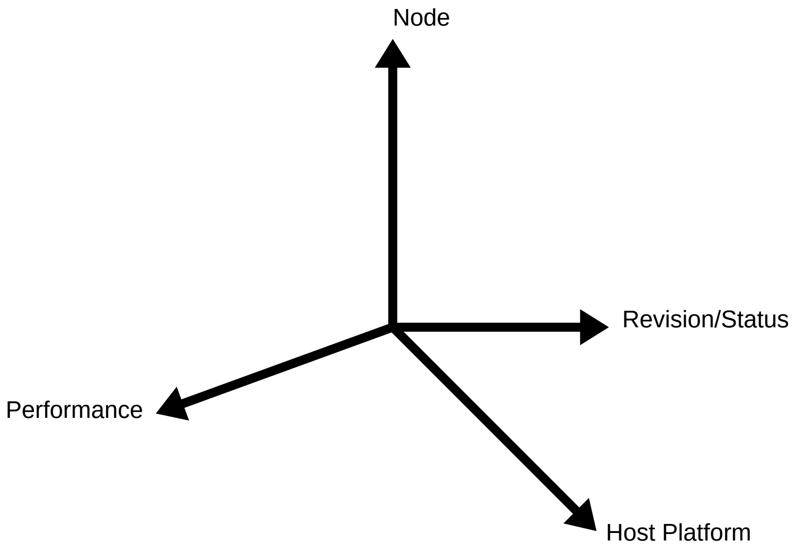
- There are multiple variables, each of which can prevent success
- Look at successful episodes, is there a common thread?

How does OpenVMS do it?

- Since 1976, OpenVMS has run on
  - VAX
  - Alpha
  - HP Integrity™
- Some users and engineering have done this without disruption
- What is the “secret sauce”?

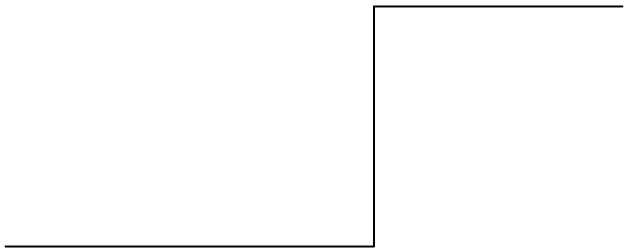
Difference issues are independent, not linked

- Each one is independent



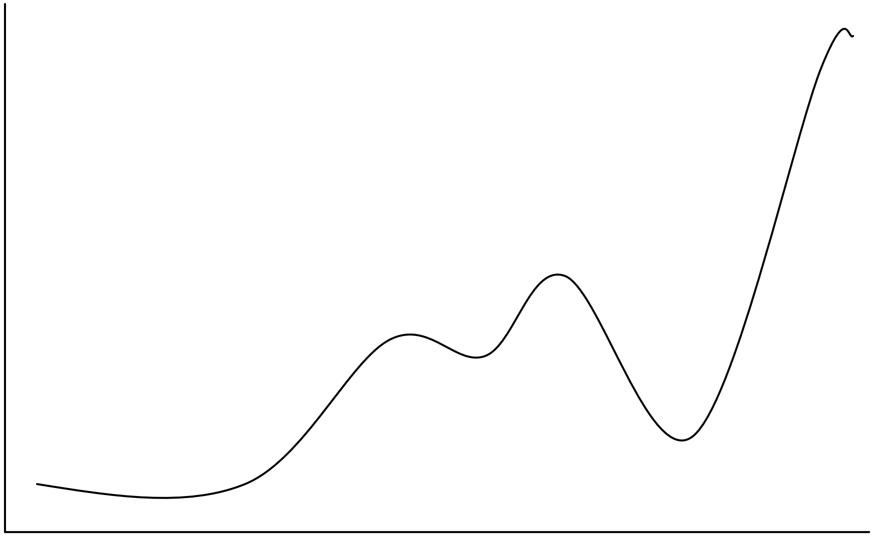
What is the challenge?

- Quantum transitions
- High risk
- No control
- Difficult to retreat



A better approach – Incrementalism or Gradualism

- Calibrated changes
- Do change as can be accommodated
- Amount at risk is calibrated by business and technical considerations



Continuity is the goal

- The OpenVMS trademark – rolling upgrade
  - Switch architectures
  - Switch system disks
- The constant is the “cluster member”, not the disk, CPU, or architecture

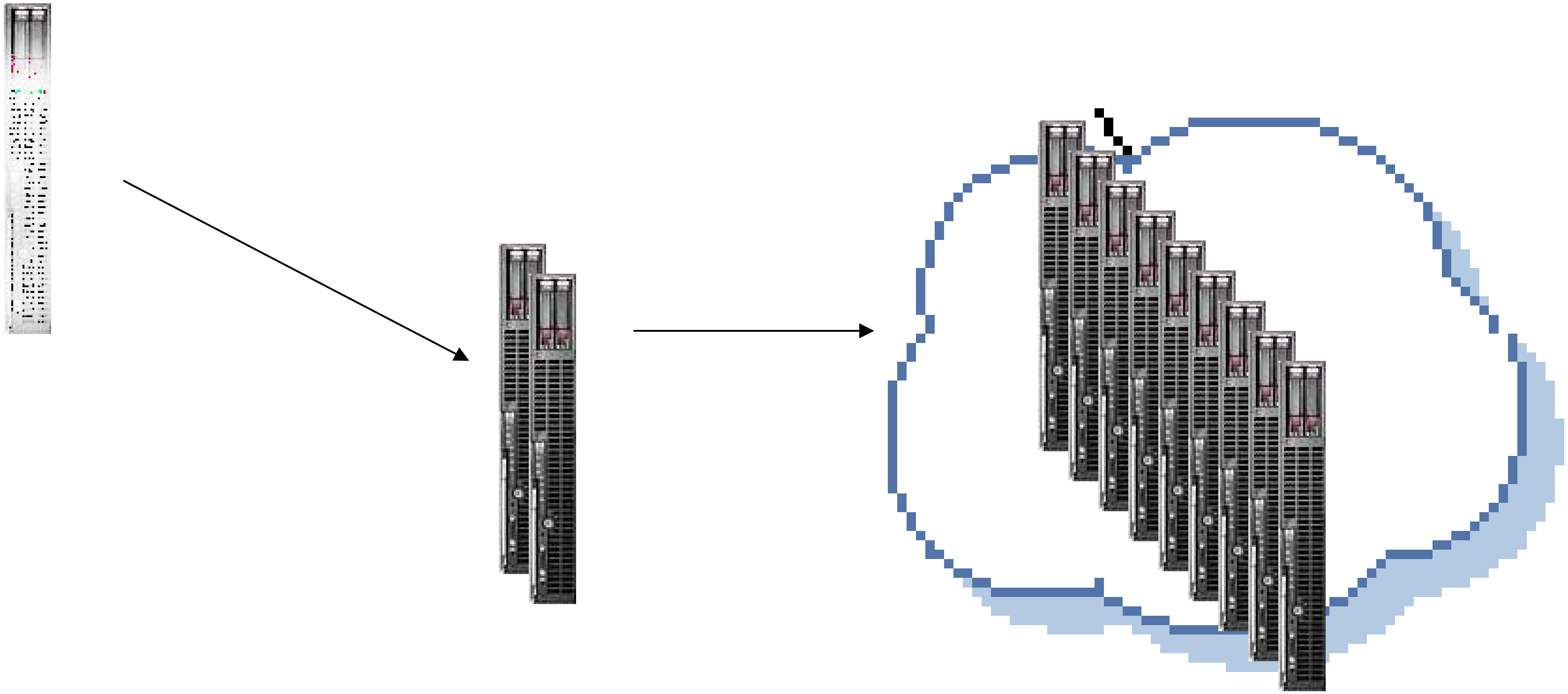
Toward the future is often a teleological trap

- The future is inherently unclear and unknowable
- Evolution is in the current, not the future. Effort will not be expended for something that is not an immediate advantage
- Change is constant
- Positioning for change is the foundation of agility

Dealing with load

- Pre-configured worker members
- Instant availability surge capacity as already active members on slices of virtual processors
- Difference between activity surge and flash spike
- Flash spike created by
  - Member hardware failure or crash
  - Flash spike in demand
- Long term phenomena are different

Back to our goal: Experiment through Production without interruption



Each step in the lifecycle is not significant

- Each increment is nothing more than a change in
  - Capacity
  - Host
  - Architecture
  - Version or revision
- “rolling reboot” is the core:
  - Add new member to cluster
  - Remove/reboot old member

Initial configuration

- “Soloist OpenVMS Cluster” [Gezelter, 2009]
- Configuration
  - Single node OpenVMS cluster
  - Single member shadow sets (system disk, data disk)
  - Fractional CPU hosting
    - HPVM
    - Stromasys Charon
    - Migration Specialties Avanti
- De minimis capital costs for prototype applications

Capacity increases over time

- Increase virtual slide
- When appropriate, add real hardware
  - Boot in second member
  - Member may be spare free-standing; or it may be a blade
  - Up to a certain point, it can be increasing slices of a virtual processor
  - Business decision, the technical architecture is agnostic on the details of the provisioning

Disk storage

- All volumes members of shadow sets
- For ordinary disks
  - Use 1-member shadow sets
  - Transition to different hardware or array by temporarily creating 2-member shadow sets
- For all shadow sets
  - Dynamic volume expansion enabled
- See “Migrating OpenVMS Storage Without Interruption” [Gezelter, 2007] HPTech Forum 2007

Operational considerations

- Volumes that are shadow sets can be migrated without interrupting normal operations
- User indistinguishable
  - File resident virtual disks
  - Real disks
  - MSA
  - EVA
  - Reconfiguration thereof (RAID)

The key underlying principle

- Changes in all cases are user indistinguishable.
- If no user perception of change, change did not happen

Where to start?

- Start process where appropriate
- If “budget challenged” the “on-ramp” (entry point) is
  - Fractional virtual CPU slice (VAX, Alpha, Integrity)
  - One/two single member host based shadow sets (may be containers a.k.a. file based “virtual disks”
- Anywhere in between, this is a business decision

Summary

- “Highly agile” is the result of preparation
- Many “cloud” offerings have substantial undisclosed and undocumented approaches, e.g., “Trust us”
- Infinite capacity is physically impossible
- Calling on reserves quickly without user disruption is the long term key

Questions

Slides and other materials:

http://www.rlgsc.com/openvms-bootcamp/2010/agile-openvms.html