Cloudy Inside: Use of Cloud Computing in Ground Systems Development
Motivation

- Business considerations for a Ground System COTS vendor
  - Mission Critical applications
    - Any deployment, even a bug fix, must be tested in an integrated environment
  - Multiple Projects
    - The COTS model depends on having multiple customers to drive product evolution with new license purchases and support
    - Every customer’s concept of operations, and technical requirements, are different
  - Multiple Products
    - To be competitive the product suite must cover several application areas
  - Long support horizons
    - Customers are on separate upgrade cycles
    - Long periods of inactivity are punctuated by urgent requests

**Bottom line:**
Need to support customers efficiently and responsibly.
GMV’s Footprint

SCC: Satellite Control Centre (real time monitoring & control)
FDS / MPS: Flight dynamics / Mission Planning System
MA: Mission analysis
PMR: Payload management & reconfiguration
PDS/SOC/GMS: Payload Data Segment / Science Operations Centre, Ground Mission Segment

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Example Configuration

- Three simultaneous projects
  - A (products X & Y, Red Hat Linux 4 32 bit)
  - B (products X & Z, Red Hat Linux 4 64 bit)
  - C (products Y & Z, SUSE Linux 10 32 bit)

- Three versions per project
  - Deployed
  - Acceptance testing
  - Next release

- Three machines per version
  - Build
  - Server
  - Client
One Year Later

- Project A has entered long-term maintenance
- Project B is upgrading to SUSE Linux 11 64 bit
  - Deployed version will remain on SUSE 10 for one more year
- Project C has added redundancy requirements and will require a second server
Mismatch

- The numbers of required environments increases monotonically
  - Projects stay in support for a very long time
- Computer resource requirements are proportional to current workload
  - Developers and testers transition to new projects as old ones ramp down (i.e. team size is relatively constant)
  - New software versions tend to require more resources than old
- Space, power and money are scarce resources
  - Filling the office space with computers is not sustainable
  - Constantly reconfiguring the existing computers is not efficient

How do we scale the computing resources with the workload, and not with the environment count?
Enter the cloud

Enabling factors

- All configurations run on compatible hardware
  - 64 bit Intel processors (Core 2 and later)
  - New hardware is backwards compatible (i.e. old instruction sets supported)
- Available hardware exceeds required performance for all roles
  - Installable memory
  - Number of processor cores
- Hardware price/performance grows as fast as the workload
  - Lab workload grows with the requirements of new software versions, not with the number of projects

Approach:

- Size hardware for the current workload
- Configure a set of virtual machines for each project/version
  - Includes simulators for spacecraft and network link delays
- Run the appropriate sets of virtual machines for the current work
  - Automatic load balancing, or fixed configurations, as required
Lab Concept

Running Environments

Cloud

Stored Environments
Results

Moore's Law Wins

- Assumptions
  - 4 new projects/year, 1 year duration
  - Old projects require 1 month maintenance every year
  - 3 machines/project
  - 2 GB + 20%/year memory requirement per machine
  - Memory capacity doubles every two years (Moore’s law)
  - Individual machine $700 (2GB), Cloud server $5000 (16 GB)
Conclusion

- Ground Systems development has characteristics that cause proliferation of lab environments (build and test)
  - High degree of project-specific customization
  - Long-lived deployments
- Cloud computing enables efficient reuse of hardware
  - Similarly to how the team’s resources are allocated to projects according to their level of activity
  - Saves space, power and money
- This enables GMV to support a growing customer base efficiently and responsively

To the cloud!
Thank you