Deploying virtualisation in a production grid

Stephen Childs
Trinity College Dublin & Grid-Ireland

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Outline

• Current trends
• Survey of virtualisation use in grid community
• Virtualising production infrastructure?
• Case study: Grid-Ireland infrastructure
• Trends in virtualisation management
• Conclusion
Current trends

• Use of “commodity virtualisation” has exploded in last ~4 years
  – Release of Xen opened up market, provided quality, free OSS option
  – Initially used for development and testing, desktop use

• VM technologies have matured considerably
  – Basic technology integrated into OTS software and hardware
  – Management tools and APIs now widely available
  – Now being used (or evaluated) for production infrastructure

• Production use brings new challenges
  – Stricter requirements than “testbed” use case
  – Must consider how virtualised infrastructure can meet them

• Move from testbed to production requires planning
Survey of grid community

- **Survey investigating use of virtualisation in production grids**
  - Conducted 21st-28th August 2008
  - Advertised on grid mailing lists (lcg-rollout, UK tb-support, etc.)
  - 63 responses (mainly from EGEE sites)

- **Results indicate large uptake of virtualisation**
  - 71% of sites have already deployed virtualisation
  - 18% currently evaluating it
Characteristics of sites

Size of sites

- 101-500: 32%
- 501-1000: 10%
- 101-499: 14%
- 6000+: 3%
- 11-50: 27%
- <10: 9%

Technology used

- Xen: 40%
- VMWare: 20%
- KVM: 10%
- VirtualBox: 7%
- vservers: 7%
- OpenVZ: 7%
- Qemu: 4%

Number of VMs deployed

- 8-20: 44%
- 21-50: 9%
- 51+: 7%
- 1-5: 40%

- Xen is the most popular technology
- Most responding sites are mid-sized
- Most sites (84%) have <20 VMs
Structure of a gLite production grid

• Central services
  – Used by multiple sites: tie sites together into grid(s)
    ▪ Information system (BDII)
    ▪ Job submission (WMS)
    ▪ Data management (LFC)

• Site-level services
  – Front-end to site resources
    ▪ Publishes resource information to grid
    ▪ Allows authorised users to access compute and data resources

• Site resources
  ▪ Compute resources (worker nodes)
  ▪ Data resources (e.g. disk servers)
Features of production infrastructure

- **Machines have long uptime, longer lifetime**
  - Contrast with short-lived test & dev. machines (or even on-demand)
  - Implies need for long-term maintenance (security patches, etc)
  - Must integrate with existing deployment and management systems

- **Machines must provide acceptable service level**
  - Performance (CPU, memory, disk, I/O depending on app)
  - Security
  - Reliability

- **Virtualised infrastructure must meet these requirements at least as well as existing physical hardware**
Virtualisation: why?

- **Customised environment**
  - Grid software has strict OS requirements
  - Legacy OS may be needed for older servers

- **Server consolidation**
  - Maximise use of existing hardware
  - Reduce hardware purchasing and management costs

- **Isolation**
  - Isolate services requiring user interaction

- **Flexibility**
  - Quick and easy deployment of new services
  - Potential for migration of VMs (load-balancing, disaster recovery)
Virtualisation: why not?

- **Performance**
  - Virtualisation has a cost
  - Not suitable for performance-critical apps. (especially I/O-intensive)

- **Management concerns**
  - Integration with existing fabric management (install, config, maintain, …)
  - Complexity and immaturity of virtualisation software
  - Can end up with VMs everywhere …

### Reasons for not using VMs

- Performance
- Management issues
- No need to
- Lack of familiarity
- Lack of time to implement
- Hardware problems
- Lack of maturity
- Lack of IW support

*EGEE-III INFSO-RI-222667*
Case study: Grid-Ireland

- **National grid infrastructure for Ireland**
  - All central and site services managed from Operations Centre at TCD
  - Site resources locally managed at sites

- **Virtualisation in use since early 2004**
  - Main motivation was server consolidation
  - Initially User-Mode Linux VM used to host login server
  - Local scripts developed to integrate with fabric management

- **Major expansion since 2005**
  - Switched to Xen for performance reasons
  - Rollout of 12 virtualised gateways to sites
  - Creation of virtualised testbed for certification

- **Currently (Aug. ‘08) >90 VMs managed across 18 sites**
Virtual gateway architecture

- **Host acts as management and installation server**
  - OS and middleware software
  - Storage for VM virtual disks
  - Supports automated (re)installs
  - Physical network connection

- **Grid server nodes in guest VMs**

- **Full gLite grid site in one box**
  - Easy installation
  - Saves power and rack space
  - Incorporates WN for testing
National architecture

- Each site hosts a virtual gateway
- Grid “point-of-presence” at site
  - Needs compact physical footprint
- Managed from central ops centre
  - Services need to be robust
Grid-Ireland experience

- **Software issues**
  - Persistent problems related to threading libraries (now largely solved)
  - Packaging of Xen software (vendor packages now available)

- **Management problems**
  - Stable VM host made remote management of VMs easy
  - Installation initially via ad-hoc tools requiring manual configuration
  - Monitoring of VM placement and resource usage difficult
  - Migration of VMs difficult due to lack of shared storage
  - Integration into existing management system has helped

- **Performance issues**
  - No problems with responsiveness for interactive usage
  - Poor network performance for bulk data transfer

- **Value for money**
  - Rollout of nationwide infrastructure impossible without VMs
  - Creation of comprehensive testbed with limited resources
VM management

• 1st generation: ad-hoc tools
  – VMs installed and managed manually or with simple scripts

• 2nd generation: integration with standard configuration tools
  – Support for VM management added to standard management systems
    ▪ Quattor, OSCAR, Rocks, cfengine, …
  – VMs now treated similarly to physical machines
    ▪ e.g. Quattor fully manages from initial installation to online maintenance
  – Monitoring VM usage still an issue

• 3rd generation: tools supporting advanced provisioning
  – Commercial offerings from Citrix, VMWare, Citrix, enomalism, Platform, …
  – Dynamic provisioning: automatic migration of VMs within server pool for
    load-balancing and resilience
  – In use in grid community? OpenNebula, Globus Nimbus?
Conclusion

• Deploying virtualisation in production has advantages ...
  – Reduces hardware costs, can make management easier
  – Increases flexibility of deploying new nodes

• ... but needs to be carefully managed
  – Determine whether performance is a factor before virtualising a service
  – Develop strategy for integration with existing management systems
  – Test software to ensure compatibility

• VM software has matured and is in widespread use
  – Included in major Linux distributions, even in firmware!
  – High and increasing uptake in grid community (80% plan to increase use)

• Frontier of virtualisation is now management
  – First priority should be integration with existing systems, then ...
  – Easy migration for disaster recovery, resource optimisation
  – Effective monitoring of VM placement and resource usage