The Path to Hybrid Cloud

Cloud technology has matured, opening up new possibilities for more elastic private, public, and hybrid models. Organizations now see hybrid cloud models as an enhanced way to get value from cloud computing by leveraging the sometimes-complementary benefits offered by private and public clouds—agility, cost efficiencies, and high availability of services. In particular, hybrid clouds offer businesses flexibility and choice that can help IT balance capital and operational expenses, make optimal use of in-house resources, and improve responsiveness to changing business requirements.

How each company manages this flexibility depends on their own business needs and IT requirements. Hybrid clouds can be used to:

- Deliver business processes as complete applications through software as a service (SaaS), such as customer relationship management or human resource applications.
- Help manage unpredictable peaks in demand through cloud bursting, such as consumer-facing web services that may respond to seasonal peaks and valleys.
- Make services available quickly for a specific period of time or to capitalize on new business opportunities.

Is the latest buzz about hybrid cloud hype, or does it offer real-world opportunities to take the next step in cloud computing? This brief provides you with a crash course on hybrid cloud: why it matters, capabilities, unique technology challenges, and how Intel can help.

Intel: Making the Cloud Work for You

Intel wants to help you simplify delivery of your cloud services so your business can realize the full benefits of cloud computing. As a first step, we recommend that you build a private cloud on a highly virtualized foundation. This provides your organization with a certain level of cloud maturity and enables you to expand your cloud deployment to even more flexible models.

For more information on developing private cloud services, read Planning Guide: Virtualization and Cloud Computing.
Why Hybrid Cloud Matters

Hybrid clouds often evolve from IT’s success delivering private cloud services. As the broader organization recognizes the advantages of cloud computing and gets on board, greater demand is put on existing services. At this point, IT has a decision to make: Invest in more infrastructure technology or consider moving select workloads to a public cloud environment.

A hybrid cloud balances an organization’s need to invest in on-premises cloud technologies (Capex) with utilization of off-premises public cloud services (Opex). Because this balance will be different for each organization, hybrid clouds are not “one-size-fits-all” solutions.

Hybrid Cloud Capabilities

Hybrid clouds combine two cloud delivery models—typically private and public—allowing both to remain as unique entities but binding the two models together via technology to enable data and application portability.

The National Institute of Standards and Technology has described the essential characteristics of the cloud as broad network access, rapid elasticity, measured service, on-demand self-service, and resource pooling. These characteristics operate across three major cloud service layers: SaaS, platform as a service (PaaS), and infrastructure as a service (IaaS).

A hybrid cloud includes a few additional features:

- **Integration of infrastructure and the application environment.** In a hybrid cloud, the ability to spin up virtual machines (VMs) for IaaS or combinations of IaaS and PaaS must be the same in both private and public cloud environments.

- **Portability of applications.** Cloud-aware development builds capabilities into applications so they work the same across cloud environments.

- **Interconnectivity.** Communication and interaction between two coexisting environments facilitate the easy movement of VMs, data, and applications between individual clouds.

- **Monitoring and management across cloud environments.** While monitoring is important for any cloud environment, visibility into system health across clouds is critical.

Technology Challenges

The additional characteristics of hybrid clouds present unique technology issues that must be addressed as you plan your hybrid cloud, including:

- **Integrated systems architecture across the environment.** Before a potential workload can become a hybrid deployment, you must have at least a rough architecture of where components, functions, and data will reside.

- **Infrastructure and application portability.** Infrastructure must be able to support the environment you maintain in your private cloud so that VMs can move back and forth and applications can work across a dynamic environment.

- **Security across cloud environments.** You must be able to maintain your security, compliance, and privacy requirements in the public cloud environment.
The vision of open, extensible cloud ecosystems ties an organization’s cloud services (public and private) together into an ecosystem with portability and interconnectivity. Portability and interconnectivity are issues at every layer of a hybrid cloud. The key to addressing these issues is open standards.

The Open Data Center Alliance has defined requirements for usage scenarios in each service layer for interoperability and interconnectivity, including:

- **IaaS portability**—The ability to move physical or VM instances or images (complete with network connectivity and storage) between environments over short or long distances with capabilities such as manageability, live and at-rest migration, performance, and distance.

- **PaaS interconnection and application portability**—The ability to move applications (and related logical data structures) between different PaaS environments—development and runtime—with cloud-aware applications that maintain attributes such as feature sets, configurability, and orchestration.

- **SaaS interconnection and portability**—The ability to connect or transfer business process functionality and information via SaaS and creating mash-ups from multiple SaaS and non-SaaS applications via compatible interfaces that exchange data smoothly.

### Cloud Management Platforms

A cloud management platform (CMP) is the integrated software that delivers service quality, security, and availability for workloads running in cloud environments. CMP offerings vary widely in terms of platform maturity, architecture complexity, and capabilities. Your choice of platforms can simplify extending manageability, automation, and orchestration into public clouds.

At minimum, a CMP should provide direct user access to the system, self-service capabilities and interfaces, a workflow engine, automated provisioning, and metering and chargeback functionality.

Hybrid clouds utilize more advanced capabilities, such as:

- Performance and capacity management
- Interoperability between private and public IaaS offerings
- Connectivity to and management of external clouds
- Application lifecycle support
- Back-end service catalogs
- Integration with external enterprise management systems

### Case Study: Intel IT and Hybrid Cloud

As part of a multiyear cloud strategy, Intel IT has moved toward developing a highly available, dynamic hybrid cloud environment with three key design goals in mind:

- Create a distributed hosting architecture for applications.
- Design self-healing capabilities for application and infrastructure failures.
- Provide the ability to scale up and down for unpredictable demand.

For more information, read Intel IT: Developing a Hybrid Cloud Environment.
Cloud-Aware Application Design

Cloud-aware application development can take full advantage of underlying cloud infrastructure for improved scalability, performance, and resiliency. If a hybrid cloud is in your future, your applications can be designed now to include capabilities that minimize potential portability issues for the time when you do combine cloud environments, including:

- **Treat everything as a service.** Application capabilities should be partitioned into granular components that can be implemented, tested, and scaled separately.
- **Use REpresentational State Transfer (REST) APIs.** RESTful APIs enable easy reuse and scaling of application capabilities and shield applications from underlying technology implementations.
- **Separate compute and persistence.** Nothing is stored locally on the compute instance that is running the cloud application, providing deployment and scaling flexibility across environments.
- **Design for failure.** Although the goal is zero failure, in reality components fail, services become unavailable, and latencies increase. Designing applications to gracefully survive failures enhances the user experience.
- **Architect for resilience.** An architecture designed with a focus on the mean time to recovery (MTTR) accepts imperfection and enables rapid identification and resolution of problems when they occur.
- **Operationalize everything.** All services should be easy to maintain and troubleshoot. Instrumenting, logging, and analyzing application behavior will lead to operational improvements.
- **Implement security at every layer.** A perimeter security approach is not sufficient in a public cloud, and a more comprehensive approach is needed, such as encrypted transport into the cloud, secure coding and access control inside applications, and encryption at rest. The security of every API and data should be tested and analyzed.

For more detail, read *Developing a Highly Available, Dynamic Hybrid Cloud Environment*.

Security across Cloud Environments

Security must be integrated into every layer of the cloud. One way to enable the portability and scalability of security across a cloud environment is to assign security policies for infrastructure and applications to specific VMs based on their function. These policies are automatically assigned when that VM is provisioned. Another way is to build security into the hardware of servers and clients to protect infrastructure.

There’s a lot more to say about cloud security. For more information, read Intel’s [cloud security planning guide](#) and [Cloud Security Real-World Guide: Intel Security Technology for the Cloud](#).
How Intel Can Help

Intel makes the technologies that serve as the foundation for both private and public clouds. We’re committed to helping simplify your cloud services delivery by:

• Delivering open-standards, optimized technology built to scale in the most demanding dynamic environments
• Providing resources to help you advance your cloud projects faster
• Addressing tomorrow's challenges with ongoing innovations for cloud computing

Intel Resources to Learn More

The Intel IT Center provides straightforward, fluff-free information that addresses each of the ways Intel can help IT pros implement strategic projects like hybrid cloud computing. For planning guides, peer research, real-world customer references, solution spotlights, and live events about hybrid cloud computing, visit intel.com/cloud and intel.com/cloudsecurity.

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