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Increase Business Velocity with Enterprise Database as a Service (DBaaS)

Benefits that we have gained from enterprise DBaaS include velocity, agility, scalability, and cost efficiency.

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Executive Overview

To increase business velocity and cost efficiency, Intel IT designed and deployed database-as-a-service (DBaaS) capabilities on Intel's enterprise infrastructure. The solution is unique in many ways. For example, we were the first IT department to incorporate the commercial database technologies in use at Intel into a DBaaS system. Unlike many DBaaS solutions on the market, our system goes beyond simply provisioning database instances to provide end-to-end database management services. Back in 2014, when software-defined infrastructure was nascent, we were programmatically creating virtual machines using APIs.

Since those early days, our DBaaS system has evolved into a mature offering. It includes a variety of open source and commercial database solutions, supports both Linux* and Windows* environments, and provides strong data protection. Through automation and self-service, our DBaaS system creates business value in many ways, including:

- Application developers can launch a new database instance in less than a minute and are freed from managing infrastructure details. This capability in turn increases time to market for new products and services.
- Multitenancy and smart provisioning tactics optimize utilization of compute, storage, and network resources and enable scalability.
- New database instances can be added without adding headcount.
- Governance capabilities help us reliably meet service-level agreement requirements.

As our DBaaS system continues to evolve, we plan to use the best practices captured in this white paper to add new capabilities and technologies to further accelerate Intel's pace of business.

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Acronyms

- DBaaS** database as a service
- SLA** service-level agreement
- UI** user interface

Business Challenge

Like many large enterprises, Intel used to take the traditional approach to database provisioning—manually assigning and configuring infrastructure resources. This labor-intensive process could take weeks or even months. We also found that this approach led to problems with database quality and consistency. Different teams had varying skills with databases and would create databases with different characteristics, so there was inconsistency across the enterprise.

The problems with the traditional approach to databases did not stop with the provisioning stage. Once a database instance was created, it required manual management throughout its lifecycle—which usually involved additional staff. Intel has thousands of active database instances, but industry research suggests that with traditional database processes, on average, a database administrator can manage only 40 databases.¹

Other issues included inefficient resource utilization and stymied innovation. We found that a manually provisioned database instance used only 10 to 20 percent of assigned infrastructure resources. If new technology became available, it was difficult—and expensive—to integrate it into the database instance, generally involving an on-site vendor visit.

Intel IT is committed to continually improving IT processes to increase business velocity and create business value. In 2014, we set out on a journey to transform database provisioning and management across Intel.

Solution

To address the enterprise-wide challenges associated with database provisioning and management, Intel IT deployed a scaled database-as-a-service (DBaaS) offering as an extension to our platform-as-a-service capabilities in Intel's enterprise private cloud. The following sections discuss the benefits we have gained from DBaaS, our best practices for developing a DBaaS system, the solution architecture, and our vision for the future of enterprise DBaaS at Intel.

Benefits of Enterprise DBaaS

Enterprise DBaaS provides many benefits through automation and self-service.

- **Increased agility, velocity, and ease of use.** Developers can rapidly provision data services—on demand—in support of their business needs. New databases are ready in under a minute, and developers do not have to worry about infrastructure details. Using the Web portal or APIs, developers can easily create and delete data services, add or remove data service ownership, manage data service passwords, troubleshoot query performance issues, backup and restore databases, and migrate databases into the DBaaS system.



**DBAAS DECREASES
PROVISIONING TIME**



**DBAAS OPTIMIZES
INFRASTRUCTURE USAGE**

¹ "How Many DBAs Do You Need To Support Databases?" 2010. blogs.forrester.com/noel_yuhanna/10-09-30-how_many_dbas_do_you_need_support_databases

- **End-to-end database management.** From database creation through support to end-of-life, DBaaS handles all the details, such as backup and restore and disaster recovery. No manual processes are required.
- **Optimized infrastructure usage.** The DBaaS team knows the infrastructure well, such as which servers are not too heavily used. Therefore, we can use multitenancy to maximize storage and compute utilization. We use a “lease” approach that allows us to reclaim resources that are not in use or no longer needed. Every database is created for a six-month period, at the end of which the customer needs to explicitly renew the lease if the database is still being used.
- **Consistency.** Our DBaaS team has a core of expertise that enables all databases to be consistent in quality, functionality, and design. Our standard configuration is appropriate for about 90 percent of Intel’s use cases.
- **Constant improvement.** Our DBaaS system evolves, because we continually scan the industry for new use cases and trends to evaluate. Our open source architecture enables us to quickly and easily integrate new technologies that will provide business value.
- **Cost efficiency.** Because most of the database provisioning and management is automated and optimized, we can usually avoid both adding headcount to manage new databases and investing in new infrastructure. We also make optimum usage of suppliers’ products and associated licenses.
- **Scalability.** Users can provision resources as they need them, or provisioning can be threshold-driven, where users get an initial cluster of resources and additional resources are automatically assigned if a threshold is reached. In either case, each application is isolated and has its own failover capabilities and backup, but shares other resources. Users choose the model that fits their capacity planning requirements.
- **Time to market.** Using DBaaS, business capabilities land faster in the IT landscape, which brings competitive advantages to Intel’s business by delivering new products and services faster.
- **Security by default.** We have integrated Intel’s security requirements into our DBaaS system, including data protection in-transit and at-rest, network isolation, authentication, and access controls. We also protect data and processes in the multitenant cloud environment.
- **Governance.** Our DBaaS system enforces enterprise rules for what services to offer where, tracking of changes, and creation of new data services. The system also governs for best practices and efficiency.

As illustrated in Figure 1, every task throughout the database lifecycle is faster with DBaaS compared to standalone databases on bare metal.

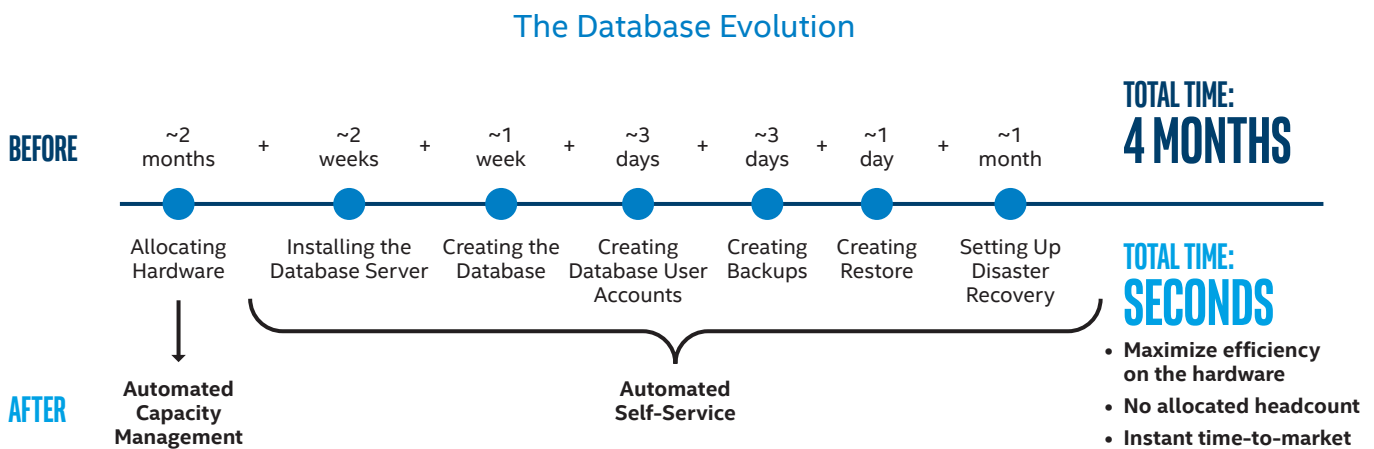


Figure 1. Database as a service uses cloud capabilities to provide on-demand, self-service, automated database processes.

DBaaS Best Practices

As we developed our DBaaS system, we learned some key lessons.

To Increase DBaaS Adoption, Provide the Tools Developers Want

When we began building our DBaaS system in 2014, we started our offering with open source database technologies. This type of offering was easier to implement as DBaaS than the commercial database technologies in use at Intel. However, Intel's application developers were unfamiliar with the open source databases and seemed reluctant to use them. Therefore, the adoption rate of our DBaaS system was low. At the end of 2015 we decided to add the commercial database technologies into the mix of available open source databases. This task was not trivial—in fact, we were the first IT department to attempt it. We even investigated hiring a consultancy to help us, but no one wanted to take on the task. So we did it ourselves. It took about six months, and we had to work through some issues, but by early 2016, the commercial database was successfully integrated into the DBaaS system.

In the ensuing years, we have increased the number of open source databases. We also enhanced the user interface (UI). Some of the UI capabilities we have added include on-demand backup and restore, user account management, the creation of database jobs, and performance troubleshooting features. Developers enjoy a unified user experience regardless of the different data technologies they are using.

Software-Defined Infrastructure and Teamwork Are the Key to Success

We found that to design and deploy enterprise DBaaS, we needed to be familiar with Intel's infrastructure—compute, storage, and network. When we began the process, software-defined infrastructure was in its infancy, and Intel's infrastructure teams were startled when we asked for the ability to interact with the resources using APIs to spin up virtual machines. At that time it was unheard of to create infrastructure programmatically internally on an enterprise infrastructure.

Understanding the actual infrastructure, however, was only part of the picture. We also needed to understand how the infrastructure teams thought, so we could work closely with them to bring the technologies together. Teamwork enabled us to create DBaaS capabilities and make the infrastructure resources transparent to the user.

The DBaaS system also had to be familiar with the application stack, drivers, and some application code. Our DBaaS offerings and the associated APIs had to be fully compatible with the standard enterprise application stack. We also had to familiarize ourselves with the various drivers that application developers used so we could help the application team solve issues that arose.



Key Learnings from DBaaS System Development

- To increase DBaaS adoption, provide the tools developers want.
- Software-defined infrastructure and teamwork are the key to success.
- Resiliency is a crucial component.
- Provide an end-to-end solution.
- Demonstrate the business value of DBaaS.
- Provide a high level of service through DevOps methodologies.

Resiliency Is a Crucial Component

When we initially deployed our DBaaS system, we provisioned only in a single data center. That was sufficient for non-mission-critical applications. However, mission-critical applications require more resiliency, so that if a data center goes down, or a storage or compute resource fails, the database survives. We have since built in high availability across Intel's data centers. We use replication and active-passive failover and have defined tiering service-level agreements (SLAs). We have a validated recipe that ensures a database meets or exceeds its tier SLA.

Provide an End-to-End Solution

DBaaS is more than provisioning—it is an end-to-end service. When we began our DBaaS efforts, most solutions available at that time were provisioning solutions only. Once the instance was provisioned, application developers still had to support and manage it. But we wanted to do more than just speed up provisioning. We wanted our system to sustain and support a database instance for the lifetime of the database. Therefore, we added in automated management capabilities, such as threshold capacity scaling, archiving, and backup-and-restore. Our self-service portal makes it easy for a developer to create user accounts, add or remove data service ownership, and manage data service passwords.

Demonstrate the Business Value of DBaaS

Initially, we encountered significant resistance from other departments. Some people perceived DBaaS as a threat, not an enablement. They feared DBaaS would make their jobs irrelevant. We worked with these departments to illustrate DBaaS capabilities and how they could help address some of the existing functional gaps and add business value. For example, some people were doing the same task over and over for each new database instance. We explained that through automation, DBaaS freed them from these manual repetitive tasks, enabling them to spend time optimizing their code, which is a higher-value activity. We also pointed out that DBaaS enabled more databases without increasing headcount. Through these communication efforts, we have seen widespread acceptance and appreciation for DBaaS, and it is now the standard method of database instantiation at Intel.

Provide a High Level of Service through DevOps Methodologies

Adoption of DBaaS was also driven by our level of service. We strive to be proactive, anticipating issues instead of simply reacting when something happens. For example, with multitenancy, we watch the server utilization carefully to avoid performance bottlenecks. If an incident does occur, a subject matter expert is immediately assigned to fix the issue. This level of service is made possible through our use of the DevOps model—our team designed and created the DBaaS system, and we are the ones that support it. A continuous integration/continuous delivery approach has enabled us to grow the DBaaS system quickly.

Stratoscale Delivers Cloud-Grade DBaaS in Enterprise Environments

Intel Capital recently invested in hyperconverged infrastructure player, Stratoscale.¹ Stratoscale delivers cloud-compatible infrastructure and services that can be deployed in any enterprise data center. Stratoscale enables multi-cloud and hybrid applications while maintaining a consistent software development process using APIs. Stratoscale's database-as-a-service (DBaaS) solution supports multiple relational database engines, both proprietary and open source. It also supports nonrelational databases such as NoSQL solutions like Cassandra* and MongoDB*. Intel IT intends to incorporate this type of hybrid cloud data services into our DBaaS system.

¹ Learn more about Stratoscale at www.stratoscale.com

Database-as-a-Service (DBaaS) Reference Architecture

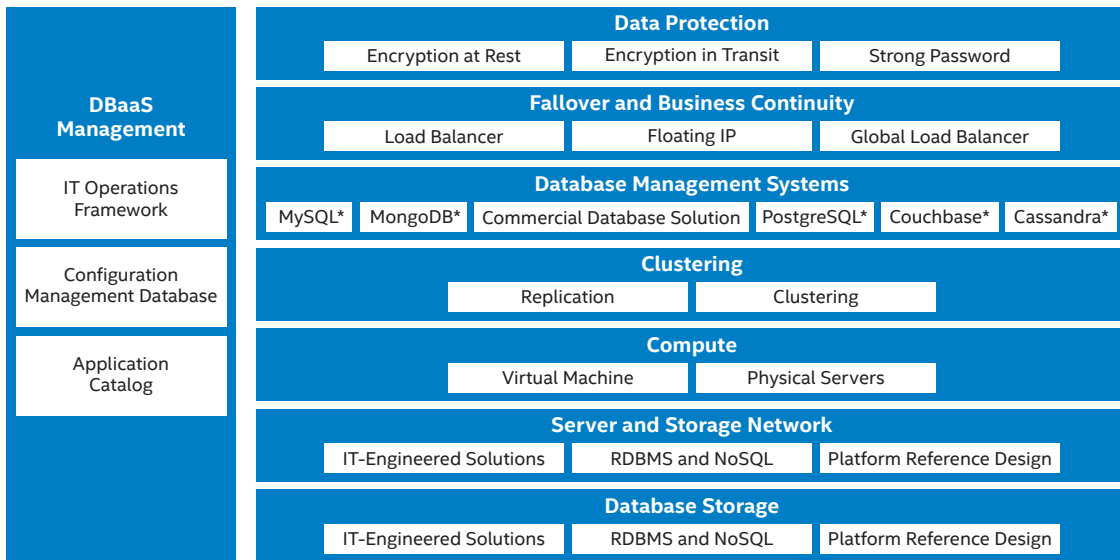


Figure 2. Our database-as-a-service solution architecture supports a variety of open source and commercial database technologies, and provides end-to-end database management and support.

Solution Architecture

As shown in Figure 2, we have integrated a wide range of open source and commercial database technologies into our DBaaS system. But more importantly, the architecture provides an end-to-end service, incorporating data protection, business continuity, and database management. The underlying infrastructure provides replication and clustering for both Linux* and Windows* environments.

Results

As mentioned earlier, enterprise DBaaS has become the standard method of creating new databases at Intel. We now have over 1,100 applications and 4,600 database instances active in the system (see Figure 3). In addition, internal calculations indicate that on-premises DBaaS is substantially more cost-effective than hosting this high number of databases in the public cloud.

Database-as-a-Service Instances

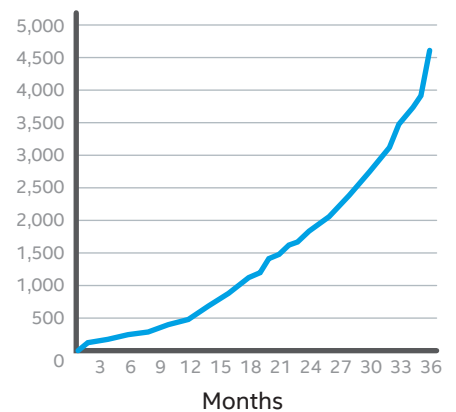


Figure 3. Application developers have eagerly adopted database as a service to increase development velocity and portability, with about 4,600 instances now active.

Next Steps

In 2018 we plan to continue automating more aspects of our DBaaS system. We envision a system that is fast and self-healing. We want developers to be able to launch a database instance with a single click. We want to evolve the system into a resilient platform with automated actions in response to events. Other capabilities we intend to integrate include failover on demand and hybrid-cloud database solutions (see the sidebar [Stratoscale Delivers Cloud-Grade DBaaS in Enterprise Environments](#)). We also intend to migrate Intel's application messaging queue system (the system that sends messages between business applications) to use DBaaS technologies. This capability, supported by Intel's enterprise DBaaS system, is not currently available in the public cloud.

In the spirit of constant improvement we are working with data center experts at Intel to evaluate innovations such as Intel® Optane™ technology to determine how they can boost the performance and functionality of DBaaS. For example, we are currently evaluating new encryption and storage clustering capabilities.

Conclusion

Over the last four years, our investment in an enterprise DBaaS system has paid off in many ways. Compared to the traditional manual approach to database provisioning and management, application development occurs faster. Infrastructure is better utilized, and databases are more consistent. Cost efficiencies have resulted from automation and self-service capabilities. We are excited to share our DBaaS best practices with the industry, in hopes that other enterprises can gain the same benefits that we are enjoying.

For more information on Intel IT best practices, visit www.intel.com/IT.



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