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Velocity at Scale — How The Deutsche Bahn Group is Shifting to a Compliant Cloud Architecture on AWS

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Introduction

Companies of all sizes around Europe are under unparalleled pressure to innovate and adapt their business models. This growing pressure is driven by a trifecta of truly global competition, high consumer expectations and an unending wave of startups leveraging cloud and 3rd Platform pillars to disrupt existing business models.

The only way to rise to the challenge is to rationalize the existing IT and at the same time make it flexible, to allow business to experiment. Cloud services of the IaaS and platform-as-a-service (PaaS) type, paid based on usage, are a powerful weapon in that fight — as proved by the skyrocketing spending in that space. IDC forecasts that more than $6.5 billion will be spent on public IaaS and PaaS in Western Europe in 2016, up 30% versus 2015. Not all is as easy as it might seem, though.

Being cloud-first is a no-brainer for the proverbial five-guys-in-a-room startup. That's how they're born. Paradoxically, it's much harder for large organizations with comprehensive IT budgets — they live and breathe with billions of euros in critical assets they have to babysit, tens of thousands of employees to service, and complex legacy enterprise architectures that they need to maintain. Talk about changing a wheel while driving on the highway. Can it really be done? If so, how? The case of Deutsche Bahn, steered by DB Systel, can help us find some direction.

Solution Snapshot

Organization: Deutsche Bahn Group is one of the largest transport operators in the world, with €40.5 billion in revenue in 2015. DB Systel is provides ICT services to the group and third-party customers. DB Systel generated revenue of €825 million and employed 3,600 staff in 2015.

Operational Challenge: The lack of IT standardization and high cost of maintaining legacy meant the group was not improving the customer experience and was losing market share. Some of the subsidiaries had initiated dangerous paths toward "shadow IT."

Solution: DB Systel contracted AWS to provide managed and unmanaged cloud services to the group and embraced a cloud-first strategy.

Project Duration: First Proof of Concepts in April 2015, contract signed in October 2015, and managed cloud services available in January 2016.

Benefits: Cost savings of between 15% and 30% versus on-premise datacenter, ability to innovate with IoT and other projects launched already in 2015.

The Status Quo at DB Group

Deutsche Bahn Group is one of the largest transport operators in the world, with €40.5 billion in revenue in 2015, with more than ten business units generating >€1 billion a year in revenue. The group consists of around 450 subsidiaries, ranging from DB Schenker (international logistics) to DB Netze Energie (delivery of electricity and gas). Of those subsidiaries, at least fifty have significant IT

spending. Overall, the group has around 308,000 employees, of whom more than 100,000 are regular IT users.

DB Systel is the subsidiary dedicated to providing IT and telecommunications services to the rest of the group. The unit is responsible for a broad range of areas, from helpdesk support to telephony, and from maintaining the ticketing system to running the proprietary network that DB Group uses to connect stations and offices. DB Systel is in effect a managed service provider, being paid by other subsidiaries with formalized contracts. It generated revenue of €825 million and employed 3,600 staff in 2015. From a datacenter point of view, it owns and operates three physical datacenters in Berlin, running around 8,000 physical and virtual servers overall.

Importantly, in 2013 DB Systel was greenlighted by the group board to start offering IT services for third-party companies, leveraging its expertise in areas such as mission-critical logistic back-end and network monitoring. Conversely, the largest of the other group subsidiaries also host IT staff of their own in their business units. Based on those aspects and on the legacy, subsidiaries have a fairly high degree of independence around when and how they trigger investments in "their" IT systems.

Challenges and Solution

The DB Group IT architecture managed by DB Systel is imposing. The service provider is responsible for more than 630 applications in production. 60% of those have been written from scratch in-house over the years, whereas 40% are built on standard software such as SAP or Oracle PeopleSoft. However, more often than not even those third-party applications are heavily customized, with tens if not hundreds of DB Systel developers whose only task is to maintain and customize them further.

The lack of IT standardization across subsidiaries, the complexity of the organizational structure, and the high cost of maintaining legacy environments was hampering DB Group's growth plans. The group was not as agile as competitors in rolling out new applications and improving the customer experience, which meant some of the subsidiaries were losing market share. Internal pressure was heating up, and some subsidiaries had initiated dangerous paths to "shadow IT" by contracting cloud services directly, outside the group's compliance policies. The whole group saw its long term 2020 growth targets at risk, because IT was acting as an inhibitor of innovation.

Cloud Providers Evaluation and Selection

At the end of 2014, the situation began to evolve. Management changes affecting the group CIO and the managing director of DB Systel ushered in a whole new approach. In February 2015, DB Systel started to explore cloud infrastructure options that could help the group achieve agility and cost savings. In April 2015, the DB Systel board created a small, independent task force led by René Schneider to formally define requirements and engage with an external IaaS provider. The team laid out a set of around 100 technical requirements, including:

- Basic aspects such as the ability to procure virtual machines of a specific size, support for storage protocols and database technologies (Microsoft SQL, Oracle SQL) and operating systems in use at DB Systel (Microsoft Windows Server, SUSE Enterprise Linux, Red Hat Enterprise Linux)
- Challenging requirements such as availability of a virtual private cloud (VPC, i.e. a set of compute and storage resources running on a logically separate network)
- Datacenter presence in Germany for lower latency and regulatory reasons

Interestingly, being a service provider itself, DB Systel had the luxury of foregoing research on managed service capabilities or IaaS integration partners. All of the implementation and operation skills would come from DB Systel itself.

After discounting IaaS suppliers that didn't meet requirements, only Microsoft Azure and AWS remained as options, and only AWS had full control of its German datacenter infrastructure. At that point, the decision was made to test AWS' capabilities.

Challenges Overcome: Proof of Concept and Contracting Process

With the intention of quickly responding to business needs, DB Systel and AWS worked together on the first proof of concept, which consisted of setting up a full virtual datacenter on AWS, including policies and network connectivity. The AWS technical team provided extra support and the proof of concept was completed successfully within a week.

The second step was to assess AWS' ability to comply with the regulations impacting DB Group, which is a partly state-owned company. In particular, the IaaS provider has to comply with the German federal regulation for data protection — "Bundesdatenschutzgesetz." Following the assessment, DB Systel was able to ascertain that AWS did comply (and was the only provider to do so fully at the time). This provided the backing for DB Systel to select AWS as the preferred supplier, and in May 2015 the formal contracting process kicked off.

According to DB Systel, this was the largest hurdle in the project. Group-level Security and Compliance offices, external to DB Systel, were involved in the contract discussion, and in the process of auditing AWS. Group Board level was also part of the process. The aspect that required most work internally was the fact that AWS — like most other large scale cloud providers — allows adjustment to its standard contract clauses, but doesn't sign into ad hoc contracts, even with its largest customers.

As audits and contract negotiations carried on over the summer, the task force continued to run POCs on both basic and advanced technical features, in particular testing the VPC offering. Due to the fact that both AWS and DB Systel have their main network backbones in Frankfurt, connectivity into the cloud was convenient to set up with physical cables for testing. After entering into production, DB Systel replaced that with a best practice of redundant connectivity by Versatel and Deutsche Telekom.

In October 2015, the contract negotiation was concluded and the agreement between DB Systel and AWS signed. Unmanaged access to AWS (see below) was provided to the first customers immediately, with more jumping in over the following months. The managed AWS-powered services became officially available to DB Group on January 1, 2016.

Achieving Goals

With the contract signed, DB Systel became the compliant, compulsory provider of AWS services to the whole of the DB Group. DB Systel started offering two types of service on AWS:

- DB Enterprise Cloud "Managed"
- DB Enterprise Cloud "Unmanaged"

Let's analyze them separately.

"Managed" Cloud

In this scenario, DB Systel offers application hosting, development and maintenance based on AWS infrastructure, similarly to how it offers those services based on the on-premise datacenter infrastructure it owns. This means the subsidiary has no direct point of contact with AWS services, which are used by DB Systel technical staff. DB Systel is responsible for every layer of the stack, with the exception of the data protection layer, which remains the responsibility of the subsidiary.

According to DB Systel, moving applications from on-premise to IaaS is the strategic focus, and any new application that DB Systel is contracted to deploy and build will follow a cloud-first logic.

DB Systel believes that around 50% of the 630+ applications it currently manages are fit for cloud as of now. With some work in terms of rearchitecting, the provider believes up to 80% of them could be moved to AWS back-ends. According to DB Systel, the key discrimination points on the feasibility of AWS migration for each application are:

- The ability to run the same application over two availability zones (i.e., dedicated datacenters on AWS in one region)
- Licensing rules and licensing costs
- Application size

Ultimately, the decision on whether to host the application on AWS versus a traditional on-premise environment will be a prerogative of the subsidiary that's contracting DB Systel. However, DB Systel is positive that when costing-in the infrastructure expense in the framework contracts (see below), the case for AWS becomes very compelling.

"Unmanaged" Cloud

IDC maintains that this is the most innovative scenario, and one that is enabled by AWS' advanced capabilities in terms of identity and access management rights. DB Systel is the owner of AWS' contract, receives the bill for any expense occurring on it and operates with administrator rights on the AWS environment. It then sets up fully compliant "User accounts" that can be requested and employed by the various subsidiaries. User accounts have a restricted set of rights, with limitations around:

- Network connectivity: By default, and to reduce security breaches, virtual machines can either have access only to the Internet (no Intranet access), or only to Intranet geographical access (by default, only the German AWS Region can be used).
- Service catalogue: By default, only a set of standard services from AWS can be used. To gain access to advanced AWS services (e.g., AWS Lambda or AWS IoT service), DB Systel staff needs to be notified and grant access.

The limitations are ultimately embodied in a set of predefined virtual datacenter templates embedding security and privacy settings by default. In the "unmanaged" cloud, the subsidiaries receive user accounts on AWS and then set off building and managing the infrastructure, application, and processes by using those certified templates. DB Systel is only in charge of maintaining network connectivity and IT compliance (see above), paying AWS and charging back the costs to the subsidiary.

Success Stories

In the first seven months of operation of the AWS-based cloud, there were several success stories in Deutsche Bahn Group. Some examples for the "managed" cloud space include:

- DB Systel is currently using AWS basic and advanced services (e.g., AWS RedShift and AWS Dynamo DB) to set up a **vast Open Data platform**. The goal is to collect all non-confidential information from the DB Group (e.g., location of stations, travel schedules, length of tracks) and make that available freely in the form of APIs so that local governments, app makers, and so on, can leverage them to innovate.

- **IoT platform for cargo train tracking**. The group is equipping a first batch of cargo trains with small, inexpensive devices transmitting location via GPS. DB Systel is using the AWS IoT service for data ingestion and data collection back-end, with the goal of offering corporate customers real time information on cargo position.

- **IoT platform for escalator maintenance**. Thousands of escalators are in operation daily across German railway stations. Due to their sheer numbers, the DB Station und Services AG, the subsidiary responsible for managing station facilities, had a very hard time detecting problems, with faults going undetected in some cases for weeks. Combining sensors (currently being installed in escalators across the country) with AWS IoT services will allow DB Group to monitor status in real time and dispatch maintenance much more quickly.

DB Systel reports that most of the workloads deployed in the "unmanaged" service have been Web-based application space. This does not mean that the loads are not critical, however:

- bahn.de, the main consumer portal for the group, including online ticketing and real time information on the train status, is running a hybrid infrastructure on AWS, managed by the responsible business unit. The application is complex and multitier, including several Java layers and connectivity to other on-premise systems.

- DB Regio Bus, a subsidiary responsible for local bus services operating 13,000 buses countrywide, decided to migrate most of its IT load to DB Enterprise Cloud "Unmanaged." It went through the process to receive AWS user accounts from DB Systel and moved its full load to AWS capacity. It had planned for a 21% reduction in overall monthly infrastructure costs, and ended up with a 28% decrease — now gunning for additional reductions thanks to rationalization of the application landscape. DB Regio Bus is now running a "serverless" infrastructure, with 100% of the loads sitting on AWS.

- DB Schenker Logistics used the AWS Australia Region as a target for full disaster recovery of their on-premise datacenter in Sydney. Thanks to the predefined network rules and the templates provided by DB Systel, it took DB Schenker only one and a half months to have a working disaster recovery setup in place.

- Some subsidiaries have running proof of concepts for Citrix virtual desktop environments running on AWS virtual machines and benchmark them with what was previously available.

- Enabling other subsidiaries to try out AWS services directly in an "unmanaged" fashion has already provided DB Systel with a funnel of additional demand for advisory services, often times converting into "managed" cloud contracts, creating a win-win situation.

Business Outcomes

When it set off with AWS-based services at the beginning of 2016, DB Systel had a goal to generate at least €1 million in revenue per year from the other subsidiaries, linked to those AWS environments. As of August 2016, DB Systel reported that that target had already been exceeded, and in fact it is now facing some pressure to quickly expand the cloud task force team to deal with demand (see below).

DB Systel was very impressed by AWS' technical capabilities and IaaS/PaaS portfolio, which DB Systel deems unequalled in the industry. The geographical reach and readiness of the AWS engineers to quickly set up POC environments and help kick-start the process was also much appreciated.

In terms of benefits for the DB Group at large, the business plan for moving to a cloud-first approach was built on cost saving expectations of 15%–30% versus the on-premise datacenter environment.

Costs included both capital expenses (annualized) and operating expenses, as long as they were linked to infrastructure elements replaced by AWS IaaS/PaaS solutions. Costs included staff, energy, hardware Capex, system management software licenses, and hardware maintenance fees. All implementations executed so far fell in that bracket of savings, according to DB Systel.

DB Systel was in a privileged situation to execute such comparisons, because it already acted as an independent service provider and had a quite sophisticated measurement system in place to price services delivered from its own datacenter based on cost-per-VM and so forth. Initial learnings showed that savings can be even stronger than the initial targets when small one-workload-per-server physical server instances are replaced with small virtual machines.

Savings aside, IDC believes that the AWS migration is starting to exert a positive influence at a strategic level. This is true for:

- DB Systel, which is gaining lots of kudos from the other subsidiaries and is boosting its image as a business-enabler (e.g., with the IoT system for escalator maintenance). More concretely, the division is now able to use that expertise to offer managed AWS cloud services to third-party customers, increasing revenue outside of the DB Group.
- Compliance and security departments. With a centralized, corporatewide data location strategy and logging services and policies enforced, it can do without shadow IT and avoid the creation of dangerous "black holes."
- DB Group as a whole, which can now leverage large public-cloud capabilities in a compliant fashion to experiment with digital transformation initiatives and fight back against the expanding list of competitors in the mobility service arena.

What's Next for DB Group?

While much has been accomplished in the first half of 2016, IDC believes that the journey to flexible cloud infrastructure for DB Systel and the broader group has just started. IDC believes some of the key milestones in the future will include:

- **Training on cloud capabilities**. To support the IaaS-first approach, DB Systel is now ramping up staffing with a team specialized in migrating traditional apps to AWS. Training in AWS services, setup, and migration is a cornerstone in this. Short term 0–6 months.
- **Pure innovation**. With the power of cloud services beneath its feet, DB Systel has started trying out new things. It has a working group trialing the use of Amazon Alexa cognitive language recognition software in helpdesk environments. It is exploring new AWS services as they appear, including Machine Learning and AWS Workspaces. Lots of these innovations are showcased and developed further in DB SkyDeck, a digital innovation lab allowing DB Systel employees to experiment and get feedback on new, technologically-driven business ideas. Short term 0–6 months.
- **Migration of ever larger portions of workloads onto AWS**. DB Systel does not have a set target for this, and the option of DB Group-owned infrastructure will remain for the foreseeable future — a move that IDC deems savvy. Ultimately, it is the subsidiaries and business units that have to decide on which back-end to host their applications. This game of demand and supply will lead to continued flip of the balance of workloads towards AWS. Mid-term 0–12 months.
- **New offerings by DB Systel.** The division is now assessing the feasibility of new offerings on top of the "Managed" and "Unmanaged" options above. These will continue to boost cloud usage and revenue for DB Systel. Mid-term 0–12 months.

- **Application standardization**. The expanding popularity of standard IaaS/PaaS services is leading IT professionals across the group to rethink the approach between custom applications and standard applications. DB Systel leadership is empowering staff with the concept of standardizing applications that bring no differentiation to the group, and allocated the resources to developing new cloud-enabled business models. Long-term 12–36 months.

- **Multicloud coverage**. On the strength of the experience around AWS, the DB Systel cloud team is now starting to assess multicloud strategies, especially for SaaS environment types in SAP and Oracle cornerstone areas. Long-term 12–36 months.

Conclusion

IDC maintains that DB Group is currently in a unique position compared to other massive organizations in Europe, in that it has found the organizational and governance keys to the use of IaaS cloud capacity. Savings and, more importantly, innovation, have already started to surface, opening up a promising landscape for the coming months and years.

IDC believes that the DB Group experience can yield fundamental learnings for other enterprises of similar size grappling with the cloud question. Key lessons learnt include:

- **Gain high-level support of top management, both business and IT leaders**. Obtaining strategic support is key to the success of any initiative, and having a leadership that's open to making a decisive move to external cloud services is paramount.

- **Map your applications by both data regulation and intellectual property risk level**. DB Systel uses a no-nonsense five-grade scale (very high risk to very low risk) to assess whether and how a multitier application can be shifted to an IaaS off-premise. Clearing the governance hurdles is the most important aspect, as technological maturity is very high and hurdles in this area are on the verge of disappearing.

- **Make yourself familiar with auditing and compliance tools** (e.g., access management, logging) at your cloud service provider. The stronger the toolset and the more familiar you are with it, the shorter the path to enterprise-grade adoption.

- **Fill the staff and skills gaps early on**. In the IaaS world, the best performers are either strong IT generalists with broad understanding of programming languages and IT architectures or "weak specialists" that can expand their view. Even for an organization like DB Systel, with a vast IT talent pool and a clear cloud direction, training and hiring processes can be a bottleneck. Kicking those processes off in parallel to the contract negotiation is a smart move, as demand tends to grow faster than staff supply.

- **Be pragmatic on "hybrid mode" for multitier applications**. Based on its experience, DB Systel recommends selectiveness in the multitier applications that are built partly on-premise and partly on IaaS off-premise. Traffic costs, latency, and the need to set up encryption systems can make this approach expensive or counterproductive. IDC believes it is important to calculate the cost/benefit first. In non-regulated industries, it can be more practical to either leave the full front- and back-end on premise, or migrate it completely to cloud.

- **Use a spearhead-and-net approach for your cloud transformation**. Large companies with compartmentalized IT departments naturally tend to clam up when change is introduced. In order to help drive change in those environments, DB Systel successfully employed a two-step process. First, a small, driven task force of cloud specialists (the spearhead) supported by senior management acts independently to run POCs and set the strategic direction. Then, an increasingly broader net needs to be cast in the IT organization to involve other departments and promote successes internally.

Methodology

The project and company information contained in this document was obtained from multiple sources, and most importantly from direct interviews with DB Systel executives by IDC analysts.

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