CASE STUDY

1&1 vs. DISH

A tale of two Open RAN networks

TelcoDR

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Executive summary

German mobile virtual network operator (MVNO) 1&1 and Rakuten recently announced a long-term partnership to build a fourth mobile network in Germany. In doing so, 1&1 will become the first European operator to commit to building a network entirely based on open radio access network technology (Open RAN). To deliver this new network, Rakuten plans to build a private cloud for the network's data infrastructure, comprising of four central data centers for the core network as well as hundreds of decentralized data centers throughout Germany, connected to thousands of antenna locations via fiber optics. Rakuten will own the build of the active network equipment and the overall performance of 1&1's mobile network, while data centers and fiber optic lines will be provided by 1&1's sister company, 1&1 Versatel. With this approach, 1&1 will have access to the Rakuten Communications Platform (RCP) stack of access, core, cloud, and operations solutions.

Over in the United States, DISH also announced it is building a fully virtualized, Open RAN-based greenfield network. Unlike 1&1, DISH's design goes all in on the public cloud, using Amazon Web Services (AWS) to deliver both core and edge infrastructure to their subscribers.

These similar goals – building greenfield Open RAN networks – yet utilizing differing strategies by building a private cloud as opposed to using AWS' public cloud, presents a unique opportunity to compare the total cost of ownership (TCO) of the two approaches. In this case study we demonstrate that 1&1's approach will cost almost twice as much as DISH's public cloud strategy. Additionally, by building a private cloud, 1&1 can't take advantage of the continuous innovation, scale, and breadth of native services in the public cloud and will have to build or procure and manage software solutions for core services like storage, databases and analytics, in addition to building and operating data center infrastructure.

Introduction

Operators are facing significant capital expenditure (CapEx) in the move to 5G. To improve CapEx efficiency and save nearly 250 billion across the 5G deployment cycle, they are leveraging sharing models through partnerships with hyperscalers and other operators, according to Analysys Mason. With the rollout of 5G, telcos are beginning to look at Open RAN technology to reduce costs in the most expensive part of the network: the RAN. Open RAN aims to disaggregate the siloed nature of the RAN market, where a small set of vendors such as Ericsson, Huawei, and Nokia have historically offered tightly coupled, proprietary equipment and software.

The Open RAN standards being developed by the O-RAN Alliance use virtualized network principles and technologies to bring features such as network malleability, improved security, and the ability to use COTS hardware and reduce CapEx and operational expenditure (OpEx). A Light Reading analysis of Rakuten's approach to building its Open RAN network references a Rakuten claim that its network would be 40% cheaper than a traditional network. DISH's Open RAN network is expected to be 50% cheaper than a traditional one.

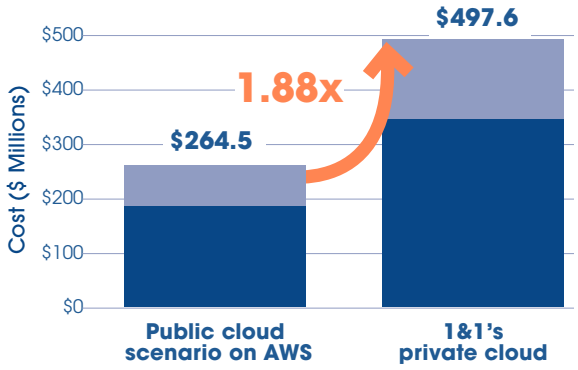
To deliver the network for 1&1, 1&1 Versatel will build four central data centers and hundreds of decentralized data centers - effectively building a private cloud to deploy the Rakuten solution.

In contrast, DISH will not build any new data centers and instead will use AWS to host its core network. It will also use AWS Local Zones and AWS Outposts to deliver functionality at the edge of the network, closest to the radio infrastructure and end customers.

TelcoDR conducted a deep dive into each of these two very different approaches to building out infrastructure, comparing the respective impact on CapEx and OpEx for these greenfield networks. To build a comparative model, we apply the DISH approach to infrastructure to the 1&1 plan. We assume 1&1 will use OpenRAN and the use of Rakuten Symphony for software, as planned. However, instead of building a private cloud and proprietary data centers, we assume the use of AWS.

What we found was 1&1's are almost double what they could be if they were to use the public cloud, as DISH plans to use AWS. Instead of spending and estimated $500M over 5 years, they would spend $264.5M

Figure 1: Cost Comparison between 1&1's current data infrastructure plan and AWS Scenario



How DISH will use AWS

TelcoDR utilized publicly available information on DISH's proposed approach to an AWS-based network design, verifying facts and feasibility with industry experts. There are three dominant attributes of the proposed AWS/DISH collaboration that provide key cost and technical differentiators: (1) the ubiquity of AWS regions across DISH's proposed service area; (2) cost of optimized infrastructure, in the form of Graviton-based Arm solutions (unique to AWS); and (3) the availability of AWS Outposts and Wavelength to deliver edge compute and performance requirements.

Ubiquitous data centers

As of 2021, cloud hyperscalers (including AWS) have built 700 datacenters, with close to half of them located in the United States[1]. AWS, in particular, has built a reputation for operational excellence over 15 years of operation, and provides service level SLAs and proven uptime that exceeds those of most on-premises data centers and co-lo providers. Mission critical, and sensitive government workloads are certified to run on AWS, and CSPs like DISH are blazing a new trail by adopting the public cloud for telco workloads. Building these data centers is highly CapEx intensive; for example, in 2020 the hyperscalers spent an estimated $100B in CapEx[2]. AWS invests nearly $1B CapEx per availability zone, and they typically build at least 3 availability zones for every region they build[3].

While historically telcos have each had to invest and maintain their own data center infrastructure, public cloud offers a new choice. Instead of dedicating resources to building and managing physical infrastructure, telcos can turn to fully managed public cloud services that include hardware, security, failover, and human capital. In addition, the pricing model of hyperscalers is to charge customers for usage only; for example, billing by the minute, by the row of DB storage or by the API call. While this approach will incur ingress and egress network costs that the telco wouldn't normally have to pay on their own infrastructure, the massive CapEx expenditure of building a data center is eliminated.

AWS has 24 regions globally, with 8 new ones planned over the next several years. There are currently 4 regions in the USA and 1 region in Germany.

AWS Graviton Chips

Another great differentiator for AWS is their custom built processor, called Graviton2. Graviton2 processors are 64-bit Arm Neoverse cores which are available on a wide variety of instance types and come

in varying combinations of CPU, memory, storage, and networking capacity, giving the customer the flexibility to choose the appropriate mix of resources for their applications. Graviton2 workloads have been independently proven to provide a **40% price performance improvement** over AWS Intel chips. At re:Invent 2021, Amazon announced the availability of **Graviton3** chips which promise to be 25 percent faster than Graviton2, a 3x speedup for machine-learning workloads and will use 60 percent less power.

DISH **has indicated** that it will be using AWS Graviton-based instances to power its compute workloads, and for the purposes of our analysis we have assumed wherever possible Graviton instances will be selected.

AWS Outposts and Wavelength

The third differentiator for AWS is the availability of 2 services: AWS Outposts and AWS Local Zones. Outposts is a service where an AWS-managed rack, hardware and all, is provided to customers for use in their on-premises data centers, and provides access to the other AWS services.

AWS Local Zones place compute, storage, database, and other select AWS services closer to end-users. With AWS Local Zones, customers can easily run highly-demanding applications that require single-digit millisecond latencies to their end-users. Each AWS Local Zone location is an extension of an AWS Region in geographic proximity to end-users and provide a high-bandwidth, secure connection between local workloads and those running in the AWS Region, allowing customers to seamlessly connect to the full range of in-region services through the same APIs and tool sets.

DISH plans to use **AWS Outposts and Local Zones** for its edge locations. While AWS does not currently offer AWS Local Zones in Germany, for the purposes of this paper we have assumed that by the time 1&1's network launches, it will have Local Zones in major metro areas and Outposts in less densely populated areas.

Assumptions on DISH's AWS cost for comparison

We have assumed DISH's AWS costs will include the following:

COMPUTE

- Linux pricing
- Xlarge instances (4 vCPUs, 16GB RAM)
- 1 instance / 600 subscribers
- General purpose solid-state drives (SSDs) (gp2)
- 80% reserved instances, 20% on-demand
- All upfront costs
- Three-year term

NETWORK

- Ingress / egress fees

The Rakuten/1&1 plan to build and operate Europe's first virtualized network will cost twice as much for its data centers than if they used AWS.

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How much will it cost to build 1&1's private cloud network?

In order to calculate the TCO of the 1&1 network's data infrastructure, we included the cost of purchasing, installing and operating privately-owned infrastructure for four major data centers, plus the cost of doing the same thing for 100 edge locations. Though the total number of servers would be the same if everything was hosted in one data center, building four separate data centers eliminates the ability for 1&1 to benefit from economies of scale. With four separate data centers, 1&1 must purchase real estate, hardware, power, cooling, and provide the human resources to operate each data center.

According to 1&1's annual shareholder's report, they currently have around 15 million subscribers, split between mobile and broadband. To calculate the cost of building the data centers, we have assumed that the amount of hardware needed is for 15 million subscribers and will not increase over 5 years.

Other data center assumptions include:

- Build out of a tier 3 data center that is high performance and high density, including the acquisition of space via a lease
- Computer room air handler (CRAH) with variable frequency drive (VFD) cooling tower
- Row-based hot-aisle containment
- High-efficiency uninterruptible power supplies (UPS) for power generation
- Raised floors
- Dropped ceilings
- Fire suppression / detection
- Power distribution units (PDUs)
- Disaster recovery
- Insurance costs
- Professional fees associated with the buying of land
- Taxes

How much will it cost to build 1&1's private cloud network?

Excluded from private cloud estimates are software license fees that would need to be purchased regardless of on-premise or cloud location.

To estimate data center costs, we used TelcoDR's Data Center Calculator. By inputting criteria such as country, number of telco subscribers and percent virtualization of servers, we can calculate the TCO for an on-premises data center and compare it to the cost of running everything on AWS.

In the calculation, a German telco with 15 million subscribers that is planning to build four data centers with 100% virtualized servers at a 10-1 server consolidation ratio is taken into consideration. As mentioned earlier, due to the loss of economies of scale, costs will exceed that of one big data center. We estimated the cost to build one data center in Germany for a telco of 3.75 million subscribers (Table 1). This way, we will keep the amount of servers equivalent, but factor in the extra building costs as well as labor costs.

Assumptions for TCO calculation

15M SUBSCRIBERS

100% VIRTUALIZED

4 DATA CENTERS

10:1 SERVER CONSOLIDATION

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How much will it cost to build 1&1's private cloud network?

Table 1: CapEx and OpEx breakdown to build one data center in Germany for a telco of 3.75M subscribers (in USD Ms)

TOTAL CAPEX (Annualized CapEx = $4.95M)	**$30.32**	**ANNUAL OPEX**	**$12.3**
Hardware price of IT devices (refreshed every 3 years)	**$7.9**	**Power consumption cost**	**$1.2**
Servers	$2.2	Cost of electricity for IT equipment (servers, networking equipment and storage system)	$0.8
Storage	$4.6	Cost of electricity for cooling resources	$0.3
Networking machines	$1.1	Cost of electricity for power delivery of generation system and DC lighting	$0.1
Hardware price of operating devices and systems for IT equipment	**$10.0**	**Networking fees**	**$0.5**
Power delivery and generation systems including UPS systems and PDUs	$5.1	**Personnel cost (personnel salaries)**	**$4.5**
Cooling resources	$3.1	**Maintenance and repairs costs (includes maintenance personnel)**	**$1.6**
Enclosures and containment (racks)	$0.3	**IT virtualization software license recurring cost**	**$4.0**
Lighting system and other auxiliaries	$1.5	**Property tax**	**$0.2**
Other infrastructure costs	**$12.4**	**Insurance costs**	**$0.3**
Cost to build facility	$10.7	**Colocation services**	**$ -**
Fire protection systems	$0.1		
Interest and Fees	$1.2		
Land costs	$0.4		
Other costs	**$0.016**		
Land tax	$0.004		
Professional fees	$0.012		

How much will it cost to build 1&1's private cloud network?

1&1 plans to deploy 100 edge locations across Germany. We assumed that each edge location will have two racks and we added the associated capital and operating costs calculations.

Annual costs incurred are estimated to be $17.25 million ($12.3M OpEx + $4.95M annualized CapEx) for each data center (Table 1). To determine the total costs for four data centers, we multiplied this number by four, and then multiplied by five to determine the five-year TCO. Additionally, we determined that annual costs for the procurement, labor, maintenance and operation of 100 edge locations will add $30.5 million per year, leading to a **total estimated TCO of $497.6 million for 1&1's data center infrastructure.** (Table 2).

Table 2: Five-year TCO calculation for 1&1's four data centers and edge locations (in USD Ms)

Annual cost for four data centers (17.25M × 4)	$69
Annual cost for 100 edge locations	$30.5
Total annual cost*	**$99.5**
Five-year TCO	**$497.6 M**

*Estimate does not include software license costs

Overall costs to run workloads on AWS

To estimate 1&1's AWS infrastructure needs, we have modeled the DISH design for 1&1 and deployed in Germany. For our estimate of AWS costs, we have assumed the same amount of virtual software, given 1&1's plans to use Rakuten private cloud as opposed to the use of the public cloud.

The way the infrastructure is laid out under DISH's plan is similar to 1&1's: similar size, similar Open RAN plan. The main difference is 1&1 use of the Rakuten private cloud vs the use of the public cloud. Therefore, in our estimate for AWS costs, we assumed the same amount of compute.

Based on TelcoDR's experience, most telcos adopt an r5 (memory optimized), c5 (compute optimized), m5 (general purpose) mix of instances with an approximate ratio of 10, 45, 45 percent, respectively. The **AWS Graviton2-based instance** equivalents are r6g, c6g, and m6g.

In addition to Frankfurt, where AWS is already deployed, Germany has 10 more metropolitan areas. Therefore, we will assume if 1&1 were to use AWS, they would use 10 AWS Local Zones and 90 AWS Outposts.

Based on Amazon's pricing for AWS Outposts, it is assumed that 1&1 would choose a **general purpose small unit** for workloads at a price of approximately $204K. For 90 outposts, the total cost is calculated as approximately $18.4 million per year. However, based on market practice, cloud computing services offer discounts of approximately 40% for bigger contracts.

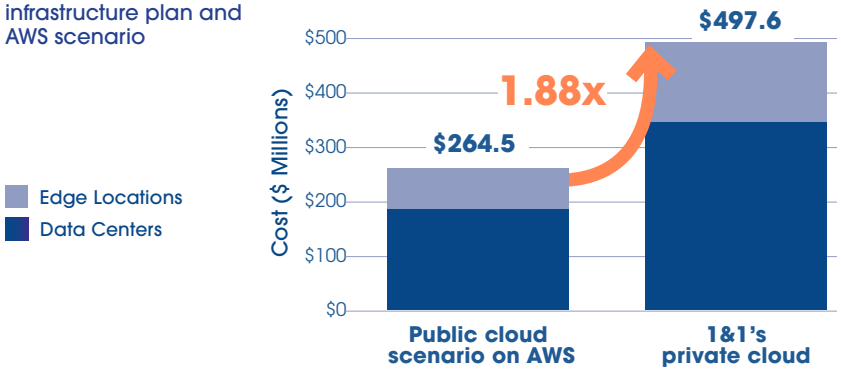
Table 3: Breakdown of annual AWS costs in Germany for a Telco with 15M subscribers (in USD Ms)

Compute	$23.3
Storage	$4.7
Data Transfer	$2.7
Labor	$5.5
AWS Outposts	$14
AWS Local Zones	$14
Total (per year)	**$52.9 M**
Five-Year TCO	**$264.5 M**

By adding the cost for Elastic Block Storage (EBS) and data transfer, the total cost comes up to an extra $14 million per year. For Local Zones, the main cost driver is data transfer out of AWS. Data transfer will double the usual cost it would have been without Local Zones. Using TelcoDR's Data Center Calculator, we also added in the other AWS costs, which brought us to a total of $264.5 million over five years (Table 3).

1&1's private cloud plan comes out to be 1.88x more expensive than if it chose to run everything on AWS (Figure 1).

Figure 1: Cost comparison between 1&1's current data infrastructure plan and AWS scenario



Differences in data center costs

There are many reasons that can explain the difference in costs between 1&1's original plan and the option of running everything on AWS.

In our estimate, 1&1 would have to pay $42.8 million to construct all four data centers (Table 4). If this price tag were amortized over 15 years, 1&1 would be required to pay interest as well. Other major costs for on-premise data centers include the purchase price of servers, storage, power delivery and cooling hardware, land and electricity.

The high price tag for servers also includes the provision for scale. Data centers need to be built with additional capacity for uneven compute needs. Organizations waste an estimated $62 billion a year paying for extra data storage capacity that they don't need, according to a study by Stanford researcher Jonathan Koomey. The elasticity of AWS allows organizations to use exactly what they need when they need it. When more servers are required, AWS can scale up immediately, and release capacity when the need passes.

Furthermore, because hardware and software is no longer owned, Amazon takes on the responsibility and costs of maintaining the hardware and software. Disaster recovery and security are built into the public cloud and are no longer elements operators need to manage themselves.

Finally, one of the biggest downsides to building four core data centers is that 1&1 must hire and train personnel across the sites. Running on AWS reduces labor further because most of the labor attributed to maintenance, procurement, security and management is managed by Amazon. This allows organizations to get out of the business of building and managing data centers and focus the time and savings on their core competence and serving customers.

Table 4: List of major costs that will no longer be required under AWS (in USD Ms)

	1 Data Center	4 Data Centers	AWS
Construction of data centers*	$10.7	$42.8	$0
Procurement of power delivery and cooling*	$10.0	$40.0	
Procurement of storage*	$4.6	$18.4	
Procurement of servers*	$2.2	$8.8	
Annual electricity costs*	$1.2	$4.8	
Interest and fees paid*	$1.2	$4.8	
Procurement of land*	$0.4	$1.6	
Procurement of edge servers and racks**	$7.2	$28.8	
Total	**$37.5 M**	**$150.0 M**	

*Numbers taken from Table 1
**Number from TelcoDR's Data Center Calculator, based on total cost of servers, routers and switches, storage, enclosures and containment

Other advantages of AWS

If costs alone are not enough to determine whether 1&1 is making the right decision by partnering with Rakuten, there are other benefits of AWS to consider.

First, AWS has an enormous suite of services that 1&1 could use once on the AWS platform. 1&1 could leverage these products, some of which include analytics, machine learning, and artificial intelligence capabilities.

Secondly, buying and owning hardware and software locks you into these technologies for the duration of their lifetime, leaving 1&1 with legacy assets as soon as technology evolves. Deploying on AWS would future-proof 1&1's storage and compute technologies as they deploy future 5G and 6G technologies, because Amazon is continually investing in research and development (R&D) and updating its product offerings. The moment something better comes up, 1&1 could simply switch to the newer instance type or service.

Conclusion

Two companies have decided to build new greenfield networks. Both are starting from scratch and both are implementing Open RAN. They are both embracing cloud-native architecture but with one major difference: deploying their workloads on private versus public cloud.

This case study has shown that 1&1's deal with Rakuten will cost a total of $497.6 million over five years for its data centers and edge locations, while the cost to run everything on AWS will result in a price tag of $264.5 million over five years. These totals represent the cost for data infrastructure, and do not include the cost to build and procure the Open RAN hardware. All told, 1&1's current plan is on track to cost 1.88x more than what it would have cost to run its data centers and edge locations on AWS, like DISH.

In the final analysis, 1&1 is spending a lot more than it should, and DISH's strategy seems to be the best choice for telcos moving forward.

Footnotes

[1] Hyperscalers Surpass 700 Data Centers Globally

[2] Follow the CAPEX: Cloud Table Stakes 2020 Retrospective

[3] Why AWS Announces Regions in Advance

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Danielle Royston has 25 years of enterprise software experience – the last 10+ as a CEO specializing in turnarounds. Previously she was CEO of Optiva Inc. (TSX: OPT), where she pivoted the company to become a leader in cloud-native BSS/OSS on the public cloud. And now, she's on a mission to help the telecom industry move all of its applications to the public cloud and fully embrace all the competitive advantages it has to offer.

Royston is widely recognized as an industry thought leader and has been featured in numerous publications, including Capacity Media, Fast Company, Fierce Wireless, Forbes, Light Reading, Mobile World Live, Pipeline, SiliconANGLE theCUBE, Telecoms.com, TelecomTV, The Fast Mode, The Harvard Business Review, TM Forum and VanillaPlus.

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