

Amdocs - microservices based digital modernization

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EXECUTIVE SUMMARY

Amdocs is a provider of customer experience software solutions and services to communications, entertainment and media service providers. Amdocs solutions include BSS, OSS, Media & Entertainment, Digital User Experience, network control, optimization and network function virtualization.

AmdocsONE is a new umbrella modular suite that includes all Amdocs products, solutions and services mapped to, 5 CSP critical business imperatives. This report focuses on the Customer Experience Systems (CES) components of AmdocsONE that have been modernized to address Amdocs' consumer and enterprise business imperatives. DigitalONE & CatalogONE now provide a cloud-native, microservice based customer engagement solution supporting online and offline channel experience, care, commerce, ordering & catalog. The new solution provides the ability to embed intelligence and personalization, enabling features such as guided engagements, and next-best-offer. These solutions use Amdocs' new platform Microservices360 that underpins all new applications within Amdocs. These product components are positioned to address the need of CSPs to innovate new products and services rapidly; enabling a broad set of products and services that will build customer loyalty, grow revenue and improve automation.

Microservices360 is the core engine used together with DevOps and Site Reliability Engineering (SRE) to power the cloud native modularity of AmdocsONE. Microservices360 has enabled the modernization of the digital experience and catalog products. AmdocsONE also includes existing applications, such as charging and billing, which have been decomposed, modularized and provided in a cloud enabled framework. AmdocsONE provides a new modular, open and integrated business solution, backed by cloud native and microservices technology, in contrast to its previous positioning of a set of monolithic applications.



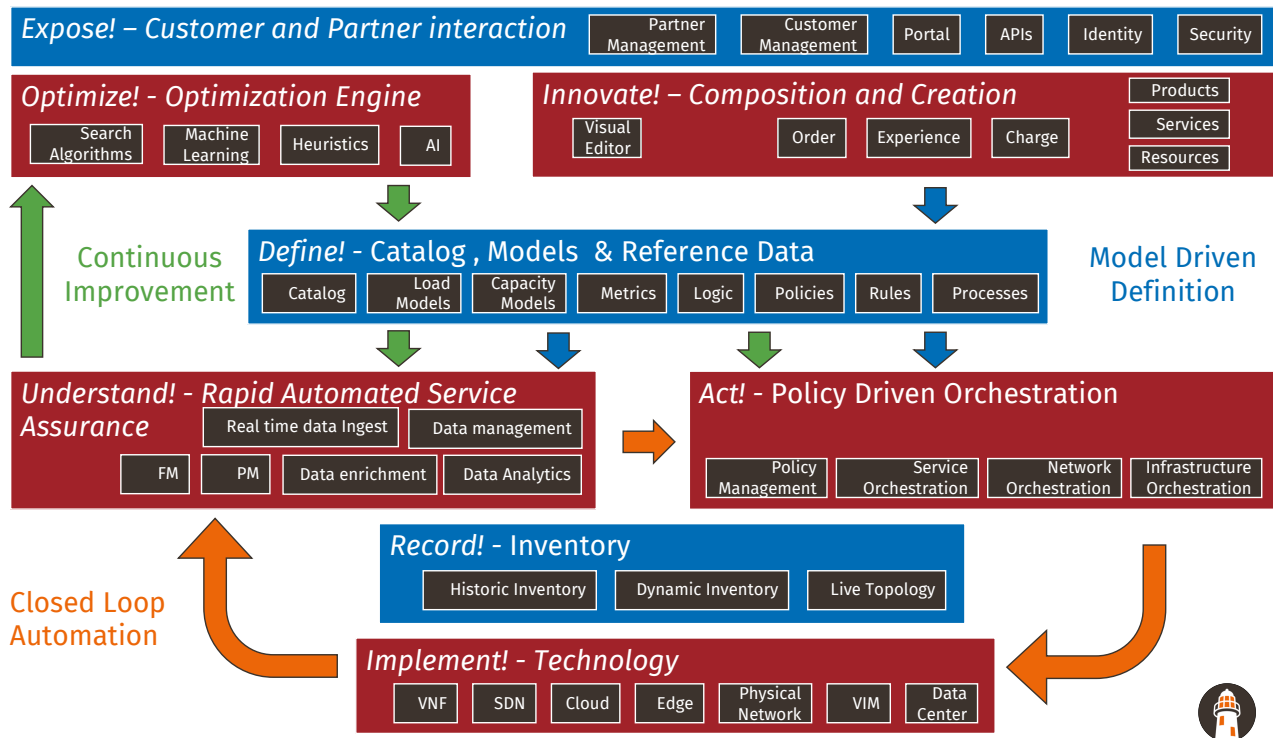
Amdocs is in a powerful position to help CSPs migrate from their traditional customer engagement systems approach to one that is cloud native and collaborative. As an existing supplier to CSPs they can enable existing and new customers to bridge the gap between the monolithic and cloud native approach and support new types of customer engagement and services.

APPLEDORE RESEARCH GROUP ANALYSIS

Mapping to Appledore Reference Architecture

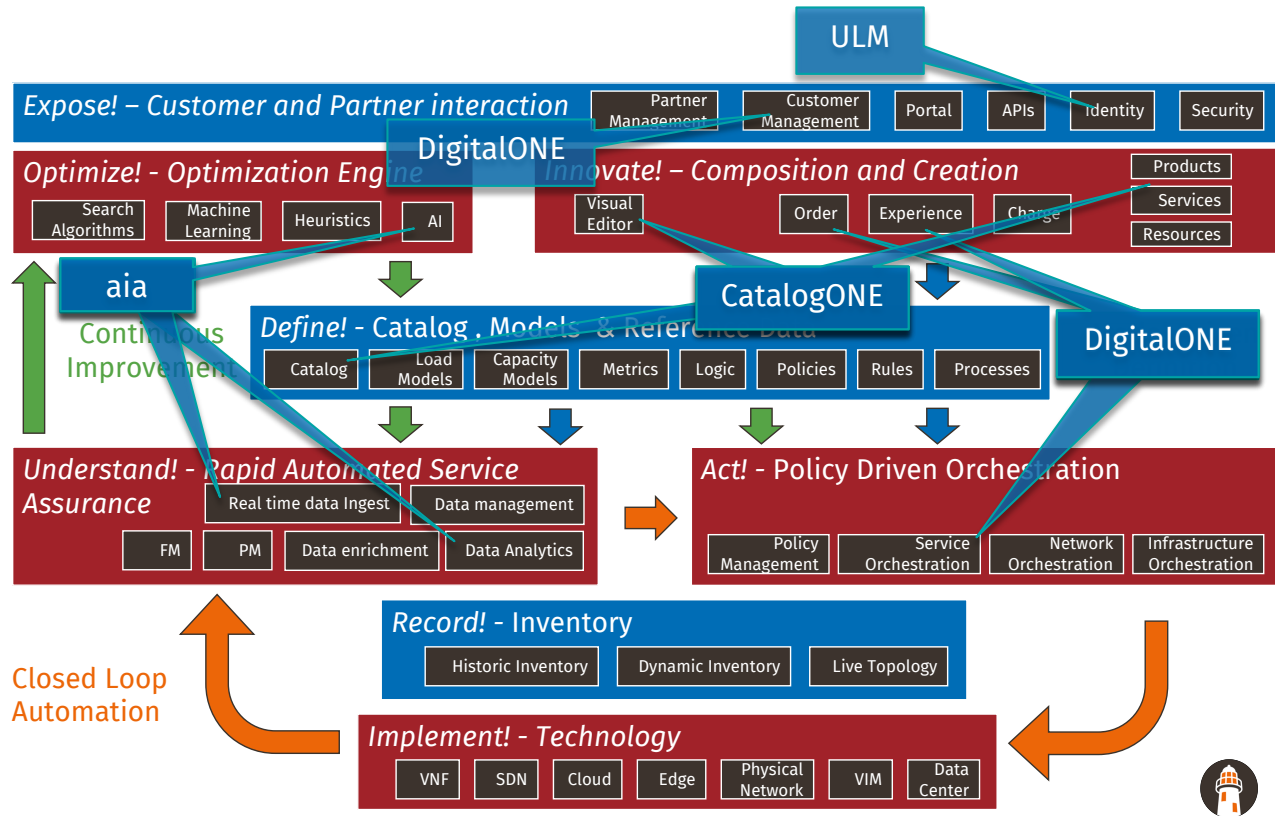
Appledore Research has identified a reference architecture and taxonomy that describes the critical needs and components to support CSP innovation and software enabled networks. This is shown in the following figure. Central to the taxonomy are four high level process needs that we believe are critical to supporting lower capital and operational cost for CSPs and to enable innovation both internally and with partners: Closed loop automation; model driven definition of components; Continuous improvement processes that seek to optimize the CSP environment and the ability to readily expose all the capabilities of a CSP to customer and partners. For more on each of these topics please visit www.appledoreresearch.com.

Figure 1: Appledore Taxonomy and Reference Architecture



Source: Appledore Research

Figure 2: Mapping AmdocsONE CES Solution to Appledore Taxonomy and Reference Architecture



Scope: This figure shows the positioning of the new CES components of AmdocsONE and associated cloud systems aia and ULM. Amdocs has a much wider capability with “powered by ONAP”, OSS and traditional CES systems that is not shown in this figure.

Source: Appledore Research

AmdocsONE¹ CES provides customer and revenue management systems. DigitalONE and CatalogONE are new solutions addressing customer engagement and enabling new business. DigitalONE and CatalogONE address the functional aspects of the Appledore taxonomy related to:

- Expose! – The exposure of CSP capability to customers and partners through APIs (based on TMF open APIs) and through different customer touchpoints (for example, portals, selfcare

¹ AmdocsONE also includes modules based on ONAP, which has key sponsorship from AT&T a key Amdocs customer, and network capabilities. This report focuses on the Customer Experience (CES) capability of AmdocsONE. The “powered by ONAP” and network capabilities of AmdocsONE will be covered in a separate solution profile. In this profile where we use the term AmdocsONE we are referring to the Customer Experience capabilities of AmdocsONE.

applications, call center applications, retail applications and social media). Providing improved customer and partner experience through customer management applications such as self service and retail. Amdocs ULM (Universal Lifecycle Manager) provides identity management including the management of user relationships (for example, family) and user group access rights. ULM is a cloud based component.

- Act! - The customer facing aspects of Policy Driven Orchestration, particularly service orchestration. DigitalONE is responsible for the orchestration of products and services in response to customer orders.
- Innovate! - Innovation of new customer services, products and bundles through catalog management. CatalogONE provides federated catalog management to any third party catalog enabling enriched products and services. Delivery of new customer services with order, experience and charging processes. For example, providing new means of capturing revenues with flexible payment and billing, monetization.
- Understand! – aia provides data analytics for DigitalONE and CatalogONE delivering the customer experience aspects of Appledore's Rapid Automated Service Assurance. For example, providing intuitive care recommendations throughout the customer lifecycle. aia supports real time data ingest from customer experience data sources. aia is a cloud-based component.
- Optimize! - The optimization of customer experience in response to multiple customer experience KPIs in real time with AI/machine learning.

Amdocs is embracing DevOps across the lifecycle process from sandbox to full scale deployment based on its Microservices360 platform. Appledore believe that Amdocs approach here is in line with IT best practice and that Amdocs can take a leading position in adoption of this approach in Telco.

Appledore believe that for innovation success in software enabled networks, much of what has traditionally been seen as separate systems of BSS, OSS and Networks needs to be merged, with everything becoming software. Continuing the historical distinctions between these types of software may ultimately limit the innovation possible in the future

Appledore however recognize that the reality of most CSPs today is to view software networks as a continuum of existing physical networks, which need to fit within an existing BSS and OSS environment. By enabling customers to benefit from a fully functional micro service enabled platform, whilst enabling continued use of key legacy systems Amdocs is hopefully providing an evolutionary path for its customers to fully adopt micro service-based innovation. By providing end to end business processes, that will be familiar to customers, on top of the new microservices platform this will hopefully bridge the traditional approach to BSS and the possibilities that can be provided by a fully enabled microservices platform

SWOT Analysis

Strengths

- Market Leader in Telecom OSS/BSS market with large-scale deployments at top tier CSPs.
- Has led the industry in CEM based solutions. Detailed understanding of customer touch points in the lead to cash process cycle should build trust with CSPs to facilitate process change improvements and the adoption of microservices approach in CSPs.
- AmdocsONE builds on Amdocs' existing leading position in BSS with a large installed customer base.
- Amdocs is enabling existing customers to adopt DigitalONE and CatalogONE by integrating its traditional systems with its new solutions. For example, the integration of CatalogONE with SDC (Service Design and Create) and DigitalONE with ODO (Order Delivery Orchestrator) and SOM (Service Order Manager).
- Amdocs has a strategic partnership with AWS which supports the deployment of AmdocsONE on the public cloud. AmdocsONE products are optimized to run on AWS and allow CSPs confidence to select AWS as a public cloud vendor. Amdocs also have a partnership with Microsoft Azure.
- Amdocs has a strategic partnership with RedHat and is using OpenShift as the underpinning for its Microservices360 platform. This enables flexible deployment of Amdocs applications across different cloud environments.
- AmdocsONE development approach is driven by APIs and builds on TMForum API initiative to provide a strong set of API driven services.
- AmdocsONE with Microservices360 positions Amdocs as a leader in adoption of microservices and cloud enabled software in the communications market.
- Microservices360 has built a strong program and methodology across company meaning that microservice projects are more likely to succeed.
- Microservices360 is well structured with clear customization and integration points for customers
- Microservices360 is well structured with clear points where customers can choose to replace key opensource component foundations.

Weaknesses

- AmdocsONE is positioned to support the traditional subscriber centric business relationships (based on subscribers directly making orders for services). This means that the opportunity

to support indirect customer services with online/real-time engagement may be missed in this model.

- AmdocsONE services are very closely aligned with existing BSS domains and CSP business model and processes. Amdocs need to ensure that this alignment does not simply lead to the implicit continuation of existing CSP business models. Amdocs is looking at distinct business models in its offerings in media and IoT.
- Appledore believe that the existing hard boundaries between BSS, OSS and Network will blur as everything becomes software. Appledore believe this blurring is important in maximizing automation and innovation from software enabled networks. Within AmdocsONE there are distinct approaches to microservices in the “powered by ONAP” network/OSS area from the CES area. There is a possibility that this reinforces distinctions between network, OSS and BSS functions. Amdocs should ensure that it uses its cross network/OSS/BSS experience to minimize these boundaries preventing cross OSS/BSS innovation.
- AmdocsONE encompasses solutions based on both Amdocs’ microservices360 platform and on ONAP opensource. Whilst these are bundled together the exact business and technical tie between these solutions is currently unclear.
- AmdocsONE is currently tied to a consistency only approach to data. This approach may limit innovation where OSS and BSS capability need to exist closer to the network and/or where processes become more online and real time.

Opportunities

- AmdocsONE can enable the evolution of existing BSS applications whilst rapidly allowing new service innovation. Amdocs if they put the right emphasis have the opportunity to use AmdocsONE to coach CSPs in innovating new services with partners.
- Microservices360 can be an enabler for helping CSPs to fully adopt Microservices and CD/CI delivery methodology.
- Support for multi-vendor environments enables co-development with customers using Microservices360 platform increasing the adoption of the Amdocs platform.

Threats

- Non-traditional services may be delivered to customer by third party applications bypassing or avoiding order engagement with CSP. Potential that much of what constitutes traditional BSS (DigitalONE and CatalogONE) is bypassed by these services and non CSP vendors.
- CSPs retain traditional software delivery and integration approaches meaning that benefits of microservice platform are not realized in Amdocs CSP market.

Summary

1. AmdocsONE CES' focus is about enabling cloud native technologies and modularity for customer experience. It supersedes their CES Customer Experience Systems.
2. This report focuses on the Customer Experience Suite applications of AmdocsONE.
3. AmdocsONE new CES builds on Amdocs' investment in its Microservices360 platform.
4. AmdocsONE's initial cloud native and microservices focus is BSS customer engagement systems. DigitalONE is the resulting product offering providing care, commerce and ordering applications.
5. AmdocsONE's initial cloud-native and microservices focus is the Master Product Catalog. CatalogONE is the resulting product offering.
6. The rest of Amdocs' CES legacy is now packaged as Cloud Enabled solutions integrated as modular "Macro" services within the AmdocsONE framework with open APIs aligned with TMForum API standards.

COMPANY

Company Basics

Name	Amdocs
Year founded	1982
Headquarters	Chesterfield, MO
CEO	Shuky Sheffer
Company Type	Publicly traded company
Revenue FY 2018 (total)	USD 4 billion 2018
Employees	26,000
Product segment	BSS, OSS
Geographic focus	Global
Primary products	AmdocsONE; CES
Key partners	
Key customers	AT&T, Globe, Telstra, T-Mobile, Sprint, PLDT, TIM, BT/EE

Source: Amdocs, Appledore Research

Amdocs distribution of revenue by business segment 2017

Business Segment	Revenue
BSS	\$2.5B
OSS	\$0.5B
The Group	\$3.0B (\$4.0B 2018)

Source: Amdocs

Amdocs percentage of revenue/geographic segments

Geography	Revenue 2017	Revenue 2016	Revenue 2015
North America	65.9%	64.0%	70.1%
Europe	12.6%	13.8%	11.6%
Rest of the World	21.5%	22.2%	18.3%

Source: Amdocs

Acquisitions

Acquisition	Year	Description
Comverse, Inc	2015	Expanding and diversifying BSS global customer base, particularly in Asia Pacific, Latin America and Europe.
cVidya Networks, Inc.	2016	Revenue assurance and fraud management solutions
Vindicia, Inc.,	2016	Software-as-a-service subscription management and payment solution provider
Brite:Bill Group Limited	2016	Personalized digital interactive billing services
Pontis, Inc.	2016	Contextual digital engagement solutions
Kenzan Media, LLC	2017	Software engineering services company providing customized, end-to-end solutions focusing on digital transformation, and platform-as-a-service and cloud native application development using DevOps and microservices.
Projekt202	2018	Customer Experience software delivery and development
Vubiquity	2018	Media linear channel and Video on Demand solution
UXP Systems	2018	Digital Identity

Source: Appledore Research, Amdocs

CUSTOMERS AND MARKETS

Significant AmdocsONE Customers

As an evolution of their existing product suite all Amdocs customers already use parts of the solutions that compose AmdocsONE. Listed below are customers that Appledore believe are making significant use of the DigitalONE, CatalogONE and the microservices360 platform underpinning AmdocsONE.

Customers	Deployment
American Wireless Operator	Refer to case study later in paper
European Quad Play Operator	Refer to case study later in paper

Source: Amdocs, Appledore Research

Amdocs also note a number of other operators that are making use of capabilities of AmdocsONE and the microservices360 platform, where the customer is deploying microservices360 and customizing it to map with their architecture choices.

Competitors

As a full OSS/BSS suite AmdocsONE competes with other full suite providers such as Netcracker; Oracle; Ericsson; Huawei and Nokia. It also competes with a large number of companies that specialize in specific areas of OSS and BSS.

AMDOCSONE

AmdocsONE is a complete set of products and services that include BSS, OSS, digital, media, network solutions. It targets the entire spectrum of CSPs (from tier 0-2 operators to tier 3-5 operators and MVNOs) and media companies who are looking to expand their portfolio into the sphere of communications. The AmdocsONE approach has been adopted to enable Amdocs to:

- Deliver to customers much quicker,
- Allow customers to have more ability to pick and choose applications as they need them
- Support continuous iteration and improvements to customer services.
- Enable coexistence with legacy BSS and OSS and evolution of solutions

AmdocsONE, with the new CES applications DigitalONE and CatalogONE, is a new approach by Amdocs to enable customer modernization and digitalization. It is focused at customer business needs rather than features and functions. It is an evolution of Amdocs' CES portfolio with new Microservice based solutions that coexist with legacy BSS/OSS applications. The existing CES (Customer Experience Systems) suite has been modernized into a series of cloud native and cloud enabled solutions. The new approach allows the customer to rapidly make use of new cloud native "minimum viable solutions" whilst still continuing to leverage the existing Amdocs CES capabilities and other existing Amdocs applications, such as Ensemble and Kenan. AmdocsONE is focused at enabling a CSP with a hybrid and a legacy network.

AmdocsONE new CES is seeking to break from the past practice of a suite of monolithic applications and move towards a more open system, based on microservices. This is with the aim of improving CSP agility and innovation; elasticity and cost savings. AmdocsONE seeks to move from a situation where projects are taking multiple years to deliver, to one where customers can rapidly and iteratively benefit from capabilities and features to support service innovation, service scale and lower service cost.

AmdocsONE has been supported by key investments by Amdocs:

1. Amdocs investment of about 85% of its R&D in new offerings notably its cloud native applications DigitalONE and CatalogONE as well as its underlying Microservices360 platform.
2. Amdocs investment in acquisitions, notably its purchase of Kenzan to support the adoption of microservice delivery process.
3. Amdocs investment in an open partner ecosystem, notably its strategic partnership with AWS for IaaS and Red Hat for PaaS

Amdocs' new CES is positioned to augment and coexist/federate with legacy Amdocs and competitor products based on using an open, standard architecture with industry standard APIs to quickly integrate with other products and solutions. By working with existing solutions, it can enable innovation without a major transformation project.²

AmdocsONE roadmap approach

The complete rearchitecting of a product portfolio as extensive as Amdocs' into microservices is a big task. Amdocs has adopted a phased approach to moving to cloud native initially focusing at network functions and then moving to customer engagement BSS functions. Amdocs has implemented a gradual modernization of its BSS portfolio building on top of its legacy and in parallel to its modernization of its network functions. It has prioritizing key parts of the portfolio for rearchitecting based on what it believes is the rate of change demanded by its customers.

- Amdocs have prioritizing the re-design of systems which support business agility (systems of customer engagement). Here they have moved directly to a "cloud native" microservices approach. These applications must be agile and flexible since this is where the industry believe that most innovation is currently happening. Amdocs "direct move" to microservices and domain driven design was made relatively simple because of the alignment of the traditional applications with TMF TAM.
- Amdocs has adapted existing systems as macro services where operability and cost optimization are critical (systems of record). Here they have made existing capabilities capable of deployment on the cloud "cloud enabled". Here the new platform provides Amdocs with more IT agility (for example, upgradeability and maintenance) whilst at the same time not affecting reliability and stability. These will be transformed to a micro-services platform in the future

² AmdocsONE provides a set of network offerings focused on virtual network expansion. This offering includes several modules, for example, SDC and A&AI that are part of the powered by ONAP solutions. These will be considered by Appledore in a separate solution profile.

Within the BSS transformation, Amdocs has a phased and prioritized migration of functions to the microservices platform based on business value and focus on systems of engagement with the customer. Amdocs have currently prioritized systems associated with Experience, Care, Order capture/handling and customer management.

AmdocsONE product structure

Amdocs has adopted a domain driven design approach for AmdocsONE new CES. Amdocs has structured its capabilities into a hierarchy of business domains, domains and sub-domains with each sub-domain providing a set of functional APIs based on the TMForum's domains and open API initiative. These APIs are then supported by microservices enabling the capabilities to be flexible capabilities which are scalable on demand.

Amdocs have based their domain mapping on TMForum's domains but have gone beyond the TMForum standards by identifying sub-domains at the next level down. They are working actively with the TMForum to feed this back into the TMForum standardization committees.

Commercial model

AmdocsONE new CES retains a licence-based model for each specific domain and subdomain. AmdocsONE new CES is a modular system that is open and integrated with each "domain" module and even "sub-domain" microservices capable of independent implementation.

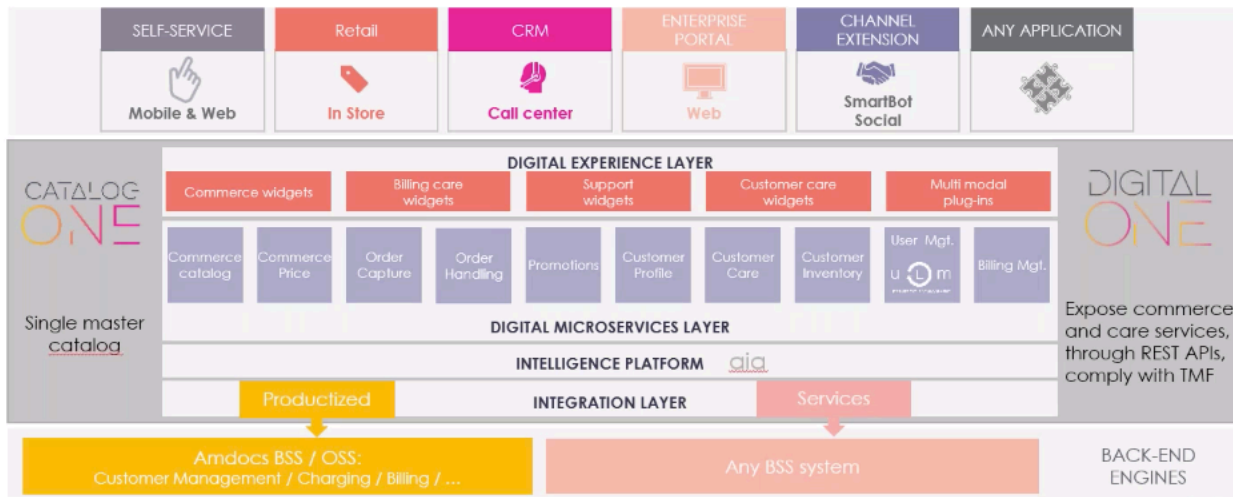
Currently Amdocs is not looking at a "scale as you use" SaaS model for AmdocsONE as this would require a change in typical customer engagement. Amdocs note that CSPs are happy to stay in their legacy procurement approach to CES systems as it is less costly in terms of business and system change. It should be noted that other parts of the overall AmdocsONE portfolio are provided as SaaS such as Optima, Vindicia, Brite: Bill, Vubiquity,

Currently there are relatively few CSPs who are using the complete AmdocsONE and its Microservices360 underpinning in production. Many CSPs are already starting their modernization focused at specific business needs, such as offer creation. Amdocs is seeing that the majority of CSPs understand the need for a move to a micro service architecture. AmdocsONE they believe will allow CSPs to start the micro service journey and obtain service scale and agility. Amdocs expect a number of projects, spanning a spectrum of use cases to be live in the coming months. Amdocs is already noting distinct geographic distinctions in CSPs approach to micro-services;

- In North America there a number of microservices projects with operators, such as Comcast, very keen to close the micro-services gap with Netflix.
- Europe by contrast is still in an experimental/first exploration of micro-services.
- APAC is focused on public cloud and less on micro- services.

Appledore’s understanding is that the licence-based model is framed by the five business imperatives and by the different domains and sub-domains that support these. The new microservices based components of AmdocsONE are sold in a modular way. Customers can specify the customer channels and the specific processes they require and buy new capabilities gradually as needed. These functional capabilities in the area of catalog, care, commerce and ordering are illustrated in the following figure.

Figure 3: DigitalONE cloud-native enablement platform



Source: Amdocs

DigitalONE

DigitalONE is the commerce and order management platforms for Amdocs delivered as Cloud native microservices. It, with CatalogONE, is the first phase of delivery of cloud native services aligned with customer engagement need.

The primary focus of DigitalONE is IT applications supporting customer engagement elements of BSS. Amdocs believes that they are the first vendor to introduce a fully microservices based solution in the areas of catalog and ordering (Order capture & order handling). Appledore believe that this is correct, though at this stage we have not done a full market assessment to fully confirm this.

Amdocs have developed end to end business processes within DigitalONE. They see a continued need for strong end to end CSP business processes and believe that customers will innovate quicker within existing processes that they understand. Amdocs bring process and CSP domain knowledge to their DigitalONE offer that can help differentiate them with CSPs.

CatalogONE

CatalogONE is a next generation enterprise catalog and provides the catalog platform for all of AmdocsONE delivered as Cloud native microservices. CatalogONE is certified on AWS.

Amdocs has based its catalog approach on the TMForum Open APIs with its two distinct catalog views which speaks to different user communities.

- Product/Offering which supports the marketing community
- Service/Resource which supports the technical community.

CatalogONE is a single centralized catalog that supports different role-based user interfaces with visual tools and guided wizards. These allow everyone from network, IT and up to marketing/business to work on their relevant parts: Network can create new services; IT new products; and the business can define new offers and bundles. With ONAP effectively having its own catalog, CatalogONE is capable of working in a federated manner with the ONAP catalog to allow seamless product and service definition.

CatalogONE provides the typical capabilities of a centralized catalog. By leveraging the microservice360 platform Amdocs are able to benefit in terms of service discovery and the ability to scale out with need.

CatalogONE can be used to federate local or third party catalogs. As an example, CatalogONE has been integrated with the ETSY commerce platform to demonstrate the ability for a CSP to incorporate non-communication products into an overall offer. Product and marketing managers are able to browse and select products from ETSY to combine with traditional CSP offerings.

AmdocsONE Case Studies

North American Prepaid Wireless Operator

AmdocsONE alongside existing legacy Amdocs applications is already being used with customers. Using AmdocsONE a North American Prepaid Wireless Operator is now able to provide on-device activation of customers sold through third party retailers. This is enabling significant reduction in calls to call centers and improved customer experience. AmdocsONE and the underlying microservices has enabled the operator to rapidly introduce this new capability with a Proof of Concept in about 6 weeks and the system being turned live rapidly afterwards.

In this case study DigitalONE & CatalogONE has enabled Amdocs to effectively compete with smaller more agile competitors to win and then successfully deliver innovative solutions. It has allowed Amdocs to change the customer perception of large, lengthy and costly delivery projects.

Amdocs note that in delivering this solution with microservices they have also been able to innovate and change the way in which customer engagement occurs. It has allowed them to move from a traditional telco fixed business flow, where a customer must first authenticate before they use a system, to a webscale customer engagement where the customer is first presented with offers and service and authentication only occurs at the end of the transaction.

European Quad Play Operator

AmdocsONE has been deployed in a European Quad Play Operator to address the problem of long time to market (TTM) for new services and offers. CatalogONE has also allowed them to unify a number of siloed line of businesses and create cross business bundles. Prior to deployment new offers were typically taking up to 9 months to create. With AmdocsONE the operator is achieving a TTM of 1-2 weeks for new offers and can make changes to existing offers in hours. This has been achieved through the use of the CatalogONE which has enabled 80% of offer/service development to be achieved through configuration. Previously 70% of offer changes required system integration.

The introduction of DigitalONE, with its underlying microservices based platform, has also allowed performance issues to be addressed. In the existing systems there were major scalability issues which affected order process flows, leading to aborted orders and slow rendering of customer interfaces. By delivering on a cloud native infrastructure the operator is able to benefit from the solution being always available and automated granular scaling of the application as needed.

MICROSERVICES360 PLATFORM

AmdocsONE is based on Amdocs Microservices360 development platform and methodology. This has been rolled out to 6,000 Amdocs developers worldwide. As the name indicates this platform has been developed to enable ubiquitous use of microservices within Amdocs. It also aims to allow Amdocs to embrace Opensource practices and create a strong framework for product innovation. Microservices360 provides a unified platform for microservices development across the company. Microservices360 is responsible for managing the operability aspects of the microservices (such as monitoring, security, logging) - so developers can focus on writing functional services which. can run on any infrastructure.

Program

Amdocs see microservices as being about software design principles rather than necessarily service size. In developing Microservices360 they have worked with Martin Fowler and Thoughtworks (a leading visionary consultancy for Microservices).

Microservices360 has evolved firstly as a program within the company, then becoming a robust platform before ultimately allowing development of modules. Amdocs state that it took one year to build the program and that getting the structure right has been critical to the program's

success. The acquisition of Kenzan, a pioneer in microservices, has been central to this work. Success with microservices has seen a complete change in R&D, development and delivery principles within Amdocs.

Key challenges in the program have been:

- Alignment of all people on a single set of principles when everyone has a distinct view of what microservices are.
- Building platform with a minimum set of capabilities to enable development teams to work quickly

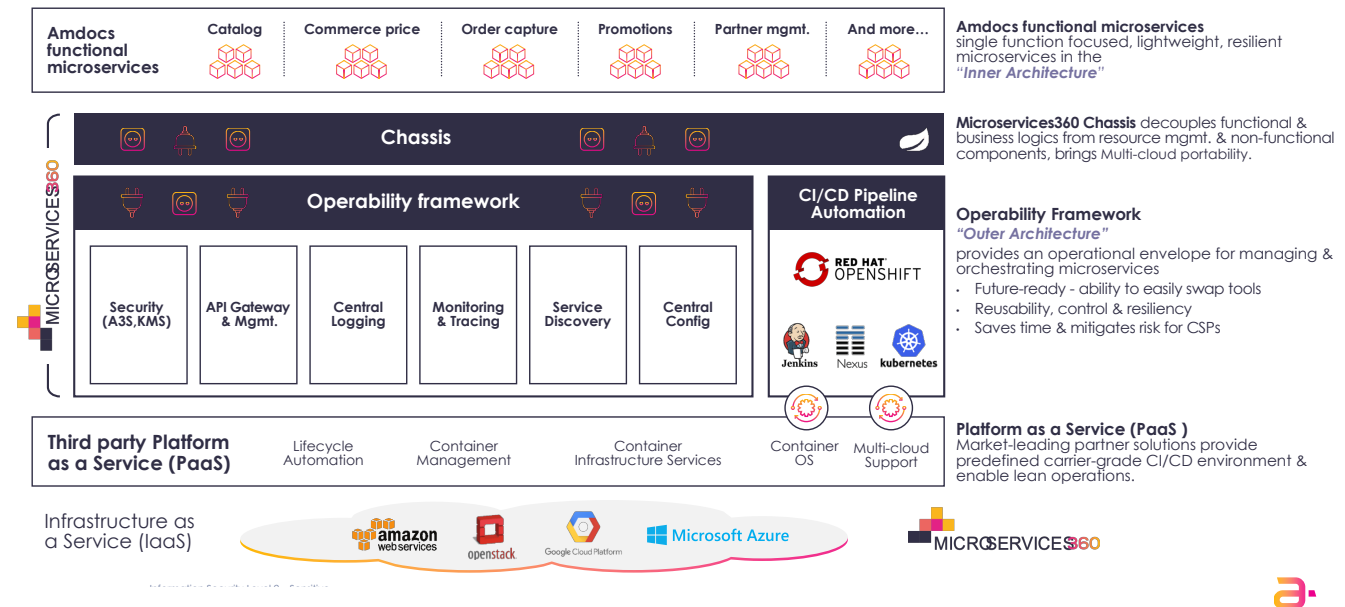
Amdocs is noting major gains from implementing microservice360 platform; including in current projects with CSPs, some of which are co-developing on the same underlying platform. They would like to see similar benefits within their whole customer base and are seeing serious interest in customers implementing microservice based solutions.

It should be noted that ONAP and Amdocs' support for this Opensource initiative do not rely on the MS360 platform and AmdocsONE.

Opensource foundation

Microservices360, has been built using cloud native best practices and Industry leading open source technologies underpinned with key partnerships with technical leaders. The following diagram outlines Amdocs Microservices360 architecture detailing the inner architecture focused at the microservices infrastructure management and the outer architecture which provides the customer interaction services, backend services and DevOps automation framework.

Figure 4: Amdocs Microservices360 platform



Source: Amdocs

The Amdocs architecture is primarily based on OpenSource components shown in figure. These are augmented by a number of Amdocs proprietary extensions.

The target state architecture for all AmdocsONE components is cloud-native, consisting of open interfaces which enable plug-and-play connectivity and stateless, highly-scalable microservices which allow efficient scaling and deployment across geo-redundant data centers and clouds.

By breaking its existing monolithic BSS systems into micro-services, individual functions within the component can be scaled up and down to minimize resource utilization. The stateless nature of the micro-services allows updated functions to be introduced alongside legacy functions and then for traffic to be gradually routed to new functions with no need for scheduled maintenance windows.

Amdocs has a strategic relationship with AWS as well as relationships with Azure. Microservices360 makes use of opensource tools such as Kubernetes, Jenkins and Docker.

Amdocs has a strategic partnership with RedHat leveraging their Open Shift platform within Microservices360 to allow portability, and carrier grade reliability. This portability allows applications to be built “on premise” and then deployed to cloud infrastructure such as AWS or Azure.

Deployment model

Amdocs note that in adopting an Opensource microservices platform they have to be flexible in allowing a customer to make their own platform choices. For example, Amdocs has chosen Elasticsearch as its search and analytics foundation but needs to enable a customer to replace this foundation with a different opensource component such as Splunk. To support this Amdocs has a DevOps charter and reference architecture governance for Microservices360. Microservices360 provides an abstraction layer for the developer with guidelines for CSP tools. Amdocs see this capability as a way for the developers to reuse its integrated development ecosystem.

Amdocs note that one of the key principles of AmdocsONE is that it allows customers to choose specific solutions/components to add into an existing architecture/implementation. The customer should not require full transformation to enjoy the new benefits and capabilities that AmdocsONE provides.

Microservices360 is a platform that provides a set of capabilities and services that customers can pick and choose from according to their business needs, and then use them to continuously iterate and improve their business operations and customer experiences. This is enabled by the AmdocsONE cloud-native, microservices-based architecture.

Release model

Microservices360 has enabled Amdocs to move to an agile recursive approach to delivery. Amdocs have adopted a staged model to new feature release:

- An MVS release (Minimum Viable Solution) is first produced;
- Multiple iterations of MTV releases (Minimum Tested Value)
- Final ADM (Application Developer Marketing) release

At each of these stages, functionality is released to production, with a customer able to use new functions much more quickly than in the traditional waterfall release model.

Amdocs states that it is currently achieving two sprints per month, with a core release monthly and a full release (marketing ready) being achieved every quarter. Amdocs is aiming to be able to define functionality at the beginning of quarter and have delivery by the end of that quarter.

As part of the microservices approach the Amdocs has adapted its test approach for the needs of CI/CD and microservices. It retains unit tests to exercise small pieces of software within the microservice. Built on top of this are:

- Contract tests that verify the interactions at the border of the service.

- Integration tests that verify service interfaces between components, verifying communication paths and interactions.
- End to end tests that tests whole system against external requirements and goals.

Customization and configuration

Microservices360 and the AmdocsONE products are structured for customization and configuration at three levels.

- A core layer where Amdocs' own proprietary products sit. This is immutable with no visibility of code by the CSP.
 - The core layer exposes functional APIs based on the TMForum Open API manifesto.
 - The core layer exposes a set of cloud native non-functional APIs for all products to enable deployment on different environments.
- A common extension layer, built on the core layer, in which common industry customizations and templates of best practice can be added to AmdocsONE. The CSP has visibility of this code. The CSP has the ability to use APIs modify the behaviors of a Amdocs Microservice or to extend them with new microservices. Examples of common extensions are:
 - Localization in terms of names and addresses
 - Integration with tax engines
 - Integration with payment systems
- A CSP specific layer where CSP specific integration and practice can be enabled.
 - Customers can extend from fixed extension points with their own separate microservices.
 - This layer effectively provides a BSS SDK.
 - This layer enables large customers, such as at&t, to extend the product to meet their very specific innovation requirements. Amdocs note that these innovation requirements are more often focused at change in experience, rather than changes in the underlying digital microservice layers.

The use of clearly defined layers and integration points enables the agile CI/CD deployment of AmdocsONE components, Amdocs best practice as well as CSP development.

Microservices360 data persistence approach

In adopting a microservices architecture issues of data consistency, availability and partitioning in distributed computing systems (CAP theorem) need to be explicitly addressed. Appledore look at this in more detail in our “Dynamic Inventory” market outlook.

AmdocsONE has chosen to continue the existing OSS/BSS principles of strong consistency (versus availability) in its solution. AmdocsONE retains the use of transactions for existing relational database interactions. When using NoSQL databases, it is adopting a two-phase commit transaction approach supported by message sending guarantees enabling eventual consistency. To get best performance from these transactions its microservice design principles enforce only one update in a microservice flow and ensuring that database update is always the last step of the microservice flow. In the event of eventual consistency causing a problem rollback is implemented within each microservice.

AmdocsONE has taken this approach because there is no real time aspect to the functions being provided. Data availability delay is not critical for the currently prioritized AmdocsONE microservice applications and the CSP services and business model they support. CSP order type processes are still expected to prioritize data consistency.

Amdocs note that eventual consistency brings a cost in terms of performance and complexity. For some applications that require high data throughput and low latency between processing such as “Online Charging”, targeting eventual consistency may not be relevant. In a general manner, not all microservice patterns and best practices can be applied to all business processes. Amdocs is working with SW design authorities (such as, Thoughtworks and Contino) to explore different approaches and use cloud native landscape best practice.

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