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***white
paper***

**Cloud
Messaging:
Extending
Cloud
Orchestration**

Cloud Messaging will help enterprises to achieve seamless integration of business processes spanning multiple applications, clouds and smart devices.

This Ascent White Paper explains the concept and describes the learnings from a Healthcare sector Proof-of-Concept.

Cloud Messaging: Extending Cloud Orchestration

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About the Atos Scientific Community

The Atos Scientific Community is a network of some 100 top scientists, representing a mix of all skills and backgrounds, and coming from all geographies where Atos operates. Publicly launched by Thierry Breton, Chairman and CEO of Atos, the establishment of this community highlights the importance of innovation in the dynamic IT services market and the need for a proactive approach to identify and anticipate game changing technologies.

Executive Summary

We are living in an increasingly connected world. By the year 2020 it is expected that most things will, in some way, be connected to the Internet: be they phones, cars, houses, citizens, customers etc. The possibilities that arise from having such an interconnected world are very exciting and will open the door for transforming the way that we do business. There will also be a trend towards more devices, applications and data sources being connected to and serviced from the cloud. As a result, enterprises will look to release themselves from some of the constraints of on-premise hosting and dedicated application stacks, instead adopting cloud computing approaches to enable links into the wider connected world.

However, in many cases, cloud strategies have to vary according to specific business applications or processes, since there is rarely a one size fits all solutions. This can lead to complex hybrid delivery models, where workflows and data flows may span multiple public and / or private clouds. Process inefficiencies and disconnects arising from the implementation of disaggregated cloud services present a significant risk to the integrity of established business operations.

"Cloud Orchestration"¹ focused primarily on the concept of orchestrating the business processes and end-to-end services in a multi-cloud environment, harmonizing workflows independently of the underlying infrastructure. With the advent of smartphones, tablets and other intelligent devices that are now participating in the complete enterprise ecosystem, interaction patterns between cloud components and service consumers become even more complex.

There is a strong need to extend the business process links beyond the traditional boundary of the enterprise and ensure that the right information is sent securely to the relevant processes on time. This is where Cloud Messaging will play a crucial role in enabling cloud orchestration to extend out to the Internet of things, enabling the inclusion of a whole range of smart devices and disparate sources of data (including social media).

"Cloud Orchestration"¹ and Cloud Messaging will help enterprises to achieve seamless integration of business processes spanning multiple applications, clouds and smart devices. Such integrated messaging will not be a "nice to have" requirement, but a "must have" prerequisite for effective and efficient future business process management, not limited to an Enterprise Service Business but also addressing Extended Enterprises issues. This White Paper explores these challenges and proposes potential solutions based on research conducted by the Atos Scientific Community in the area of Cloud Messaging.

This White Paper also provides some simple high level explanations of the complex world of Cloud Messaging and the enabling of integration across heterogeneous landscapes and the Internet of Things. It highlights some associated business and technical challenges, and proposes a solution direction which addresses messaging between clouds, applications and the Internet itself.

¹<http://atos.net/en-us/home/we-are/ascent-thought-leadership/ascent-white-papers-form/cloud-orchestration-a-real-business-need.html>
Atos has won the 2013 NASSCOM award in Process Innovation Category - http://atos.net/en-us/Newsroom/en-us/Press_Releases/2013/2013_02_15_01.htm

Business Impact

The limitations of a single stack solution may well be seen as a constraint for enterprises adopting a cloud platform. Unlocking the potential of hybrid delivery models can provide total solutions, better aligned to specific business requirements. For instance, many enterprises are adopting very specialized SaaS services like salesforce.com, workday.com, google apps etc. for their day to day business in addition to their on-premise enterprise applications. Cloud Messaging opens up a whole new range of possibilities regarding the selection, integration and application of standard cloud solutions.

The approach may unlock further added value services to end customers. Combining effective integration of smart mobility and the Internet of Things, further extends the “art of the possible” for cloud based solutions.

For effective Cloud Messaging, the anticipated key challenges are:

- ▶ **Cloud Portability and Persistence**
The assured continuity of workflows when moving application workloads from one cloud to another.
- ▶ **Quality of Service delivery and management**
Performance, reliability, end-to-end Service Levels etc.
- ▶ **Messaging standards**
Enable simple, unambiguous translation of instructions across different platforms (both synchronous and asynchronous), security of message routing, integrity and encryption.

Historically, enterprises used tight coupling of applications within defined infrastructure environments for any business process integration, but they are now progressively looking to exploit the cost saving, agility and best of breed application benefits of moving to cloud based solutions. Unfortunately achieving cost saving and agility can sometimes be at the expense of process integrity.

As a simple example, moving CRM to the cloud may appear very cost effective, but in making the move other business processes integration (including any devices which are accessing associated data), may become disjointed or broken. Of course the integration links can be rebuilt, but this impacts some of the major advantages of a cloud delivery model - flexibility and agility.

This then triggers a question for an enterprise: How can disparate cloud applications and data sources (see *Figure 1*) be made to work together in a seamless, robust and in standardized way?

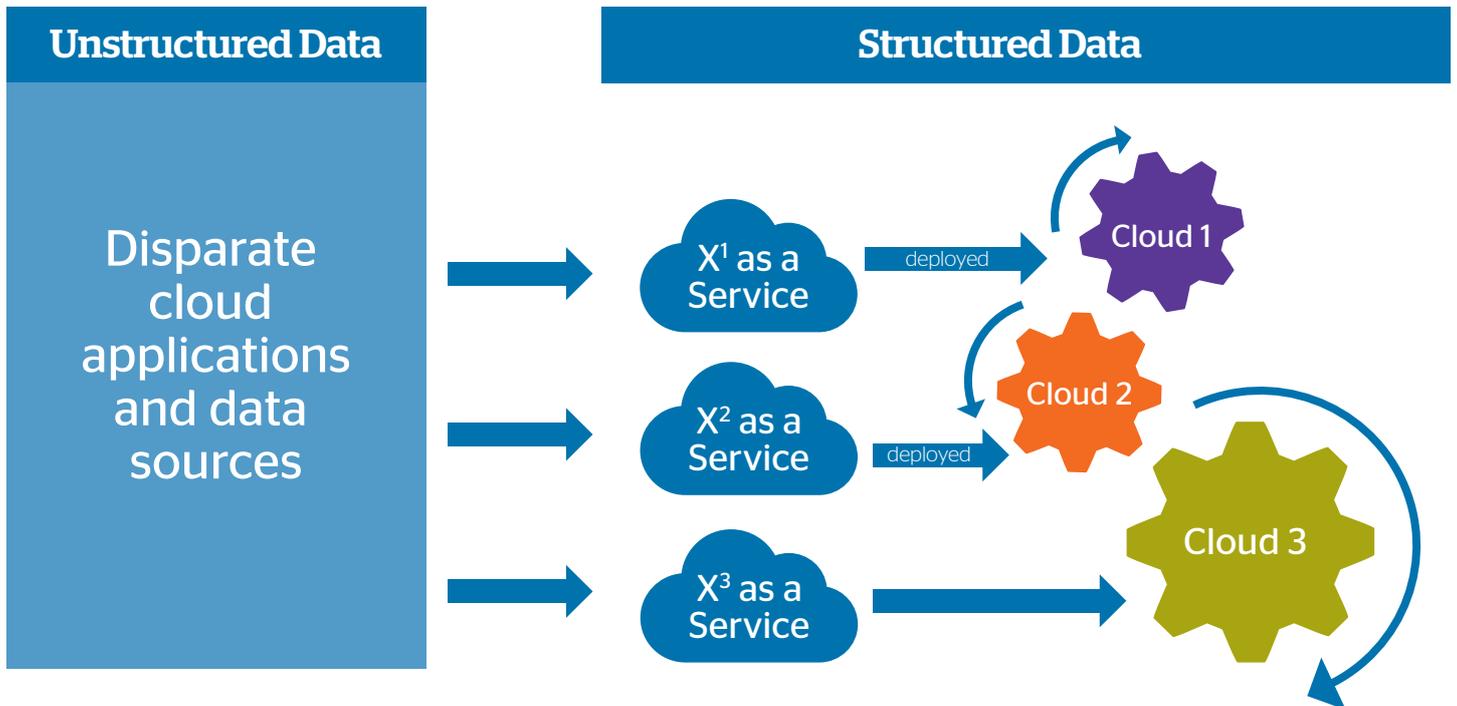


Figure 1 - Enterprise Business Challenges

What is Cloud Messaging?

At a fundamental level, Cloud Orchestration acts as tool for connecting heterogeneous clouds and the Internet of Things (IoT), whereas Cloud Messaging acts as a communication platform and enabler of interactions across the orchestrated environment.

The principle of a Cloud Messaging Platform is basically that it enables a layer of abstraction between the disparate component parts of a cloud delivery eco-system, whilst still allowing the different elements to interact in a seemingly integrated way via a definable set of messaging protocols.

Principal Architecture - Cloud Messaging

When end-user organizations push their on-premise applications into cloud environments, the need for an abstraction of messaging capabilities (rather than application-specific messaging) becomes particularly pronounced. The traditional messaging approach is poorly suited where vendor and language-specific messaging constrains the applications to use proprietary protocols. Cloud Messaging allows greater flexibility in using the technical environments and the language API's of choice, with the necessary messaging abstracted via the Cloud Messaging Platform. It also allows synchronous or asynchronous communications across networks with greater technical simplicity and efficiency.

The Cloud Messaging platform offers a shared cloud-based message queuing framework (Cloud Message QueuingCMQ), enabling messaging between various entities that wish to communicate with each other seamlessly and reliably using standard vendor neutral protocols (like AMQP - Advanced Message Queuing Protocol).

In principle, an entity is anything that can participate in a given enterprise business process. With cloud message queuing, the subscriber to a service does not need to understand the protocol used by the service provider or vice versa but can focus on requesting the required business functionality.

A Cloud Messaging platform from a logical point of view can be considered as shared queue space in a cloud which enables interoperability between various clients or entities as shown in *Figure 2*. Viewing this figure from left to right, we see clients (static or mobile) publishing requests or messages to process engines in the cloud, these in turn generate entries to the relevant process queues to be subsequently consumed by the registered client subscribers.

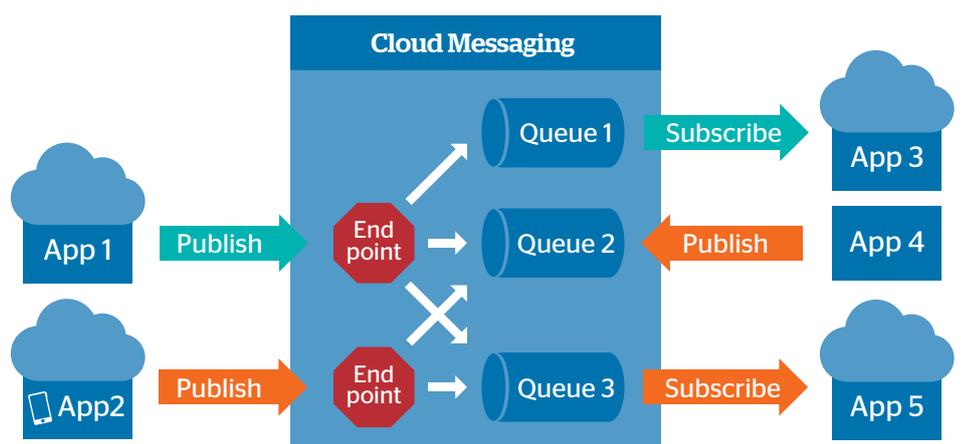


Figure 2. Cloud Message Broker from a semantic point of view

From a business perspective, the Cloud Messaging platform is responsible for the communication between various business applications, services, legacy applications, smart devices, and social media in a seamless manner as shown in *Figure 3*. Eventually, this connected ecosystem will provide a seamless end-user experience.

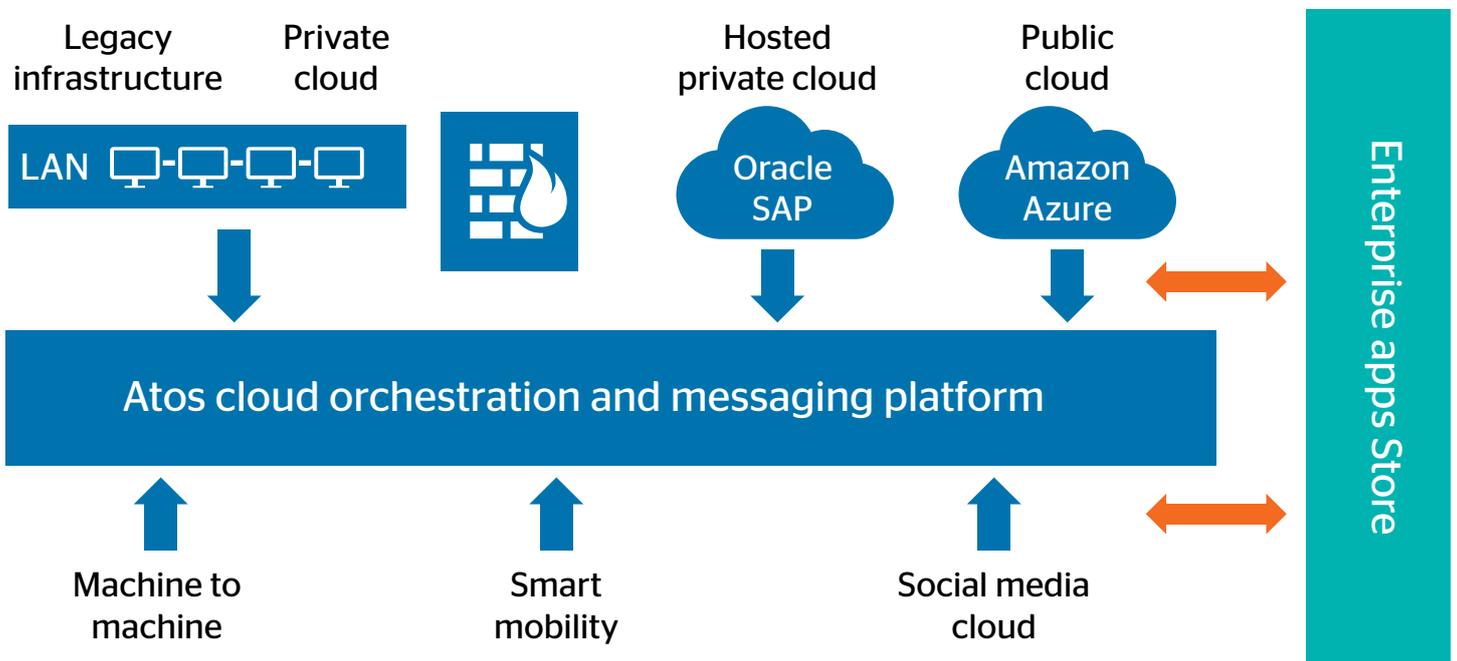


Figure 3 - Atos Cloud Orchestration and Messaging Platform

What is Cloud Messaging?

Cloud Messaging Research

As part of a Cloud Messaging Proof-of-Concept, the Atos Scientific Community has researched this topic and used some example scenarios to test ways different communication channels can be used to seamlessly integrate a disparate ecosystem of applications, services and devices.

One of the use cases considered is that of a healthcare-related business process as described below:

Consider an "at-risk" patient who needs to have his or her condition closely monitored. A smart mobile monitoring device can be used to measure the real-time health status of the patient with key data being sent via a Cloud Messaging platform to a monitoring application that is hosted somewhere in a different private secure cloud.

The data is analysed using a predefined rule set and may dynamically trigger downstream workflow activities across a number of other cloud-based applications e.g. alerting a doctor, ambulance or next of kin. Forwarding the patient's health statistics to paramedics or hospital administration can speed up the administration of time-critical first-aid. Less critical process interaction may involve the triggering of health insurance processes to ensure that any privately-funded treatments are pre-approved. Each step might run on different and disconnected cloud platforms/on-premise applications, but would be brought together as an integrated business process by the Cloud Messaging platform, as shown in *Figure 4*. Further, proofs of concept also validated how closed loop collaboration (using Enterprise Social Networking on blueKiwi) can be setup between a group of physicians using the same messaging platform.

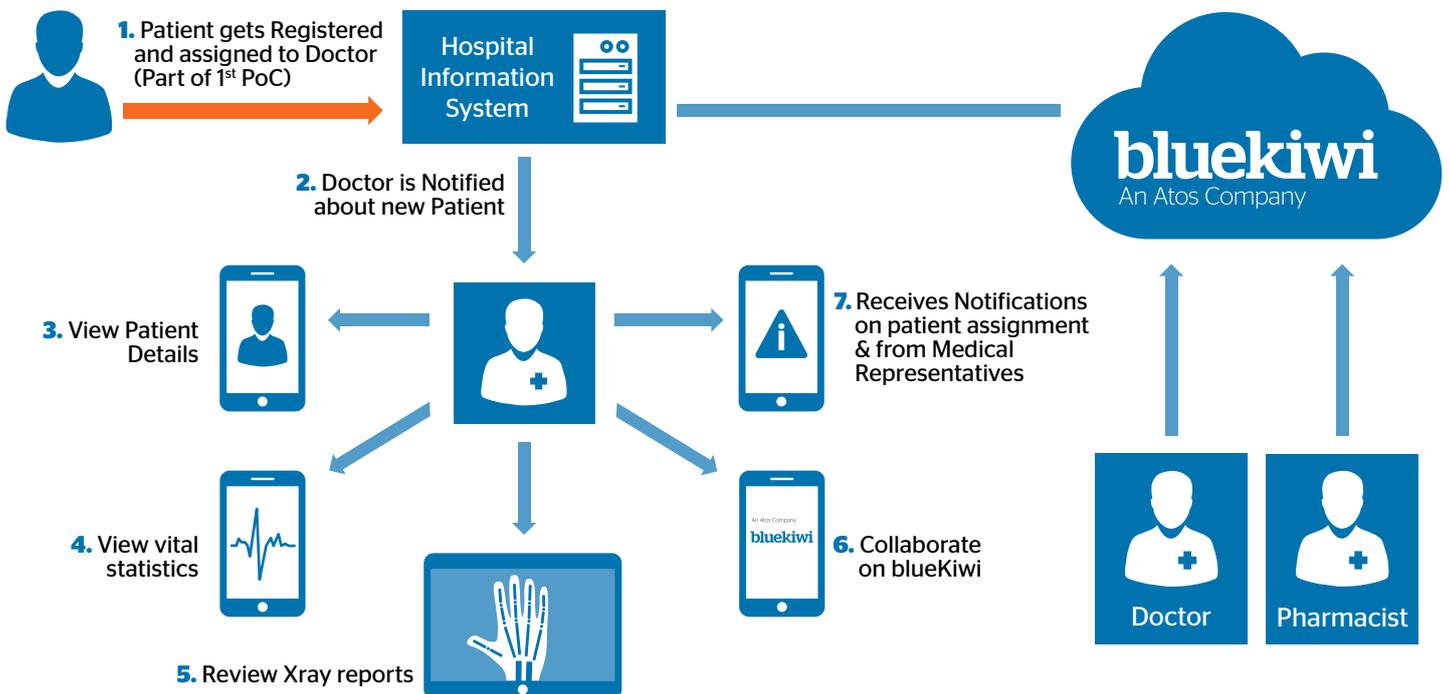


Figure 4 - Proof-of-Concept Business Scenario

From an implementation perspective, the orchestration and messaging of various protocols would work as depicted below.

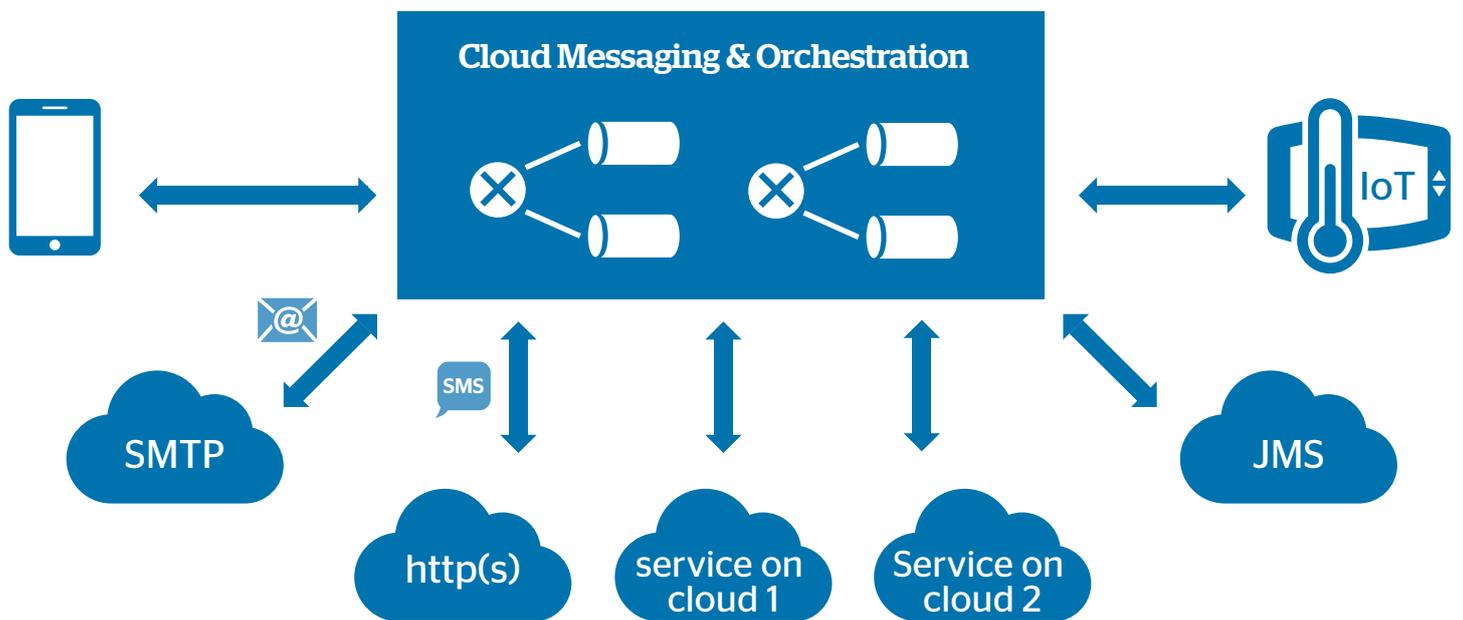


Figure 5 - Proof-of-Concept Technical Scenario

What is Cloud Messaging?

Key architectural principles for Cloud Messaging and Orchestration Platform

The essential architectural principles for a Cloud Messaging platform can be summarise as follows:

► **Security and Data Privacy:**

Authentication of users, processes and devices. Complex roles and rights model for authorization. Mechanisms to ensure message privacy and data security.

► **Multi-tenancy:**

Support for multi-tenancy and provision of flexible billing models based on the size and number of messages, number of exchanges passed, number of queues passed etc.

► **Performance, Scalability and Reliability:**

High performance for message delivery and data exchange between business processes and devices and from device to device. The systems should be able handle multiple types and priorities of messages, whilst at the same time providing the necessary Quality of Service. The system has to provide reliable messaging with durability and persistence and needs to scale well for extremely large volumes.

► **Wide protocol support:**

The platform has to support orchestration and messaging across applications and services built on varied platforms (e.g. Java, .NET) and using various protocols

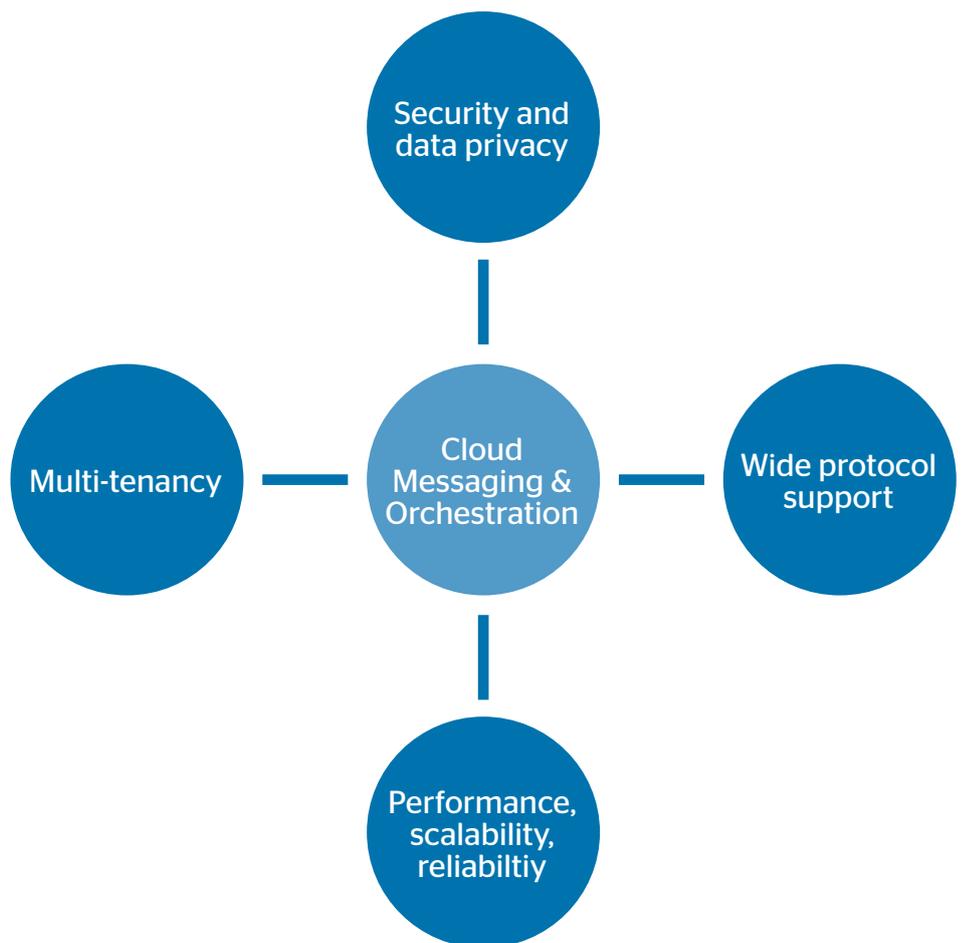


Figure 6 - Architectural considerations

For the purpose of the Proof-of-Concept, an actor-based platform was used to research the Cloud Messaging concepts; the message routing between cloud applications was established using agents. The results showed that adding new capabilities into the framework becomes simply a matter of establishing relevant messaging links between the platform and the new cloud services, using new agents. This can even include links into legacy applications and external services/applications etc, allowing them to participate in the overall business process ecosystem. The platform also enabled external devices and smartphones to connect into the business processes through cloud-agnostic messaging using standard messaging protocols like Advanced Message Queuing Protocol (AMQP). The reliability and degree of guaranteed communication was also validated by extending the actor-based platform to include load balancing and failover capabilities. At the same time, a business process activity monitoring console was developed to provide insight into the overall framework as shown in *Figure 7*.

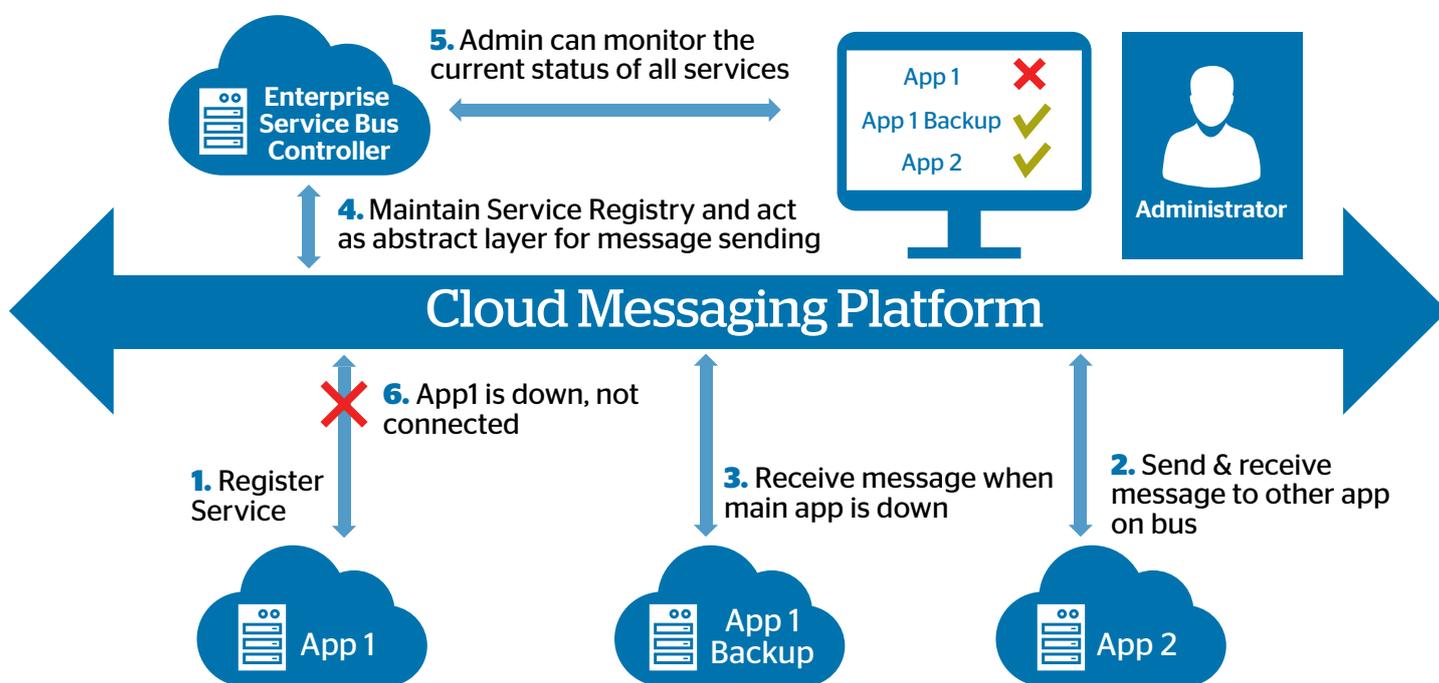


Figure 7 – Failover mechanism and business activity monitoring

The Cloud Messaging platform will enable routing, transformation, monitoring and enriching of messages through programmable agents.

As shown in *Figure 7*, each app represents a node and each Node / Messaging App can have one or 'n' agents. Each agent has a certain set of tasks to perform and is registered with the Cloud Messaging Platform controller. In case of more than one agent, agents will form a mesh to send the information. Some of the agents deployed as part of Cloud Messaging Platform will also be responsible for the monitoring of various services enabled in the mesh network. If any of the services are down, the agent takes responsibility for routing of the message to an appropriate fallback high availability service.

The Cloud Message Broker controller itself is deployed in a clustered and high availability mode.

From an implementation perspective, the architecture allows flexible deployment schemes. For example:

- ▶ Direct connection to cloud infrastructure
- ▶ API based integration
- ▶ Virtual or hardware appliance
- ▶ Cluster, part of an Hybrid cloud infrastructure, on-demand provisioning (e.g. for Hadoop)
- ▶ Flexible interface schemes
- ▶ Custom protocol handling and cloud level
- ▶ Standardized, cloud enabled messaging protocol: AMQP 1.0
- ▶ Standard IT or OT protocols.

The architecture supports federated deployment as well. In this case, Cloud Messaging platform controllers possess the ability to communicate with each other once the federated trust relation is established between two or more Cloud Messaging platforms.

What is Cloud Messaging?

Applying Cloud Messaging to Cloud Patterns

As part of the research for this paper, mapping was done on how Cloud Messaging will enable Cloud design patterns. (http://cloudpatterns.org/design_patterns/overview).

The table below details how Cloud Messaging can be used for a specific cloud pattern.

Cloud Pattern Name	Abstract	Cloud Messaging applicability
Centralized Remote Administration	How can diverse administrative tasks and controls be consolidated for central remote access by cloud consumers?	Node agents will interface with Cloud Messaging platform and allow federation giving a central access to cloud consumers
Dynamic Data Normalization	How can redundant data within cloud storage devices be automatically avoided?	Cloud Messaging agents will enable tagging of data, aggregation from various data sources and at the same time convert it into standard formats.
Dynamic Failure Detection and Recovery	How can the notification and recovery of IT resource failure be automated?	Cloud Messaging will extend the current command control system by allowing the agents to register themselves in High Availability mode.
Dynamic Scalability	How can IT resources be scaled automatically in response to fluctuating demand?	Agents will monitor various cloud parameters and based on the load will be able to scale the business processes as required.
Realtime Resource Availability	How can cloud consumers access current availability status information for IT resources?	Cloud Messaging agents will extend the current availability information to various smart devices/ Phones
Service Load Balancing	How can a cloud service accommodate increasing workloads?	Agents will monitor various end points in terms of business service load and will be able to manage the workloads.

Transformation of Enterprises to Cloud-Enabled Enterprises



Figure 8 - The evolution lifecycle of cloud-enabled enterprises

With the Internet continuing to evolve as a primary communication channel between providers and consumers of services, the connection with cloud is potentially limitless. The trends observed through the evolution of enterprise cloud adoption typically follow the stages listed below, although the starting point may vary depending on the extent of legacy system investment an enterprise has to deal with:

- ▶ On-premise hosted private cloud solutions
- ▶ Use of Software as a Service (SaaS) by moving on-premise applications to shared environments
- ▶ Move to hybrid cloud environments with a mix of public and private clouds
- ▶ Mobile, context-aware applications enabled on smartphones
- ▶ Multi-cloud business process Management
- ▶ Integration of Social Media applications and data with enterprise applications
- ▶ Next generation devices able to intelligently communicate with the wider world of connected devices to create a mesh of Internet of ThingsT (IoT).

With the emergence of collaboration platforms, enterprise social networks and the availability of contextual information, organizations are already starting to see the benefits of more richly informed decision-making. Such organizations are now willing to see how these social collaboration platforms, enterprise social networks participate as an integral part of business process in the overall enterprise ecosystem being established.

Security

With the growth in enterprise use of cloud computing comes a corresponding increase in the responsibility of system integrators to provide cloud-based platforms that offer secure communication and delivery channels. When it comes to security, data privacy etc., there are multiple parameters which need to be considered for example - service monitoring, auditing capabilities, roles and rights management etc. The Cloud Messaging Platform provides the ability to communicate with industry-standard security solutions and/or leverage some of its own built-in platform capabilities in order to address potential security dimensions as shown in the figure below.

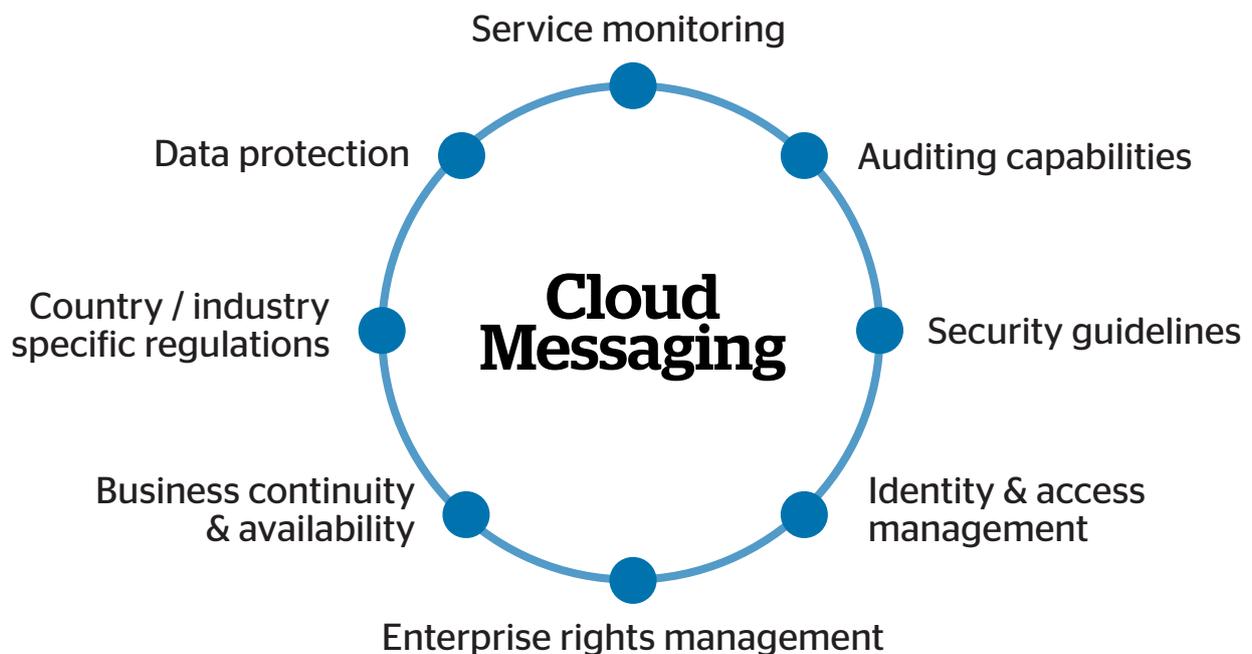


Figure-9 - Security dimensions

Cloud Messaging platforms make use of agent polling mechanisms to check various services which are up and running and at the same time enable monitoring of entry points into the platform. The Cloud Messaging platform further supports both channel as well as message level encryption for the data being transferred from one point to another.

Adoption of Cloud Messaging by Enterprises

Organizations and businesses have started adopting Cloud Messaging for enterprises to enable their business processes to run in a seamless and robust manner. Based on the Gartner, Forrester and IDC report (see *Figure 10*), cloud services will surpass \$100bn in 2016 and Cloud Orchestration and Messaging will contribute around 30% of the spend by most enterprises.

Many clients from different domains have started accepting the Cloud Messaging concepts and are using this technology disruption in order to exploit key advantages when it comes to the running of business.

For example, non-banking finance corporates NBFC have started adopting Cloud Messaging for their sales lead management services which involve integration between systems including CRM and third party geo-location / traffic forecasting at the backend; and sales lead field solutions at the front end.

Share of Cloud Orchestration and Messaging cloud services spend

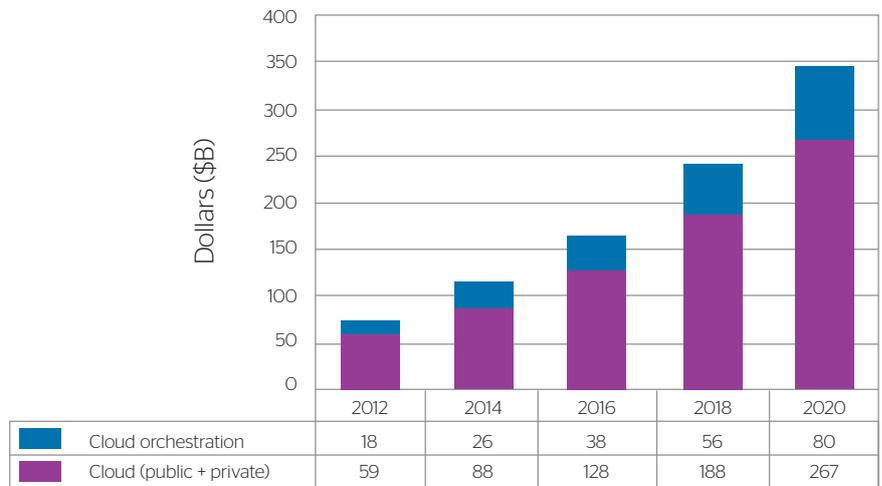


Figure 10 - Gartner, Forrester and IDC report

Whitegood industries are adapting the Cloud Messaging based platforms for managing their field services for service order management which involves on-time service order message flows from backend systems to technicians fixing problems in the field. Cloud Messaging enables technicians to get mobile device notification messages when a new service order is allocated by the backend system. At the same time, the Cloud Messaging platform acts as an enabler to connect heterogeneous application services like location tracking and reverse geo-coding services to identify, map and spot technician locations in the field for managing the service order allocation efficiently.

Similarly, the supply chain management, healthcare and pharmaceuticals industries are other examples of where Cloud Messaging can be used to provide seamless integration services.

Conclusion

Cloud Messaging offers the potential for a shared, cloud-based messaging platform that enables reliable and seamless communication between various applications and devices using standard, vendor neutral protocols. Service integrators will emerge that are capable of providing solutions that will maintain the proven benefits of cloud computing for fast and easy deployments of business services, despite the growing challenge of multiple platforms and increasing numbers of "connected components". Cloud Messaging represents one of the most ambitious and challenging of all cloud computing business models. Going forward, the challenges which still have to be addressed include End-to-End Service Level Management; continuous emergence of new technologies; and business cases for achieving idealistic service integration. Nevertheless, as the number of services, devices and business processes hosted on the Internet grows, the need for mechanisms that manage and govern their integration will become a clear necessity. This need can be now be satisfied using Cloud Messaging platforms which allow enterprises to integrate disparate ecosystems of applications, services and devices. At the same time, this approach will also simplify and improve the control that the business has over its end-to-end processes.

About Atos

Atos SE (Societas Europaea) is an international information technology services company with 2013 annual revenue of € 8.6 billion and 76,300 employees in 52 countries. Serving a global client base, it delivers IT services through Consulting & Systems Integration, Managed Operations, and transactional services through Worldline, the European leader and a global player in the payments services industry. With its deep technology expertise and industry knowledge, it works with clients across different business sectors: Manufacturing, Retail & Transportation; Public Sector & Health; Financial Services; Telcos, Media & Utilities.

Atos is focused on business technology that powers progress and helps organizations to create their firm of the future. It is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and is listed on the NYSE Euronext Paris market. Atos operates under the brands Atos, Atos Consulting, Worldline and Atos Worldgrid.



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