

Connecting IoT Devices and Mobile Applications to your Enterprise with IBM IoT MessageSight & IBM MQ

Dr. Jonathan Levell
Lead Architect for IBM IoT MessageSight
Hursley Park, IBM
levell@uk.ibm.com

Please Note – A Disclaimer

IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion.

Information regarding potential future products is intended to outline our general product direction and it should not be relied on in making a purchasing decision.

The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code or functionality. Information about potential future products may not be incorporated into any contract.

The development, release, and timing of any future features or functionality described for our products remains at our sole discretion.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

Agenda

- What is MessageSight?
- Brief MQTT Overview
- Connecting MessageSight to MQ
- A Closer Look at MessageSight's Features
- A couple of MessageSight Usecases
- Q&A

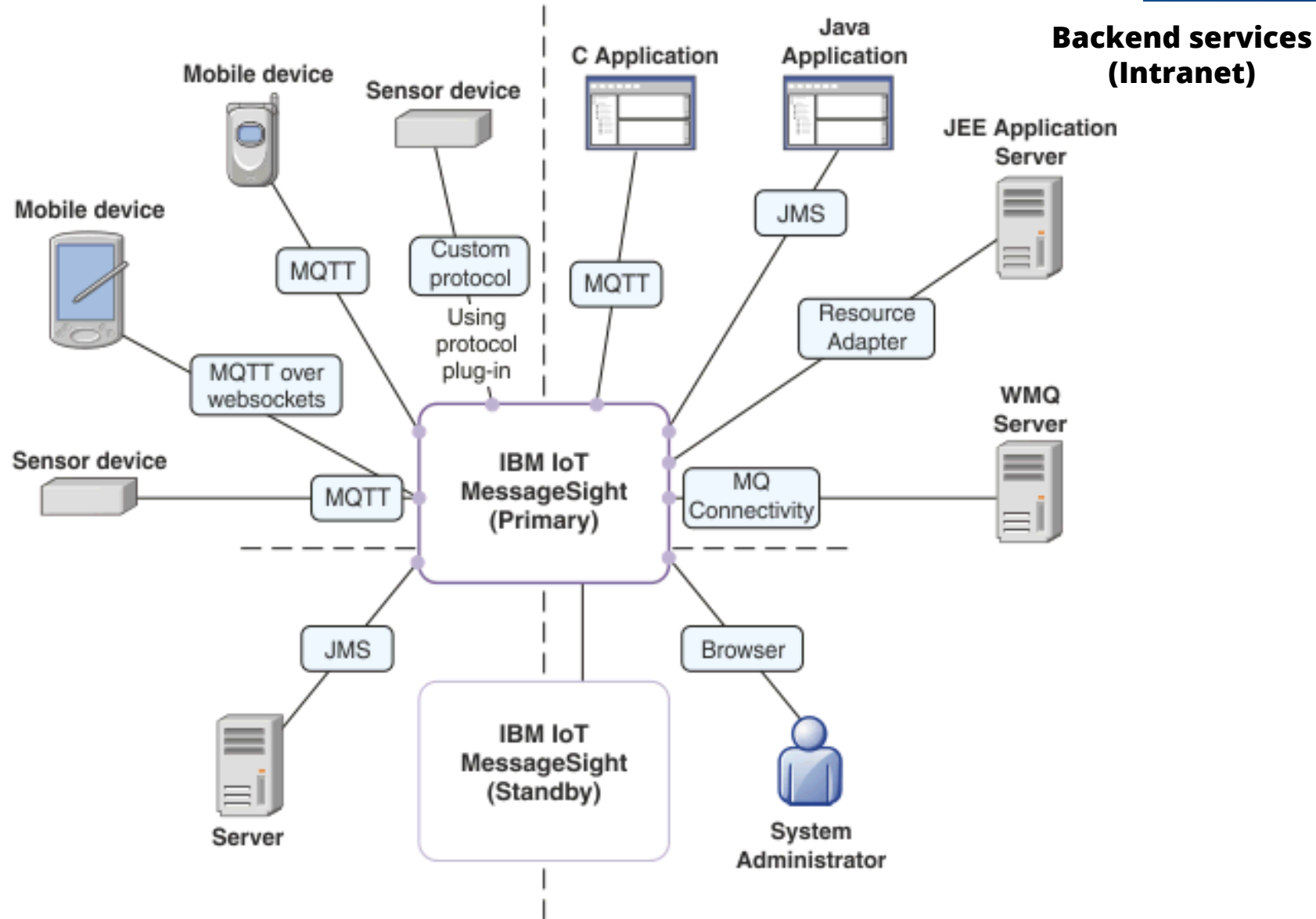
MessageSight – Gateway to the World

MessageSight is designed to make it **simple** to **reliably** and **securely connect** mobile and Internet of Things devices & data



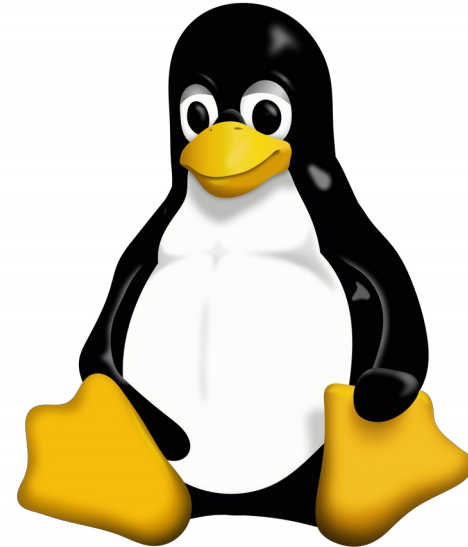
MessageSight Eye-View of the World

Clients (Internet)



Installation Options for Linux

- Standard Linux RPM
 - CentOS V7 or Redhat V7
- Cloud configurations
- Allows other software to be installed
 - Monitoring, security, administration
- Cloud, Virtualized environments
 - Public or private
- Support for Docker
- Developer edition now available on IBM Cloud Private

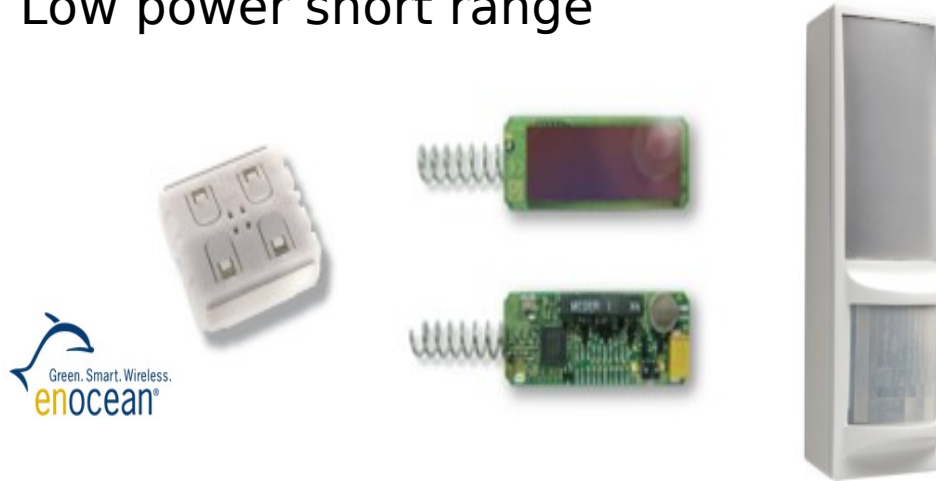


Supported Protocols

- MQTT over TCP/IP
 - Clients
 - C
 - Java
 - Android
 - iOS
- MQTT over WebSockets
- JMS
- Custom Protocols
 - Extensible framework enables customers to write their own protocol plug-ins

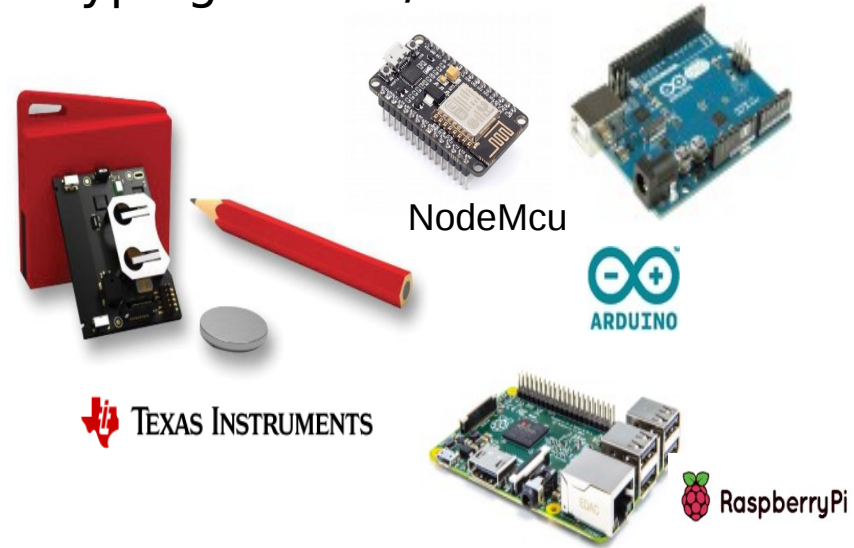
So... Devices?

Low power short range



Energy harvesting sensors

Prototyping boards/kits



Meshing nodes



Low power wide area



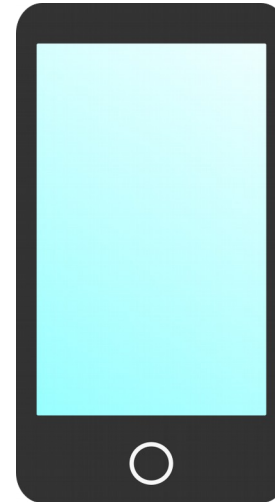
But also....

Web Browsers



(WebSockets)

Phone



**(Often in combination with
push notification)**

Reliably and quickly deliver data with MQTT

OASIS

MQTT.ORG

paho



MQTT

MQTT 3.1.1
current ISO
Standard



Open

- Open royalty free specification
- Wide variety of clients and servers
 - Hobbyist to enterprise
 - Open source to commercial



Lean

- Minimized on-the-wire format
 - Smallest packet size 2 bytes
- Scalable
- Low footprint
 - Clients: C=30Kb; Java=100Kb



Simple

- Minimal pub/sub messaging semantics
 - Asynchronous ("push") delivery
 - Simple set of verbs -- connect, publish, subscribe and disconnect



Reliable

- Three qualities of service
 - 0 – at most once delivery
 - 1 – assured delivery dups ok
 - 2 – once and once only delivery
- Copes with loss of contact between client and server.
- "Last will and testament" to publish a message if the client goes offline.

MQTT v5

The OASIS MQTT Technical Committee has developed a new version of the MQTT standard, to be called v5:

- The number jumps from v3.1.1 straight to v5, without having a v4. This is to align the spec version number with the version in the Connect packet

The committee has completed its technical work – the final Committee Specification is now available at

<http://docs.oasis-open.org/mqtt/mqtt/v5.0/cs02/mqtt-v5.0-cs02.html>

The new specification addresses a number of points that users have raised with MQTT 3.1.1, as well as adding new features

Connecting MessageSight to MQ

MQ Connectivity

Configure connections to one or more WebSphere MQ queue managers.

Queue Manager Connection Properties

Define, edit, or delete information about how the server connects to the queue managers.

✕

✎

✚

Other /

Other /

erSpec

50 | 100 +

Name

QM1Connect

QM2Connect

QM3Connect

Total: 3 Selected: 0

Destination Mapping Rule

System Administrators and M

Rules must be disabled before

✕ ✎ ✚ Other /

Add Destination Mapping Rule

Destination mapping rules define the direction in which messages are moved, and the nature of the source and target objects

* Name: ?

MESSAGESIGHT_TO_MQ

* Source: ?

MessageSightTree/SrcTopic

* Destination: ?

MQTree/DestTopic

* Max Messages: ?

5000

Retained Messages: ?

None

Enabled:

☒

* Associated queue manager connections:

Associated	Name	Connection Name
<input checked="" type="checkbox"/>	QM1Connect	10.67.45.4(1414)
<input checked="" type="checkbox"/>	QM2Connect	10.67.45.5(1414)
<input checked="" type="checkbox"/>	QM3Connect	10.67.45.6(1414)

Save

Cancel

Name	Rule Type	Source	Destination	Max Messages	Retained Messages	Enabled	Associations
No items to display							

Total: 0 Selected: 0

<

1

>

10 | 25 | 50 | 100 +

More on MQ<->MessageSight

- Each connection is a standard MQ Client connection under the covers
- Can have multiple connections to different (or the same) queue manager
- Uses 2-phase transactions for transport of reliable messages

MessageSight is easy, scalable and secure

Designed for Things

- Optimized gateway for Things and Mobile devices
- Efficient open protocol
- Event-driven awareness
- Open and industry agnostic
- Fine-grained security policies

Developer Friendly

- Active dev community
- Free developer edition
- Simple yet powerful APIs
- Simple messaging paradigm
- 40+ MQTT client libraries

Easy to Deploy

- Up and running < 30 minutes
- Task oriented UI guides administrator through first steps
- Simple and scalable management through policies



IBM **MessageSight**

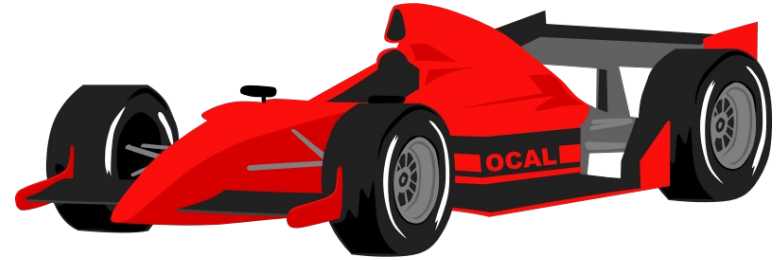
Easy to Integrate

- JMS
- WebSockets
- MQ
- Integration Bus
- Worklight
- InfoSphere Streams...
- Supports Oasis standard MQTT 3.11

Internet Scale

- Large numbers of concurrent connections
- High throughput
- Highly available
- Horizontally scalable

MessageSight Performance



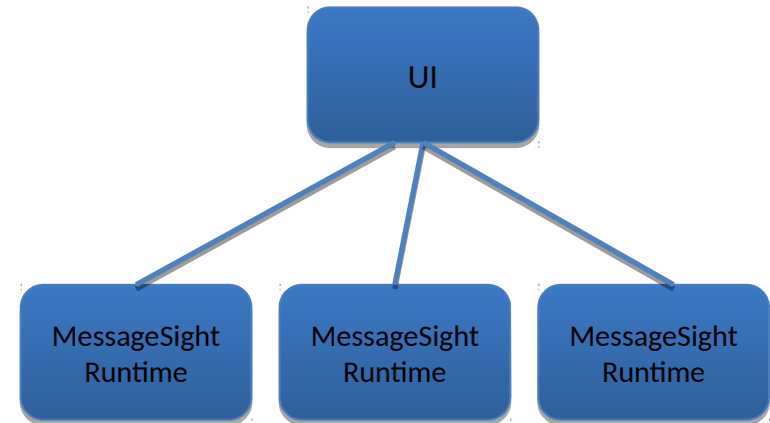
128 byte messages on server with:
Dual Xeons 10-core, 256GB RAM, SSDs, multiple 10GbE NICs

QoS	#Pubs	#Subs	Max Rate
0	Many	~100	~500K/sec
1	Many	~100	~200K/sec
2	Many	~100	~200K/sec

Connection Rate: 10K conn/sec non-TLS, 1-4K conn/sec TLS
4K concurrent/conn per GB up to 1M concurrent connections

Single WebUI for multiple MessageSights

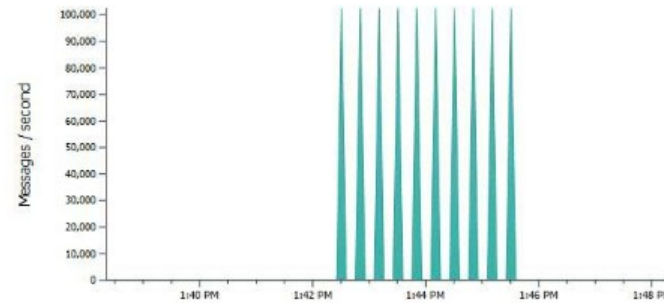
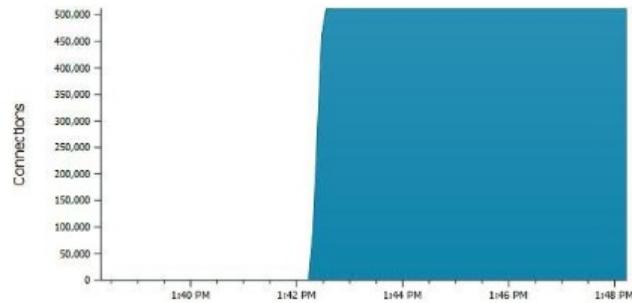
- WebUI administers multiple MessageSight Instances
- Separate Install (RPM/Docker)
- Same or different server
- WebUI uses port 9087
 - Runtime instances use port 9089 for REST Commands



Status Overview



Active Connections and Throughput



Web UI and REST Interfaces

Endpoints and Policies

[Home](#) | [Messaging ▾](#) | [Monitoring ▾](#) | [Server ▾](#) | [Cluster ▾](#) | [Web UI ▾](#)

[Return to Message Hubs](#)

DemoHub [Edit](#)

Demo Message Hub.

[Connection Policies](#)

[Messaging Policies](#)

[Endpoints](#)

An endpoint is a port that client applications can connect to. An endpoint must have at least one connection policy and one messaging policy.

   | [View ▾](#)



Endpoint	Port	Enabled	Status	Connection Policies	Messaging Policies	Description
DemoEndpoint	16102	✗	↓	? 1	? 2	Unsecured endpoint for demonstration use only. By default, both JMS and MQTT protocols are accepted.
DemoMqttEndpoint	1883	✓	↑	? 1	? 2	Unsecured endpoint for demonstration use with MQTT protocol only. By default, it uses port 1883.

Total: 2 Selected: 0

◀ 1 ▶

10 | 25 | 50 | 100 ↑

Who can connect?

[Home](#) | [Messaging](#) | [Monitoring](#) | [Server](#) | [Cluster](#) | [Web UI](#)

[Return to Message Hubs](#)

DemoHub [Edit](#)

Demo Message Hub.

Connection Policies

Messaging Policies

Endpoints

A connection policy authorizes clients to connect to IBM IoT MessageSight endpoints.

✖

✎

✚

View

Connection Policy	Endpoints	Allow Clients with Durable Subscriptions	Allow Persistent Messages
DemoConnectionPolicy	? 2	True	True

Total: 1 Selected: 1

1

Edit Connection Policy

A connection policy authorizes clients to connect to IBM IoT MessageSight endpoints. Each endpoint must have at least one connection policy.

Name: [?](#)

DemoConnectionPolicy

Description:

Demo connection policy

To restrict connections using this policy to specific clients, specify one or more of the following filters. For example, select *Group ID* to restrict this policy to members of a particular group. The policy allows access only when all of the specified filters are true: [?](#)

☐ Client IP Address:

☐ User ID:

☐ Certificate Common Name:

☒ Client ID:

☐ Group ID:

☐ Protocol:

*

Select Protocol

Specify the resources that an MQTT client is permitted to consume:

Allow Clients with Durable Subscriptions: [?](#)

☒

Allow Persistent Messages: [?](#)

☒

Save

Cancel

Configuring Topic Policies

Home

Messaging ▾

Monitoring ▾

Server ▾

Cluster ▾

Web UI ▾

Connection Policies

Messaging Policies

Endpoints

A messaging policy allows you to control what topics, queues, or global-s policy.

Topic Policies

A topic policy allows you to control which topics a client can access on IB

✕

✎

+

View ▾

Messaging Policy	Endpoints	Max Messages
DeepQ	? 1	20,000,000
DemoTopicPolicy	? 2	5,000

Total: 2 Selected: 1

Subscription Policies

A subscription policy allows you to control which global-shared durable s

✕

✎

+

View ▾

Messaging Policy	Endpoints	Max Messages
DemoSubscriptionPolicy	? 1	5,000

Total: 1 Selected: 0

Edit Topic Policy

A topic policy authorizes connected clients to perform specific messaging actions, such as which topics the client can access on IBM IoT MessageSight. Each endpoint must have at least one topic policy, subscription policy, or queue policy.

Name: [?](#)

Description:

To restrict the messaging actions that are defined in this policy to specific clients, specify one or more of the following filters. For example, select *Group ID* to restrict this policy to members of a particular group. The policy allows access only when all of the specified filters are true: [?](#)

☐ Client IP Address:

☒ Client ID:

☐ User ID:

☐ Group ID:

☐ Certificate Common Name:

☐ Protocol:

Specify the resources and messaging actions that the client is permitted to access:

* Topic: [?](#)

* Authority: [?](#)

☒ Publish
☒ Subscribe

Subscriber Settings

* Max Messages: [?](#)

Max Messages Behavior: [?](#)

Disconnected Client Notification: [?](#) ☐

Publisher Settings

Max Message Time To Live: [?](#) seconds

Save

Cancel

20

MQ Technical Conference v2.0.1.8

Flexible Policies

Policies can have variables substitution, a small number of policies can apply to many users and topics

Specify the resources and messaging actions that the client is permitted to access:

* Destination Type: ?

Topic ▼

* Destination: ?

/messages/\${UserID}

* Authority: ?

☐ Publish

☒ Subscribe

Subscriber Se

* Max Messag

Max Messag

Disconnect
Notification:

Expiry and Discard

Add Messaging Policy

A messaging policy authorizes connected clients to perform specific messaging actions, such as which topics, queues, or global-shared subscriptions the client can access on IBM MessageSight. In a global-shared subscription, the work of receiving messages from a durable topic subscription is shared between multiple subscribers. Each endpoint must have at least one messaging policy.

* Name: Description:

To restrict members:

- ☐ Client
- ☐ User
- ☐ Certificate Name

Specify the policy:

- * Destination
- * Destination
- * Authority

Administrative control of maximum message time-to-live

- Automatic expiration of messages beyond configured time, even with MQTT v3

Choose the maximum messages behaviour

- When a subscriber cannot keep up
 - Reject new messages
 - Discard old messages

Publisher Settings

Max Message Time To Live: seconds

Monitoring Subscriptions

Subscription Monitor

Monitor subscriptions using various subscription statistics. Delete durable subscriptions. Up to 100 subscriptions can be viewed.

Topic String:

*

* Subscription Name:

*

Query:

Subscriptions with Most Messages Published

Client ID:

*

Subscription Type:

All

Refresh

Messaging Policy

*

Last Updated: 8/11/16 1:54:08 PM

Actions View

Filter

	Topic String	Subscription Properties					Total Messages			Buffered Messages				
		Name	Client ID	Type	Consumers	Messaging Policy	Published	Rejected	Expired / Discarded	Maximum	Current	Current % of Maximum	Peak	Peak % of Maximum
<input type="checkbox"/>	#	#	DurableHash	Durable	0	DeepQ	772,846	0	0	20,000,000	772,836	3.9	772,836	3.9
<input type="checkbox"/>	topic1	topic1	dursubber0	Durable	0	DemoTopicPolicy	0	0	0	5,000	0	0.0	0	0.0
<input type="checkbox"/>	topic1	topic1	dursubber2	Durable	0	DemoTopicPolicy	0	0	0	5,000	38	0.8	38	0.8
<input type="checkbox"/>	topic1	topic1	dursubber1	Durable	0	DemoTopicPolicy	0	0	0	5,000	38	0.8	38	0.8

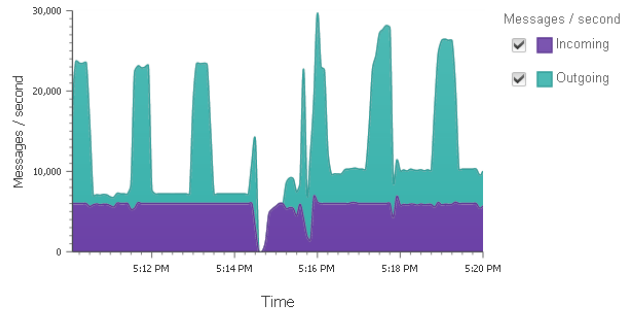
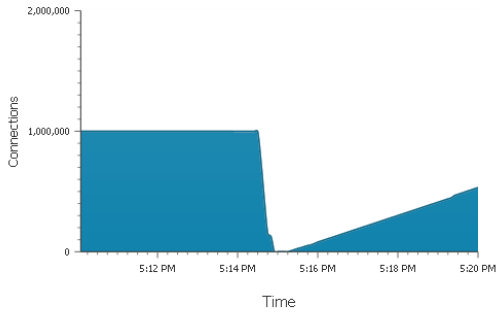
Total: 4 Selected: 0

< 1 >

10 | 25 | 50 | 100

Lots of other graphs

Active Connections and Throughput

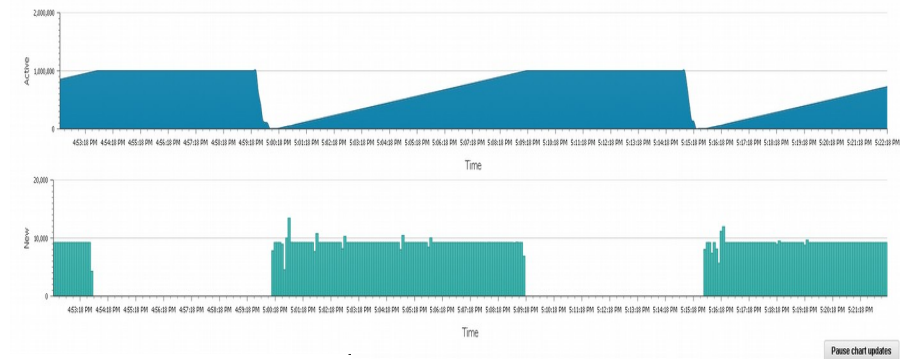


Throughput charts with incoming/outgoing rates

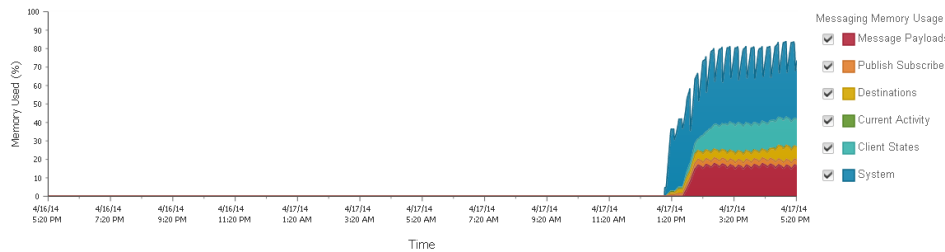
Connection charts

Connection Charts

Monitor the number of active and new connections to the server. To pause chart updates, click the button located beneath the charts.



Appliance Memory Usage



Detailed resource usage charts

Interactive MQTT Client

MQTT Helper

Connect ▼

Server

Port

Client ID

Username

Password

Clean Session

SSL

Subscribe >

[Publish](#) >

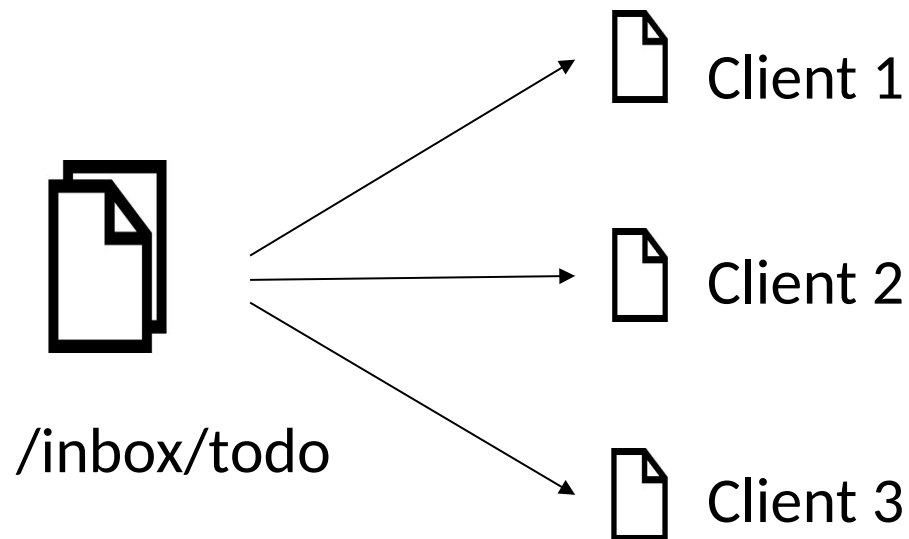
Log ☐ Follow

▼

<http://mqtt-helper.mybluemix.net/>

Shared Subscriptions

- Sharing messages on a subscription amongst multiple clients
- From MQTT, subscribe from **standard client** by modifying topic filter:
`$SharedSubscription/<subname>/<topicfilter>`



Highly Available Pairs

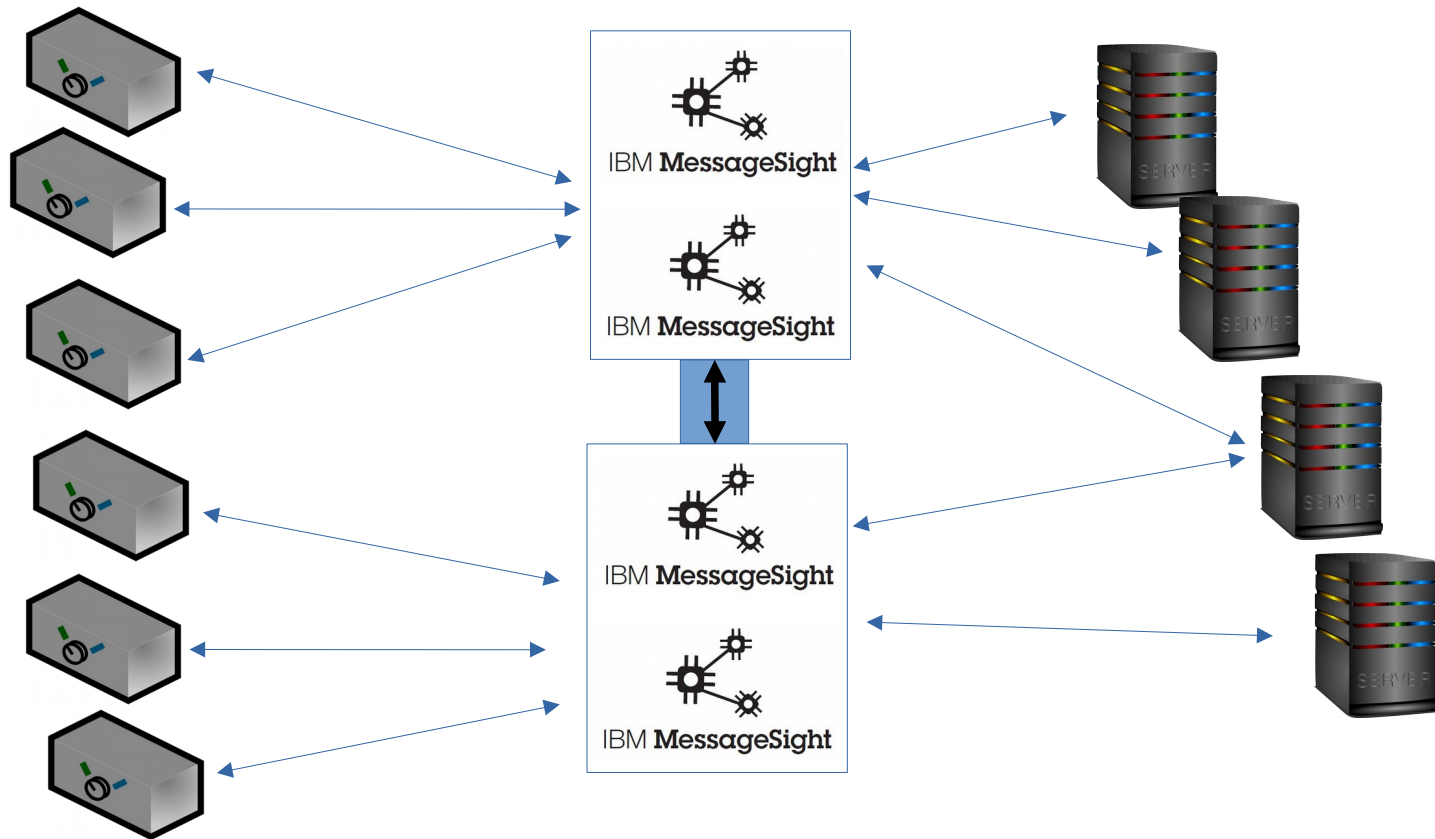
- An HA Pair is consists of a actively running system ("Primary") and another MessageSight ready to take over ("secondary").
- Communication between Primary & Secondary takes place over two separate Network Interfaces (discovery & replication) to minimise chances of "Split Brain"
- Messages (QoS > 0) are recorded at both systems before ack is sent to client.
- No Shared Storage



Clusters

Clusters add a link that messages can flow over between MessageSights.

“Device-like” subscriptions made on one MessageSight are advertised around the cluster and other nodes in the cluster forward publications to a MessageSight if it has matching subscriptions....



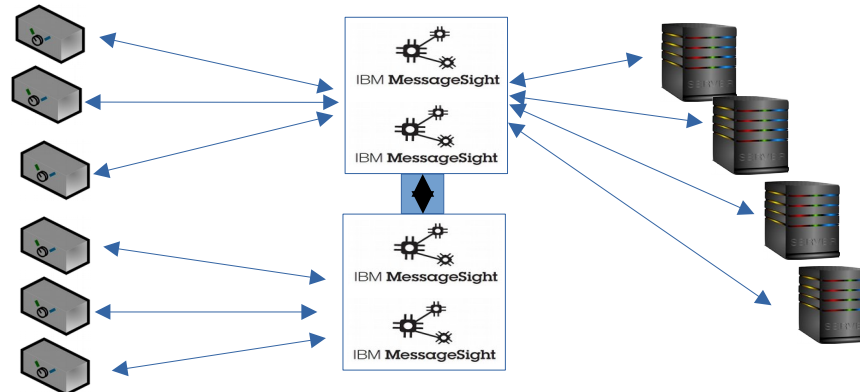
A Few Clustering Key Points

Durable clients still need a home - and to be able to find it

Buffered messages and which messages are inflight are not broadcast around the cluster

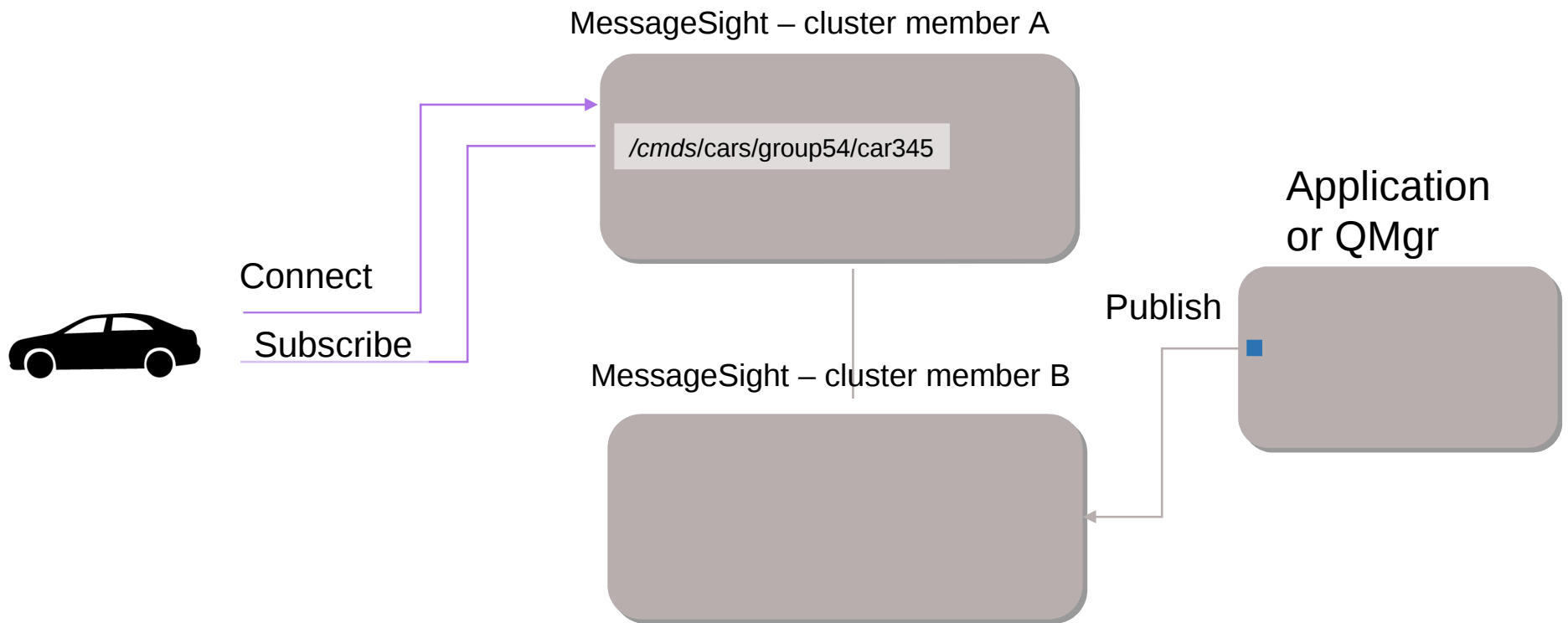
Back-end apps consuming large message volumes need to consume from all nodes where messages are incoming.

Usually
Do Not Want:



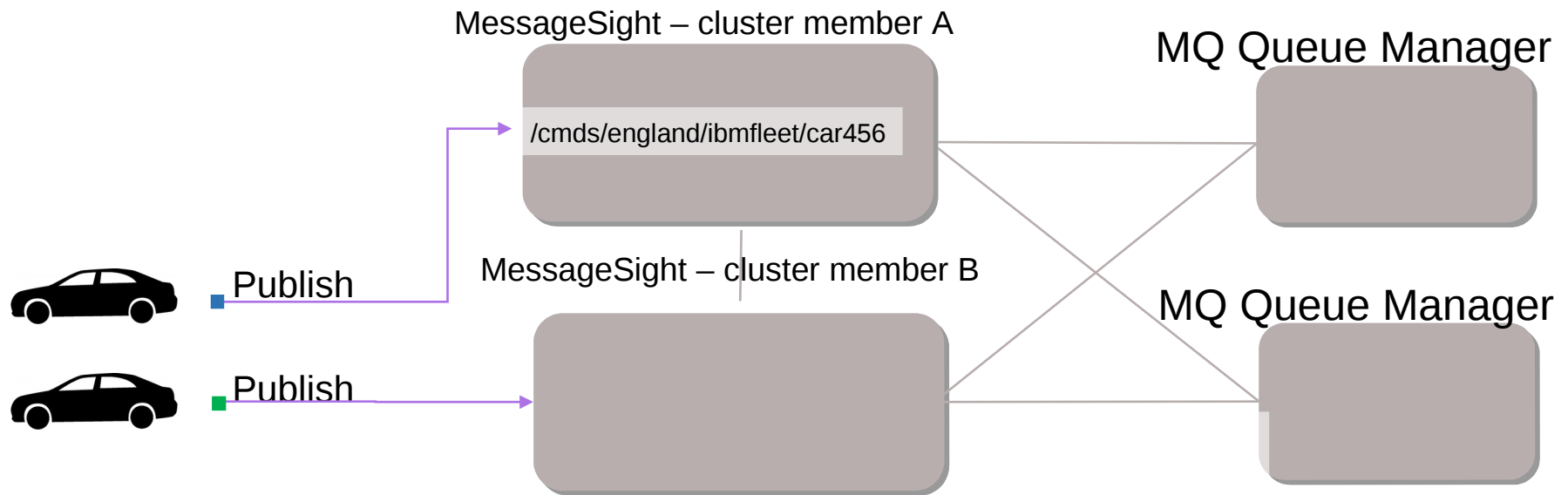
To help prevent this MQ Connectivity, JMS and shared subs (usually associated with high message volumes) are not advertised around the cluster; a separate sub needs to be created on each node.

Publish to Device



Application can publish without knowing where the client is connected in the cluster

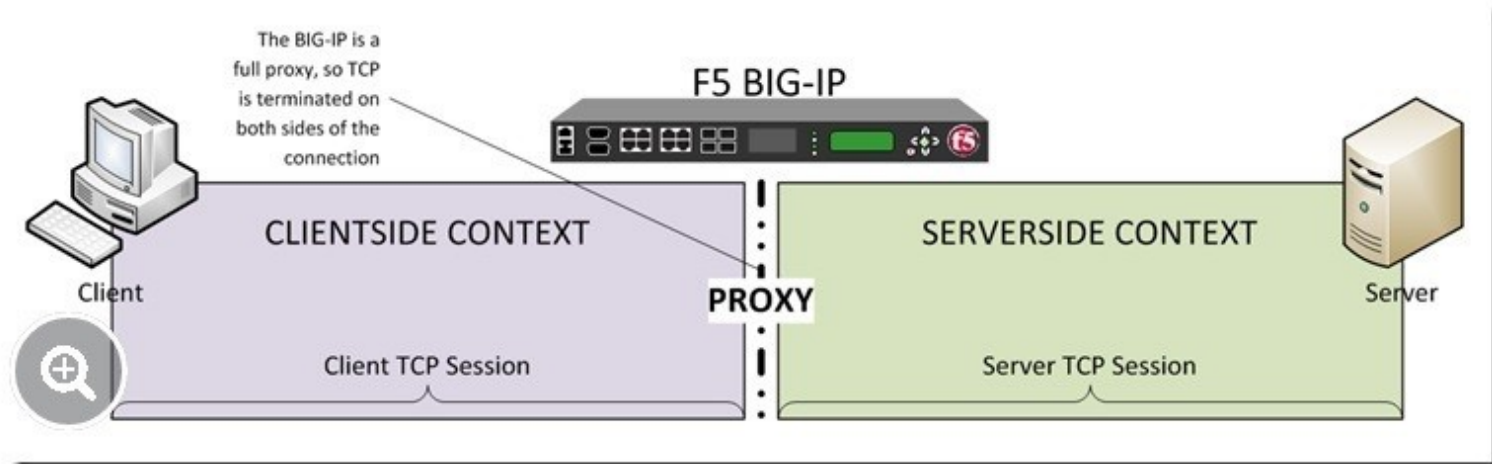
Clusters: Device to BackEnd



- Need to prevent all messages going through a single point – becoming a bottleneck
- Back-end Subs will not pull data through the cluster connector from other members
- Picture would be same if QMgr replaced with JMS App or MQTT shared sub

Balancing your workload

- Route connection requests
 - Recognize previous state
- Hide MessageSight topology
 - Multiple servers and/or HA instances
 - F5 has native MQTT support



Load Balancers: More Details

“Easy” for `cleanSession=true` clients and $QoS < 2$ publishers

For `CleanSession=false`, need client affinity to a particular “home” server (or server pair)

Client Affinity can be done e.g. based on `ClientID` by F5

Can instead have clients know about individual servers (or server-pairs) e.g. by group devices into groups of say 5000 and having a DNS entry per group

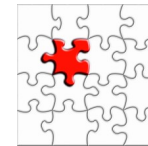
(So a device might connect to:
`group53.iot.mycompany.com`)

(Can then redirect DNS entry to move devices)



Protocol plugin point

- A protocol plug-in point in MessageSight
 - Gives the ability for IBM and trusted third-parties to extend the protocols supported by the appliance
- There is a plug-in protocol SDK to develop plug-ins
 - Protocols must be written in Java
 - Plug-ins run in an isolated environment to ensure robustness
 - The plug-in sends and receives data through MessageSight transport component
 - The plug-in uses a messaging interface into the MessageSight engine
 - The common engine ensures any-to-any communication between protocols
 - Integrated into MessageSight configuration and security models
 - Plugins do not get direct network access
 - Sample HTTP style plugin
- Intended for:
 - Legacy sensors which cannot be changed to MQTT
 - Industry-specific protocols
 - Co-existence with initial versions of IoT deployments





The Chamberlain Group Inc. developed a mobile IoT app that provides competitively differentiated capabilities and user interface

One million users can now access platform without drop off in service – 10X performance improvement

Speeds deployment and development of new features with total platform control

Opens new business opportunities for additional connected products

European Bank uses IBM MessageSight and push technology to drive personalized loan and savings offers directly to customers' mobile devices

- Innovation driven from banking transaction data
- Ensured security, confidentiality and delivery of transactions
- Lightweight responsiveness for users

GreatCall's innovative suite of easy-to-use mobile products and approach to customer care helps aging consumers live more independent lives.

An IBM IoT MessageSight – driven IoT solution connects mobile and wearable devices that scale to meet GreatCall's rapid growth, with:

- Secure support for projected 40,000 messages per second
- Single publish with multiple subs
- low latency connections that provide real time results



Grand Slam tennis tournaments use MessageSight for their scoring system to provide live scores to millions of fans using different devices

- Tens to hundreds of thousands of concurrently clients connected to MessageSight, and experiencing tournament play via iPad, Android, mobile and web sites
- Scoreboard loads are 60% faster than original flash-based solution, with subsecond response times compared with 3-5 seconds previously

143 MPH

31 of 71
= 44 %

138 MPH

146

36

5

Break
Conversion

140

168 = 83 %

597

42 of 69
= 61 %



- Publish Live Scores to Desktop and Mobile Users
- Sending over 10 million messages a minute at peak

“I was sat at the side of Centre Court one day with my smartphone app, and I heard the umpire call the point in the match after I saw my mobile phone update.”

Sam Seddon,
IBM Wimbledon Client and Programme Executive

MessageSight is easy, scalable and secure

Designed for Things

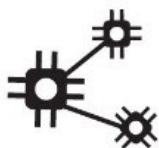
- Optimized gateway for Things and Mobile devices
- Efficient open protocol
- Event-driven awareness
- Open and industry agnostic
- Fine-grained security policies

Developer Friendly

- Active dev community
- Free developer edition
- Simple yet powerful APIs
- Simple messaging paradigm
- 40+ MQTT client libraries

Easy to Deploy

- Up and running < 30 minutes
- Task oriented UI guides administrator through first steps
- Simple and scalable management through policies



IBM **MessageSight**

Easy to Integrate

- JMS
- WebSockets
- MQ
- Integration Bus
- Worklight
- InfoSphere Streams...
- Supports Oasis standard MQTT 3.11

Internet Scale

- Large numbers of concurrent connections
- High throughput
- Highly available
- Horizontally scalable

Questions & Answers



Image Credits



“Grass Court Season is Here!” by Kate

<https://www.flickr.com/photos/43555660@N00/18161963964/>



“Pair of Seagulls” by Raymond McCrae

<https://www.flickr.com/photos/raymccrae/115980566>



Formula One Car by Gerald G

<https://openclipart.org/detail/8554/formula-one-car>