



The Quantify Cloud

Overview

Version 1.0

SUMMARY

IOT – THE NEXT INDUSTRIAL REVOLUTION

The next major industrial revolution is underway, the Internet of Things (IoT).

Quantify Technology view building automation as an extension of the Intent of Things (IoT). For a building to be “Truly Intelligent” it must connect to many systems from many vendors to provide seamless value to the consumer. More than just lighting automation or energy management, it is the delivery of a completely open, simple, limitless, extensible ecosystem.

Business processes must change as IoT delivers detailed information from an ever-increasing number of things. At its core, IoT is made up of sensors (detecting something has happened) and actuators (actioning change on sensor data and business logic). Add into the mix, software or AI (artificial intelligence), and we can now change the way we interact with buildings. The combination of sensors, actuators, data and process change is what takes buildings from smart to intelligent.

The Quantify Technology intelligent building suite has been designed from the ground up to provide lighting and power automation and management. However, the platform is designed to integrate IoT into the fabric of a building. Once fitted to the wiring, an AC Controller is field-upgradable by the consumer. Consumers can upgrade the communications and processing capacity via a feature card swap and change the user experience with a Touch Panel swap. Sensors fitted to future versions of Touch Panels, effectively extend the capabilities of the Quantify Technology solution. The consumer has invested in a sophisticated IoT platform - that can be controlled via voice, app or touch - designed to grow with their changing needs.

Underpinning the Quantify Technology platform is the cloud service. The Quantify Cloud is responsible for the secure validation and onboarding of the Quantify Technology hardware (qDevices). Additionally, the Quantify Cloud allows the consumer to change the experiences in a building. Experiences are what we refer to as the "if-then-else" logic in traditional systems. A beautiful web-based user interface configures experiences, rather than the traditional unfriendly "if-then-else" logic. At Quantify Technology, we believe, experiences simplify the users' experience, allowing the consumer to get more from their investment. Experiences mean the consumer owns their configuration database and can no longer be held hostage by external parties.

The Quantify Cloud is powerful; it also allows the connection via secure API (Application Programming Interface). Traditionally this API would be known as a High-Level Interface (HLI). Through this API, the Quantify Cloud can perform bi-directional communication with other cloud services.

At Quantify Technology, we also understand that the cloud may not always be there. Our qDevices also support a Low-Level Interface (LLI) called QDNE (Quantify Distributed Network and Enactment). QDNE allows applications and devices on the same network and owned by the same customer, to communicate directly with each other. Device-to-device communication means if the cloud disappears, the system operates in its last known configuration.

Combining both the HLI and LLI ensures third-party applications can also operate without access to the cloud. An occasional request to the HLI ensures third-party applications can participate with qDevices using the LLI. The platform has been designed to remove single points of failure.



THE ECO-SYSTEM IS ESSENTIAL

An eco-system viewpoint is essential to the future of IoT. This is because too many devices are connected today without being integrated. The components of an eco-system view include:

- **Security**
All components and systems must be secured. Commonly overlooked, security is critical to reducing operational risk and cost.
- **Scaling**
Systems must scale from one customer to many millions of customers. This scaling must be dynamic without the need for large upfront or ongoing infrastructure investments.
- **Available**
Systems must be highly available.
- **Extensible**
Systems must allow the connection of third-party services. Services must be securely connected and appropriately authorised by the user, with the user in complete control of these value-added services. Precisely like the smartphone, the Quantify Cloud platform is designed to connect to these ancillary services. Quantify Technology has an open architecture, like the smartphone, where the greater programming community can build these value-added services.
- **System Support**
Automated support reduces cost and increases customer satisfaction. Through the Quantify Cloud API and QDNE, support services can be created to improve the consumer experience.
- **Operational Efficiency**
The reduction in operational planning and the use of system templates reduces the time and cost to deploy.

The market is consolidating around the major technology companies such as Google, Apple and Amazon. During this phase, as it is more invisible to the user, security may be overlooked. Zero-hub distributed architectures is also now identified as a critical requirement. Companies are starting to realise that a building cannot contain a rack of sophisticated interconnected devices that have a single point of failure and increase the consumers' security risk.

The beauty of the cloud and robust APIs is that customers can be selective with regards to the services they consume. They can choose the best product for the job without the need for additional onsite hardware. The Quantify Cloud platform has been designed to allow this to happen. Quantify Technology encourages third party integration.

QUANTIFY CLOUD ARCHITECTURE OVERVIEW

The Quantify Cloud is the heart of the Quantify Technology platform. It is responsible for the provision of security details at manufacture to qDevices, validation of qDevices, validation of device ownership, the configuration of devices, integration to third-party applications and reporting. The Quantify Cloud is also responsible for the provision and validation of security credentials.



Figure 1 shows the Quantify Cloud platform and its connectivity to the various elements. The Quantify Cloud uses Amazon Web Services (AWS) serverless architecture.

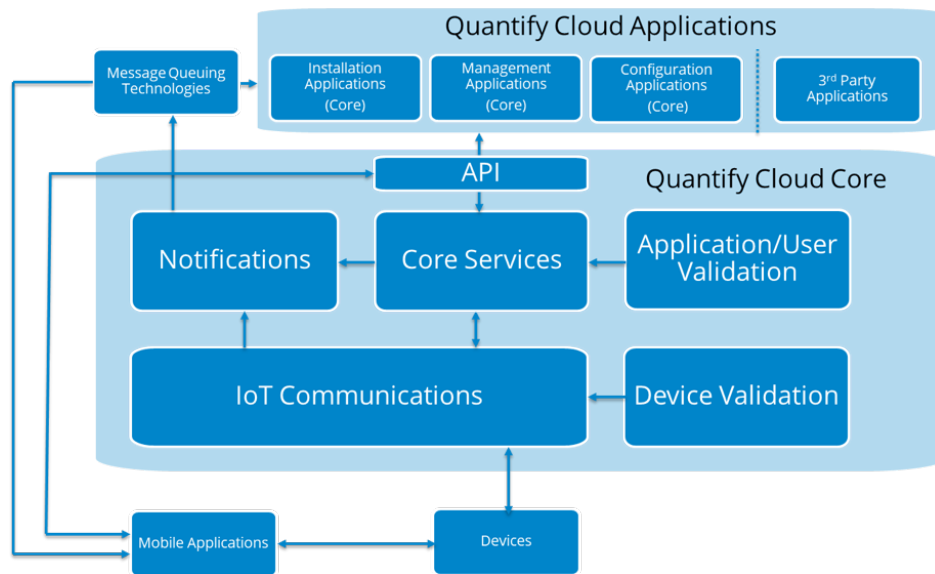


Figure 1: Quantify Cloud Architectural Overview

Devices

Devices securely communicate to the IoT communication layer via industry-standard HTTPS and MQTT. In the future, Amazon's Green Grass services provide enterprise customers with a single MQTT proxy to the internet. Green Grass terminates all local device communication and provides a single secure link to IoT communications.

Devices also communicate with each other and mobile devices, such as phones and tablets, via the QDNE protocol. This protocol allows the secure operation of devices without any gateway or connection to the internet.

IoT Communications

The IoT communications layer is responsible for secure encrypted communication to qDevices. This layer also validates that a qDevice is genuine via the device validation service.

Notifications

This layer is responsible for distributing outbound communications to devices, other than qDevices. It is a one-way process with data queued and delivered to those services via the API layer. Example uses of this service include pop-up notifications to a mobile device or the distribution of requested data to an application.

Core Services

Core Services is responsible for the day-to-day operation of the Quantify Cloud. It is responsible for securely identifying users, associating them with their devices, maintaining configurations and identifying which applications can interact with their devices and with what privileges. Application/User Validation holds information on what applications have which privileges, both at a user and device level. It is a capability that allows the horizontal scaling of the Quantify Cloud with regards to enhanced customer experiences.

API – Application Programming Interface

The API layer provides a secure authenticated standard communications path out of or into the Quantify Cloud. This layer, in conjunction with Application/User Validation, acts as the gatekeeper to the heart of the Quantify Cloud service. No services can directly interact with the Quantify Cloud without passing through this layer.



Message Queuing Technologies

This layer is responsible for receiving notifications and distributing them across the correct communications path to the receiving device, applications or services, e.g. SMS, email, 3rd Party API or push notification.

Applications

Applications that wish to interact with Core Services or qDevices must communicate via the API layer. They may not directly access services or devices. Note that one exception is a correctly authenticated and authorised mobile application running the QDNE protocol. In that case, the application is authenticated and authorised by Core Services and has the appropriate security credentials to operate QDNE.

Applications must be authorised and provided privileges by Core Services. Core Services, either at the API layer or by Application/User Validation, blocks unauthorised applications from communicating. In addition, Application/User Validation maintains a record of privileges. Should an application attempt an operation exceeding its privileges, it is blocked.

QDNE Quantify Distributed Network and Enactment

QDNE is a protocol that describes the device-to-device communication on a local network.

ADDITIONAL BENEFITS OF THE QUANTIFY CLOUD

Voice-activation as the User Experience (UE)

Using the Quantify Cloud, customers can use voice services. Currently, the Quantify Cloud supports Amazon Alexa and soon, Google Home.

Voice-activation is now consumer grade with recognition technology exceeding 95%+ accuracy, and efficient response times supported by cloud computing capabilities with Artificial Intelligence (AI). It has moved from a scarce commodity in 2015 to consumption-based surplus model in 2018. Voice-activation is a must-have for any consumer technology. Today, the primary forms of access to control consumer technology are: voice-first, app second and physical third. Advanced functions that require a screen are easily performed using any tablet, phone or web device.

Consumers are suffering from app overload. Voice allows easy access to normal use functions without an app. Native apps perform normal functions, however, it's likely bespoke apps will be necessary for advanced user functions. Native apps include Amazon Alexa App and Apple Home kit.

As each Feature Card is a cloud-native, currently AWS, the qDevices can embrace this change of UE. The Amazon Alexa Home Skill application seamlessly utilises cloud-to-cloud connectivity, to enable this feature on all Quantify Technology devices. However, if the internet were to fail, local operation via direct physical button access is still supported. Quantify Technology is not a cloud-only solution.

Artificial Intelligence and Third-Party Connectivity

This market trend is expected to transform consumer technology from 2018 onwards. Although most systems are discussing the capabilities that AI might deliver, this is just starting to enter the mainstream. The Quantify Cloud API can be used to connect to any AI while minimising technical risk.

AI is at an inflection point of "perceived value". AI has access to data, and this data is used to deliver valued recommendations. AI allows a Truly Intelligent Building to do for us what we don't do ourselves and deliver real consumer value. AI is a move from 'just technically possible' to a new paradigm of 'technically meaningful.'



qDevices embrace the full gamut of services offered through AI. The Quantify Cloud platform supports secure connections to other cloud applications allowing simple bidirectional intelligent communication.

Network Connection and Consumption Capacity

As the Internet of Things (IoT) gains momentum, security and bandwidth requirements continue to grow. Existing technologies lack both the compute and throughput capacity.

There is also an industry shift towards the service provider as the backbone. Many consumer devices tout future 5G connectivity. Cost-effective 5G means the need for the device gateway will diminish. However, most home automation systems still require some gateway with manufacturer interoperability controlled via the cloud.

Quantify Technology's modular architecture allows for a simple user-upgradable solution to the capacity problem. Should an alternative communication method be required, the Feature Card can be upgraded. These additional capabilities can then be on-boarded and configured into the system through the Quantify Cloud.

The Digitised Consumer Experience

There is a battle for the home taking place between the major technology leaders. Voice control is the first example, with this expanding to the consumers' digital footprint. Consumer choice means it is likely there will be multiple winners in this battle.

This move, in conjunction with other trends, is supported by the Quantify Cloud's native cloud strategy. Rather than have an endless stream of interconnected gateways, consumers expect simple universal interoperability. Cloud-to-cloud APIs achieves this outcome. The Quantify Cloud is also designed to keep the consumer at the centre. The consumer can decide what third party applications have access to their data, if any.

Quantify Technology also supports operation without the cloud. Should the cloud fail, consumers can still operate the system in its last known good state.

Operational Efficiency

As consumers connect more devices, consumers can experience "technical overload". Technical overload can act as a barrier to adoption.

Quantify Technology's cloud platform provides tools that allow organisations to define standard templates and experiences. These templates can then be consumed by installers and customers, effectively simplifying and removing this friction.

The Customer Experience

Quantify Technology's cloud service is business transformational, designed with the integrator and consumer in mind. Unlike most of today's systems that can be very disconnected and bespoke, the Quantify Cloud helps to reduce integration friction and decrease operating costs.

Figure 2 shows our customer-centric approach to experiences. Quantify Technology's solution is built using an experience-based model. Experiences can be saved as a template, adapted, then consumed. The reuse of experiences allows customers to move with their requirements and has the potential for significant cost savings in current and future deployment stages.



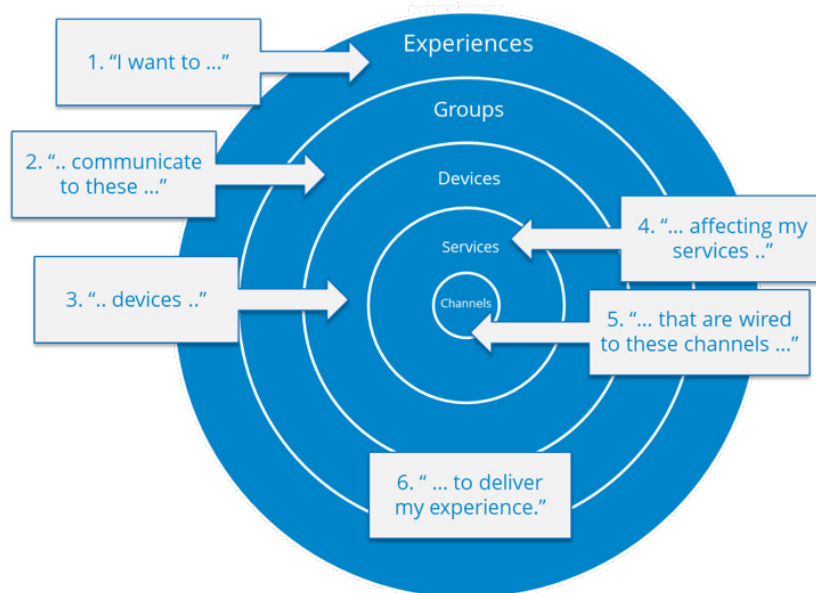


Figure 2: The Customer Experience Model

The experience model allows templates to be constructed, consisting of electrical channels and services across multiple Quantify Technology devices. A channel is an actual dimmable or a switched load. A service is the customer device connected to that channel (for example a lamp, a television). A device is the actual switch, general power outlet or auxiliary controller.

This model then extends across multiple devices, known as a Group. These Groups become configured as rooms, apartments or entire buildings. Once in a Group, the experience determines how the Group behaves to external inputs, triggers, and what output behaviour should occur. Example triggers include Amazon Alexa, buttons, sensors or even an API call from a third party service. Figure 3 shows a high-level architecture of the possible triggers. Of interest is that triggers are not dependant on the cloud. The Quantify Technology qDevices, once configured, operate in their last known good state, even on a local network.

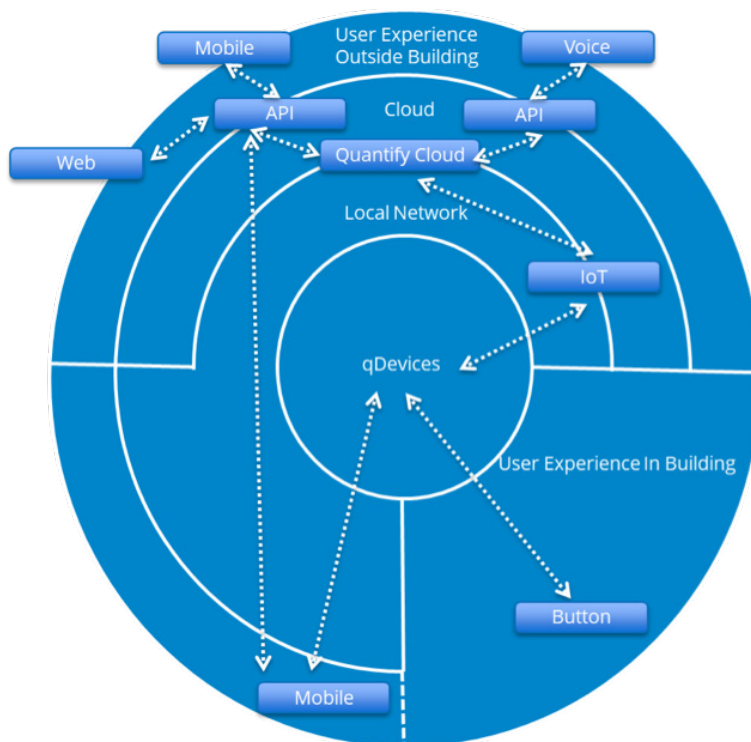


Figure 3: Device Triggers in the Experience Model



SIMPLE, INNOVATIVE, LIMITLESS

Quantify Technology's design principles are; Simple, Innovative and Limitless. These principals cover all aspects of the solution from installation through configuration and operation. Figure 4 shows these principles.

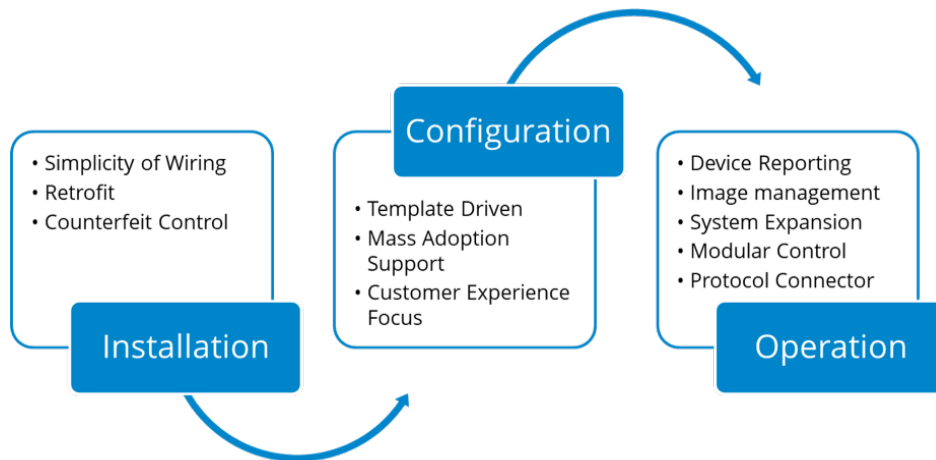


Figure 4: Simple, Limitless and Innovative

During the installation phase, the Quantify Technology system reduces the overall cost by removing expensive wiring. This reduction in wiring cost includes both proprietary backbone systems and complicated electrical wiring. The Quantify Technology system is installable in retrofit situations where no neutral is available.

The Quantify Cloud uses security features such as digital certificates and installer authentication, to ensure the integrity of the installation. By requiring this information at installation time, the solution ensures devices are genuine and installation is of a high standard.

The configuration is also simplified, with the added benefit of cost reduction, using templates. Once created, it is easy to consume a template for a building, room or experience. Templates introduce a capacity to “cookie cut” installations, driving mass adoption focused on the customer experience.

In the operational phase, the system supports device reporting and an open API. Reporting with an API allows for value-added systems to connect to the Quantify Cloud to enhance customer and the support experience. The modular design of qDevices allows for future customisation and expansion to deliver a more significant customer experience, drive efficiency and reduce support costs.

It is possible to add the QDNE protocol to third-party devices. QDNE means a third-party device could interact with a qDevice directly without the use of the cloud-based API.



SUMMARY

Quantify Technology's vision is to produce the world's first Truly Intelligent IoT platform for buildings and homes. We started with a blank sheet of paper, and without the chains of legacy systems we developed a platform that had three critical goals:

Energy Management

Quantify's solution helps to save energy, thus saving consumers money and reducing environmental impact. We enable this by:

- Gathering detailed energy usage data and enabling the analysis to better inform decisions.
- Users enable automation and energy savings measures via the defining of "policies".

Exceptional User Experience

Looking at how you interact today and looking at ways to dramatically improve this to make life more convenient, more straightforward, safer and secure. Here we look at four distinct opportunities for improvement:

- Control – enhancing your control by introducing gesture and voice control in addition to control via web, mobile and tablet platforms. Control how, when, and wherever you want.
- Aesthetics – making our products look great so they enhance the value of a home or building and allowing for extensive customisation.
- Profile Analysis – using data to establish "normal" energy usage patterns and alerting you when the pattern is "abnormal".
- Value Adding – opening the architecture allows the developer community to think of solutions that deliver additional value. The platform is not just about lighting; it's about building on vertical applications that drive adjacent market opportunities.

Drive Cost from Business

Quantify Technology control costs by:

- Monitoring – future releases of the Quantify Cloud provide reporting on what installer interacts with which devices. Installers are measured, providing consumers with a more informed choice.
- Templates – using templates means a reduction in the cost to design a building, as previous learnings get captured and pushed to installers.
- Usage and failures – future releases of the Quantify Cloud with near real-time monitoring allows usage patterns and failure detection. Again, this means cost reductions for the business and added value for customers.
- When all devices connected to the platform become aware of each other, it allows those devices to interact in a manageable and secure fashion. Connectivity is what delivers Truly Intelligent Buildings and Homes.





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