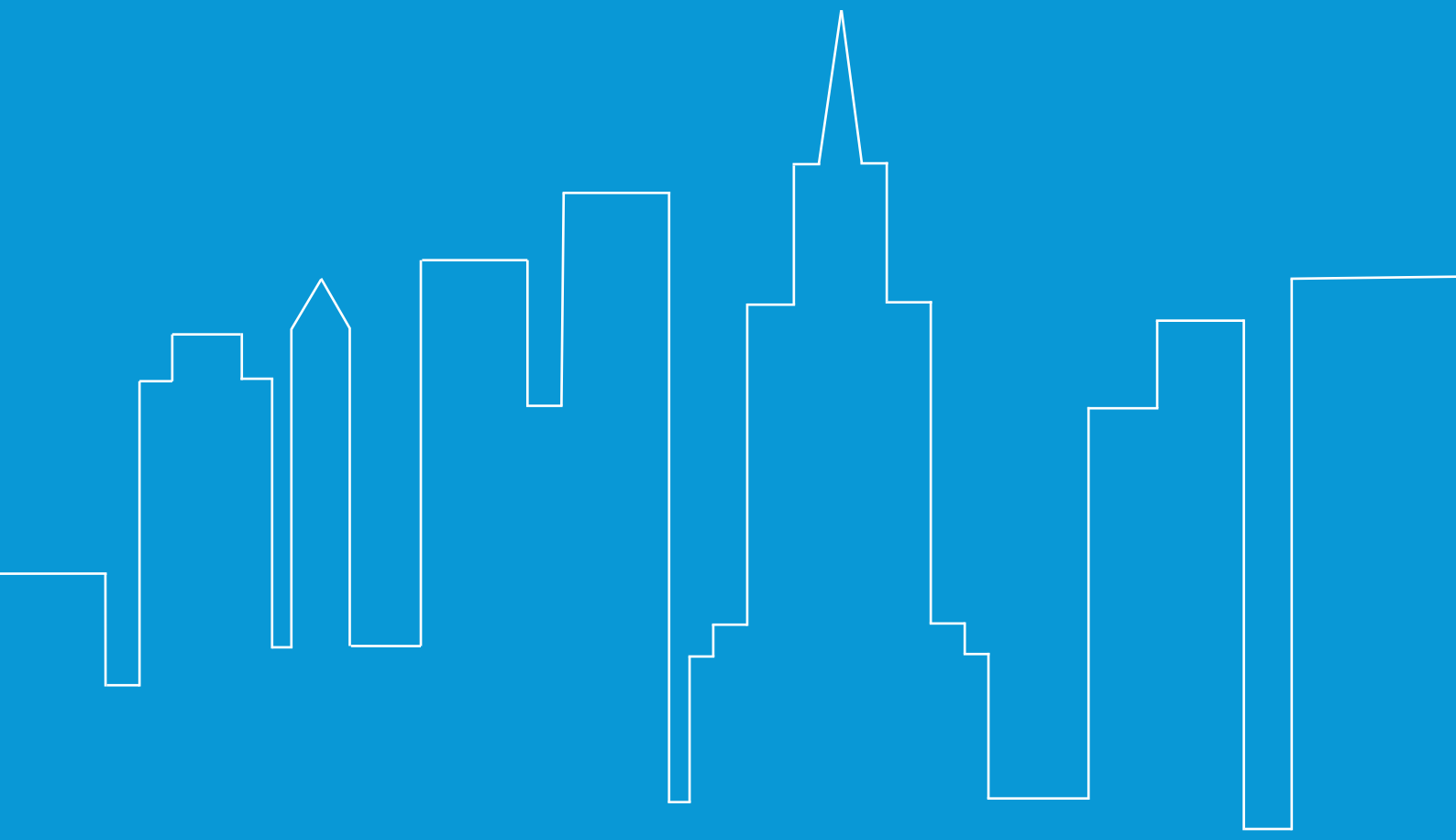
SPARKL®

Solution Brief

Distributed Intelligence in the Internet of Things with the SPARKL® Sequencing Engine



Inside This Brief

About SPARKL

Bring Machines Together

All enterprises suffer from the black box swamp. Systems that work fine on their own, but won't play nicely with others.

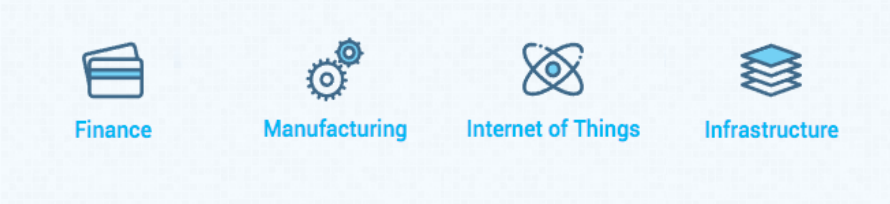
It's hard to describe how a system should work - let alone how or why different systems interact.

SPARKL® is powerful technology for managing the behaviour of distributed systems. The lightning fast, distributed SPARKL Sequencing Engine drives events between machines, applications and things.

It provides Distributed Intelligence for true fog computing, allowing edge devices to interact with or without the cloud.

Secured by blockchain, SPARKL logs every single event in a clean, connected Audit Trail to solve compliance and regulatory reporting across machines and systems, old and new.

SPARKL designs and develops the SPARKL® Sequencing Engine in London, UK. We work with partners including Cisco and Intel to market the product to innovators and customers worldwide.



Connected Supersystem

What if traffic signals could respond automatically when sensing an approaching ambulance to prioritise letting it through congested traffic?

What if information from sensors could be aggregated to determine the occurrence of a break-in or a fire?

What if real-time confidence scoring could be used to predict the potential for engine problems on an aeroplane?

These are all examples in the realm of the Internet of Things. We can look forward to a future where our buildings, towns, villages and cities will be 'smart' - connected, sensor-rich, controllable, efficient, secure and generating data that can be easily visualised and analysed.

Today, it is simply not enough for a building to just contain the systems that provide comfort to its occupants. Devices should be able to work together seamlessly so that data can received and analysed at exactly the right time.

SPARKL Supersystem

The result is a smart building of 'supersystems' where lighting, air conditioning, security and other systems pass data freely and efficiently back and forth, leading to an efficient, responsible building that minimises operational costs for its inhabitants, who can feel safe and comfortable as a result.

Today's typical high-rise building has around 30 or more disparate systems controlling various functions of the building. One system monitors and controls the heating, ventilation and air conditioning (HVAC) functions of the buildings.

Overseen by the building engineering team, SPARKL would control the various equipment types that regulate the indoor environment. Multiple set points trigger certain things to open or close, turn on or off, and more. Temperature sensors feed information into the system.

Whilst the HVAC system is humming away, the fire control system is monitoring alarms, ready to activate its sprinkler system in the event of a fire. In turn, the building's electricity meters may feed information into the building company's financial planning system to estimate costs.

All of these machines, systems and applications are doing is simply following a sequence of events through the **SPARKL Sequencing Engine**.

The Industrial Internet of Things

Through the Industrial Internet of Things (IoT), the concept of smart cities, is slowly becoming a reality. Fortune writer Stacey Higginbotham writes in a 2016 newsletter on the subject:

> "IoT isn't just the latest buzzword. It's a way to digitise information about more of our world for crazy low cost. Making use of that information requires two things: 1) subject matter expertise and 2) a platform that lets you manage the inflows of that information, the devices that information is coming from and then make sense of that data."

But many difficulties lie ahead for the Internet of Things if sensor data is continued to be shipped off to centralised controllers living in the cloud - particularly when the necessary transfer bandwidth may not exist, the connection may be patchy, or have too high a latency. We may not even want to share all our data with the cloud.

The Internet of Things still requires a collective intelligence that doesn't rely on remote decision-making, yet is still able to make cloud, edge and legacy systems work together to ensure personal and enterprise data stays in a safe, private place.

In fact, the Internet of Things is about computing, in the fog:

> "Fog computing is an architecture that uses one or a collaborative multitude of near-user edge devices to carry out a substantial amount of storage, communication (rather than routed over the Internet's backbone), control, configuration, measurement and management. This is in contrast to these functions being carried out primarily in cloud datacenters."

The SPARKL Sequencing Engine is the technology to achieve those goals. It's powerful technology for managing the behaviour of distributed systems. The lightning fast, distributed SPARKL Sequencing Engine drives events between machines, applications and things.

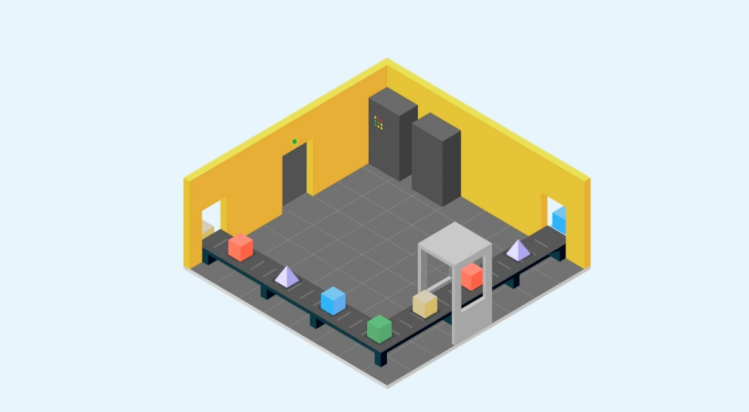
The Sequencing Engine is able to make decisions locally but hierarchically; that is, when a decision cannot be made locally, it is punted up the chain to the next level of aggregation. For example, in a site services context, we may start at the office level, then floor level, then building level, then site level, then country enterprise level, then finally global enterprise level.

Whilst the temperature in an office is unlikely to be important to the business at a country-wide level, the agility of being able to operate particular sites is important. A decision regarding comfort cooling could be made, in turn, by controllers working locally to a building.

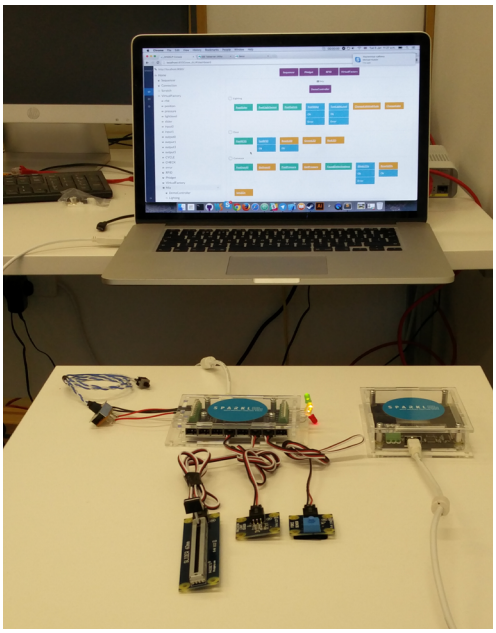
SPARKL's Virtual Factory

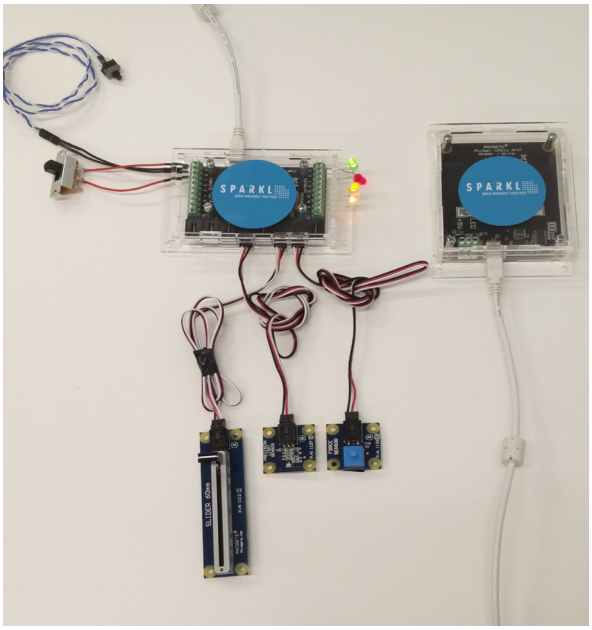
The SPARKL Sequencing Engine has been built from the ground up for exactly the kind of distributed intelligence described - where decisions are made as locally as possible, based on local analytics to hand.

SPARKL has built a Virtual Factory Floor that demonstrates this capability. In this video, you can see how SPARKL makes things work together to make sure the right things happen at the right time.



Figures 1, 2 & 3: A screenshot from the Virtual Factory video and a behind-the-scenes look at the making of the demo





These sensors - a slider, force sensor, switch, button and a light detector - were configured through the SPARKL Developer Console to react to certain things happening in the factory. For example, the purple triangle on the production line emits a loud alarm when it goes through the scanner.

This **Distributed Intelligence** is part of SPARKL's autonomics or closed-loop capability: where autonomics focuses on continually moving a system towards its desired state. An autonomics solution will continually execute a closed loop of monitoring the state of the environment, analyse it, plan a course of mitigated actions, and then execute them.

The IoT Landscape

Through **Distributed Intelligence**, every SPARKL controller is endowed with a local projection of the desired system state, and the controller continually seeks to achieve that, based on its monitoring of local state and actions that it has available.

Additionally, SPARKL is able to orchestrate multiple processes at the same time, to allow for interoperabilty. For example, if a fire detection system fails, the temperature sensors for the HVAC system can switch into emergency stand-by mode and feed data into the fire detection system, ensuring safety of the building's occupants.

This would essentially be a network of sensors serving multiple purposes into which Internet of Things applications subscribe to, for data. A SPARKL mix is the 'Data-as-a- Service' that gives this capability with localised analytics.

The Internet of Things landscape is rich in examples where a solution based on local and hierarchical distributed intelligence would be desirable. Some IoT contexts include:

- **Smart Cities**: Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response
- **Environment**: Weather Monitoring, Air Pollution Monitoring, Forest Fire Detection, River Floods Detection
- **Energy**: Smart Grids, Renewable Energy Systems, Prognostics
- **Logistics**: Routing Generation & Scheduling, Fleet Tracking, Ship Monitoring, Remote Vehicle Diagnostics
- **Agriculture**: Smart Irrigation, Greenhouse Control
- **Industry**: Machine Diagnosis & Prognosis, Indoor Air Quality & Monitoring, Offshore Installations, such as Oil Rigs and Finite State Machines
- **Smart Enterprise**: Site Services and Building Management
- **Consumer**: Connected Autonomous Vehicles, Home Automation & Insurance

Let's consider how SPARKL would handle the breakout of a fire in an office with several different types of sensors:

Two types of smoke detectors reporting anomalous readings of a fire trigger an alarm. SPARKL is notified locally of the fire.

A **fire event** (as opposed to a smoke anomaly event) is propagated to the floor controller and onto a building controller, which may be the appropriate level to communicate to the alarm system and set off the alarm.

Human presence information for the office and surrounding floors, in aggregated form, is made available by the building controller on a dashboard to a Site Services operator, so that the fire department will know where to concentrate their search and firefighting activities.

Above all, the controllers will make changes to their local environment based on local information, without decisions being made by a centralised controller.

Normally this information wouldn't be available if, for example, there was a network outage. Dot-matrix signs showing the best way out to humans that may be trapped would have their message customised by local controllers.

Selling the Unseen

Whether it's a single building, a large real estate development, or the global infrastructure market, the stark value of the smart city market is almost too obvious. In the UK alone, the 2015 Budget saw the government allocate £40 million for the Internet of Things in healthcare, social care and smart cities.

After years of workshops, conferences and articles debating ideas, concepts and issues, we have a much keener sense about the realities of building the Internet of Things, and there are already a handful of areas around the world that have put some smart city initiatives in place.

Take London, for example. Consortium HypercatCity is particularly focused on setting interoperable standards and policy nationally for the UK. And then there are cities like Bristol, Amsterdam and Chicago, who have been quietly setting the foundations in IoT for some time.

For now, it's more a case of selling the unseen. Future smart cities might eventually look very similar to what we know today, but in reality we're talking about thousands of applications, devices and things that can be combined together in potentially thousands and millions of ways.

What SPARKL does brings these technologies together - it's been designed specifically to enable distributed machines and systems to interact together through collaboration. This brings power and ease to making the Internet of Things work, and could ultimately transform a person's experience of their own city.

Find Your Use Case

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See SPARKL tutorials and demos at
sparkl.com/docs/web