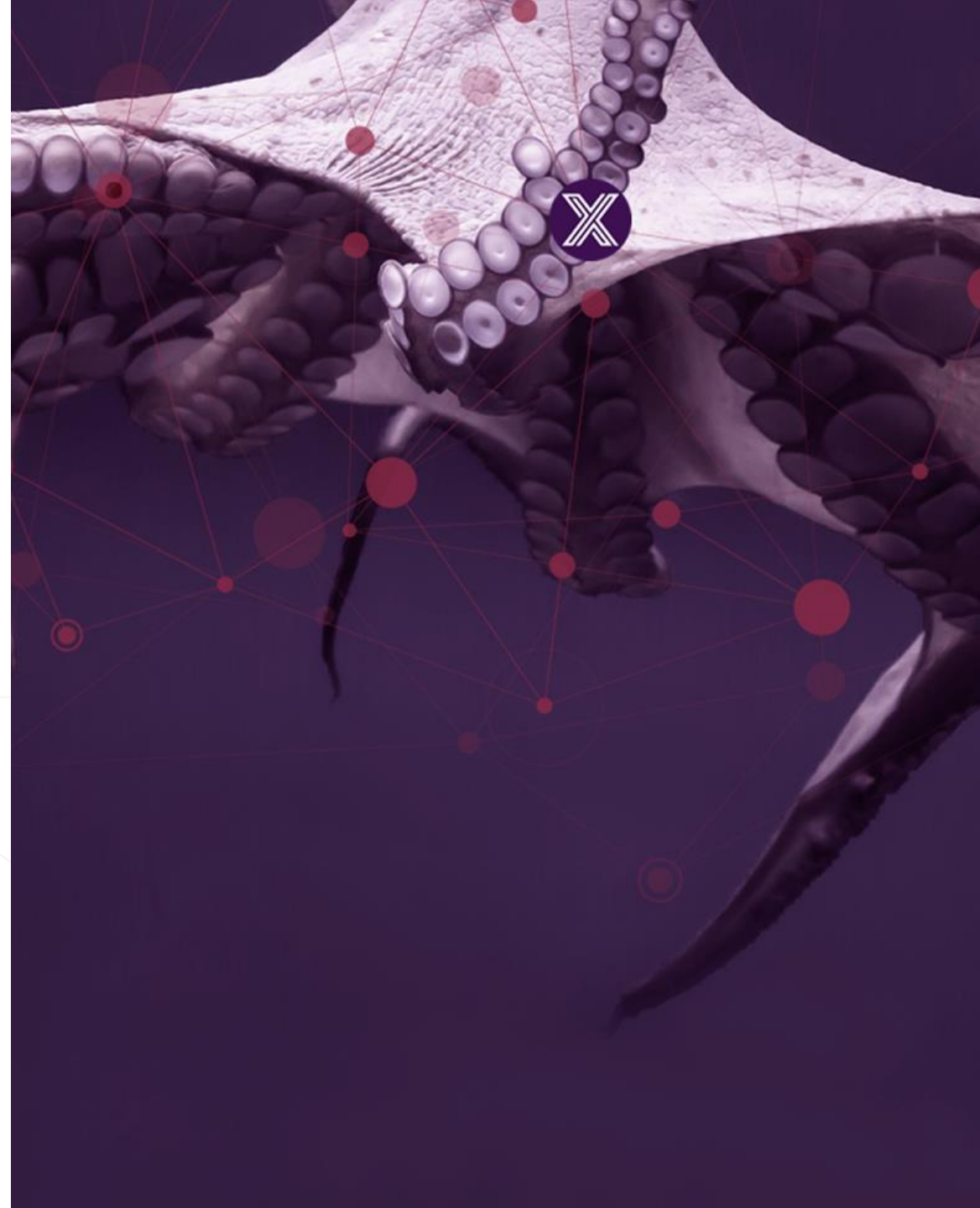




# EdgeX Foundry Introduction

Jim White & Keith Steele  
February 2019



# About Us



- Jim White (james\_white2@dell.com)
  - Dell Technologies IoT Solutions Division – Distinguished Engineer
  - Team Lead of the IoT Platform Development Team
  - Chief architect and lead developer of Project Fuse
    - Dell's original IoT platform project that became EdgeX Foundry
    - Yes – I wrote the first line(s) of code for EdgeX (apologies in advance)
  - EdgeX Foundry ...
    - Vice Chairman, Technical Steering Committee
    - Systems Management Working Group Chair
    - Ad hoc and unofficial lead architect



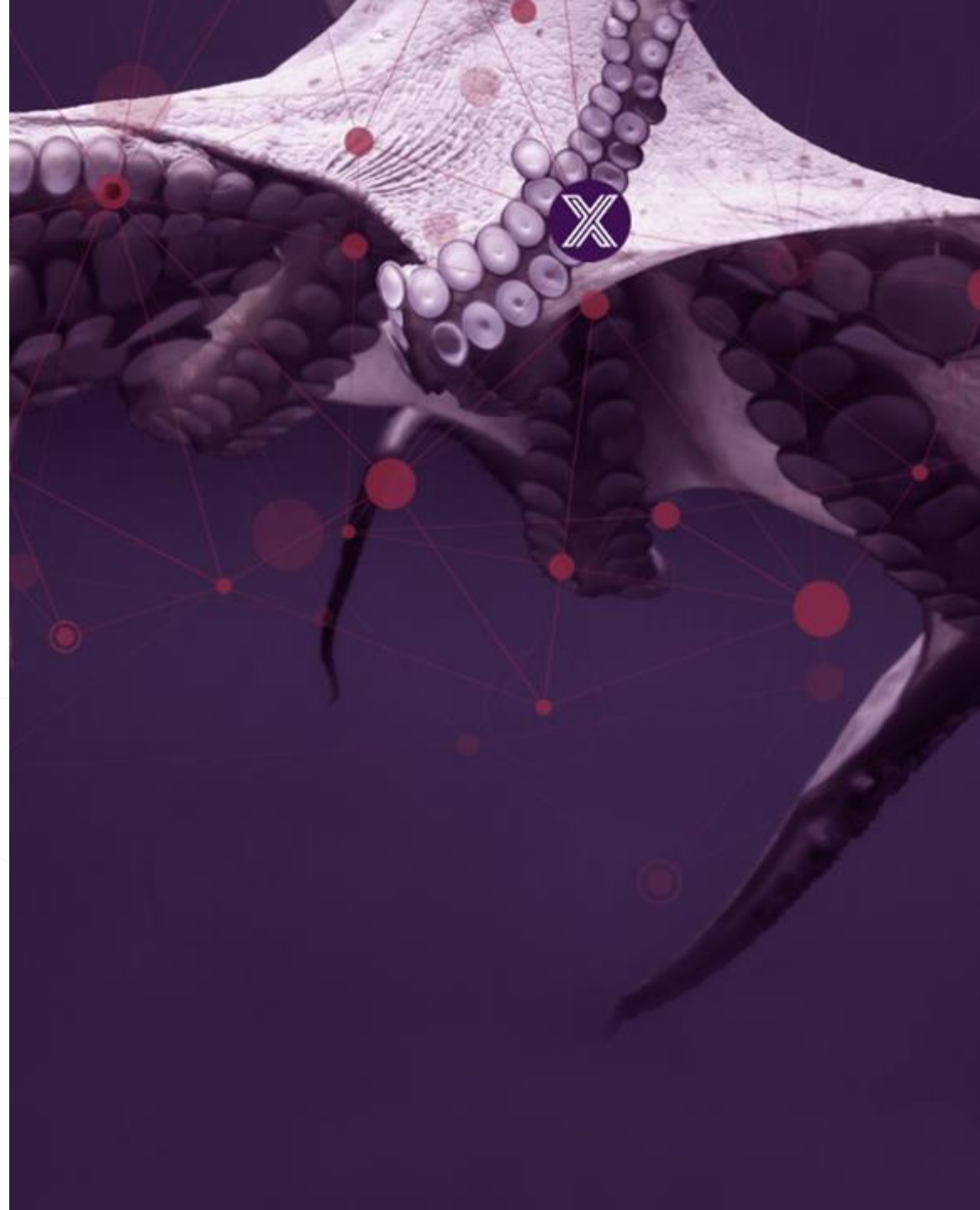
- Keith Steele (keith@iotechsys.com)
  - CEO IOtech
  - Global Middleware Pioneer and Entrepreneur
  - Launched IOtech to provide commercial offerings around the Edge X OS Baseline
  - Edge X TSC Chair and member of LF Edge Board of Directors
  - Teamwork and strong collaboration a focal point of his project leadership
  - Product quality and supportability a





# Edge X Introduction

keith@iotechsys.com





Home > Launch > Advice

Launch Advice

# Why the IoT is Doomed

The adoption of IoT is off to a slow start. IoT projects will take 2x as long as expected.

By David Houghton March 12

PCW

NEWS REVIEW

AdChoices

Device IoT

Home / Internet Of Things

NEWS

## Look before you leap

Data errors, security holes and rapidly changing standards are slowing the IoT's progress.



By Stephen Lawson

Senior U.S. Correspondent, IDG News Service | MAR 12



REFCARDZ GUIDES ZONES

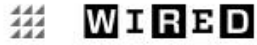
## IoT Protocol

When entering the world of IoT, you need your way around the protocols. You need to be able to communicate with the devices.



by Candace Letizia

Like (4) Comment



## 7 Reasons Why the Internet of Things Is Doomed

SUBSCRIBE

BUSINESS

CULTURE

DESIGN

GEAR

SCIENCE

SECURITY

TRANSPORT

PARTNER CONTENT JASON BLOOMBERG, INTELLIX.

# 7 REASONS WHY THE INTERNET OF THINGS IS DOOMED



Image: Kyle Slattery/Flickr

# Why is IoT hard to do?

- Heterogeneity of platforms
  - Diverse collection of OS and OS variants
    - Linux, Unix, Windows, VxWorks, embedded and RTOS, ...
  - Various Hardware (Intel, AMD, ARM, ...)
  - Cloud, gateway, smart thing (the “Fog continuum”)
- Thing protocol soup
  - Industrial: BACNet, Modbus, OPC-UA, ...
  - Wireless: BLE, Z-Wave, Zigbee, ...
  - Message: MQTT, AMQP, DDS, ...
- Variety of cloud platforms
  - Azure IoT Hub, AWS IoT Platform, Google IoT Core, IBM Watson IoT Platform, ...
- Add your favorite selection of...
  - Applications, edge analytics/intelligence, security, system management, ...
- Difficulties in determining where to start

IoT is a post doctorate in all we know and have done in computing for the last 30-40 years

- Networks/protocols
- Mobile computing
- Distributed compute
- Cloud compute
- AI/Machine learning
- ...

# Introducing EdgeX Foundry

An open source, vendor neutral project (and ecosystem)

A **micro service**, loosely coupled software framework for IoT edge computing

Hardware and OS agnostic

Linux Foundation, Apache 2 project

Goal: enable and encourage growth in IoT solutions

- The community builds and maintains common building blocks and APIs
- Plenty of room for adding value and getting a return on investment
- Allowing best-of-breed solutions

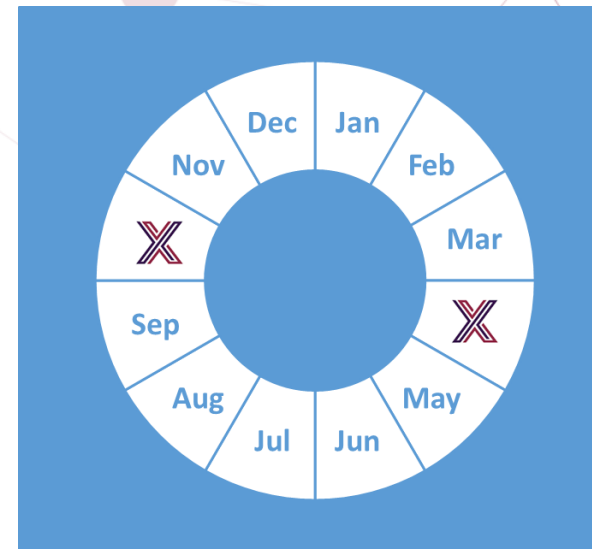


# EdgeX Foundry Goals

- Build and promote EdgeX as the common open platform unifying edge computing
- Enable and encourage the rapidly growing community of IoT solutions providers to create an ecosystem of interoperable plug-and-play components
- Certify EdgeX components to ensure interoperability and compatibility
- Provide tools to quickly create EdgeX-based IoT edge solutions
- Collaborate with relevant open source projects, standards groups, and industry alliances to ensure consistency and interoperability across the IoT

# A Brief EdgeX History

- Chartered by Dell IoT marketing in July 2015
  - A Dell Client CTO incubation project (Project Fuse)
- Designed to meet interoperable and connectivity concerns at the IoT edge
- Started with over 125,000 lines of Dell code
- Entered into open source through the Linux Foundation on April 24, 2017
  - Started with nearly 50 founding member organizations; today we have more than 75
- Release Cadence: 2 formal releases a year
  - **Barcelona – Oct 2017**
  - **California – Jun 2018**
  - **Delhi – Oct 2018**
  - *Edinburgh – April 2019*
  - *Fuji – Oct 2019*
  - *Geneva – April 2020*
  - *Hanoi – Oct 2020*





# Backed by Industry Leaders

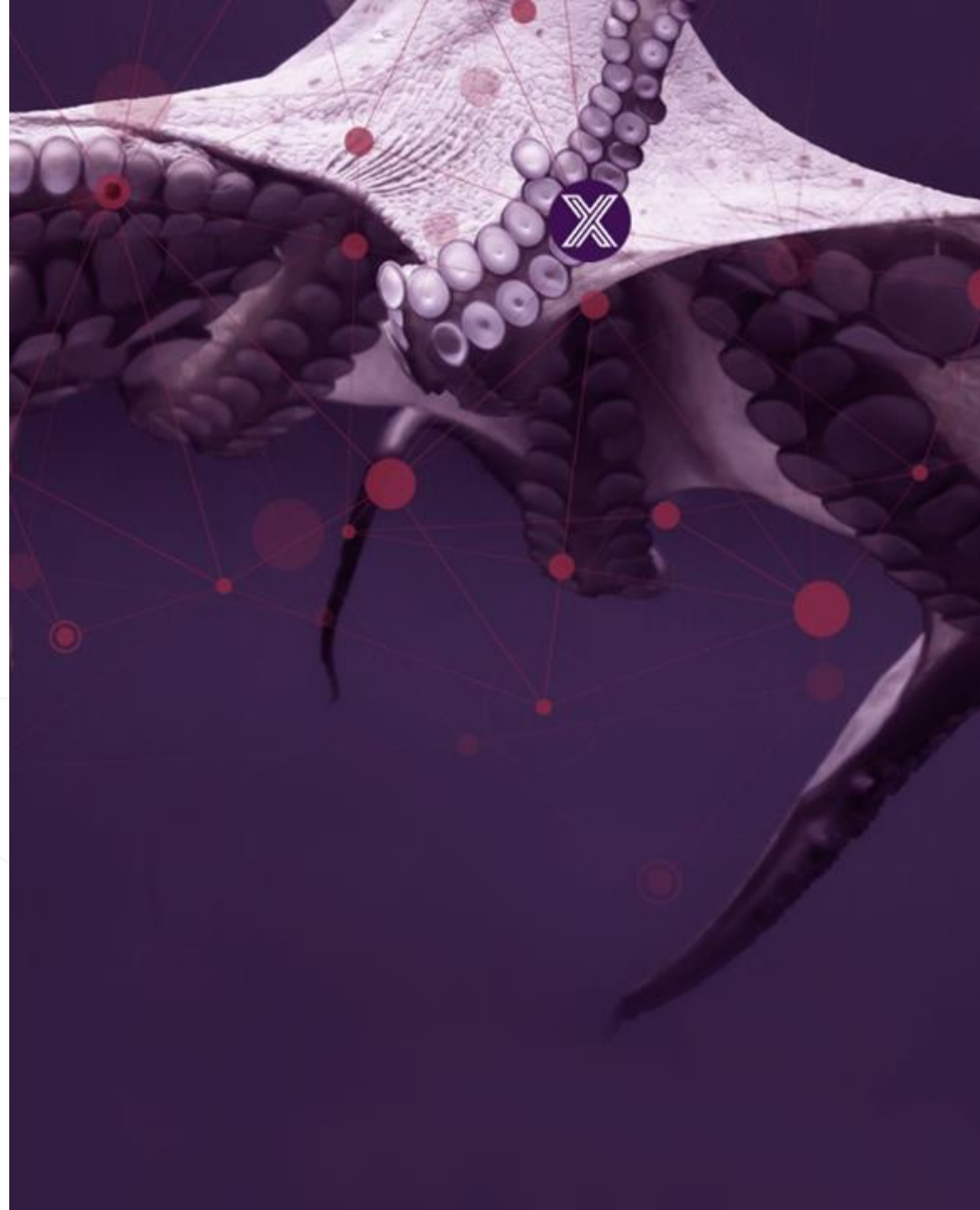
EDGE X FOUNDRY™



EDGE X FOUNDRY™

Edge X

james\_white2@dell.com



# Edge X Positioning

Through Community Extensions

Edge X

**Hard Real Time**

**“Relevant Time”**

**Response Time**

High bandwidth, QoS, sub-millisecond, deterministic

Milliseconds+

**OS**

RTOS

Traditional Linux or Windows

**Example Use Cases**

Smart Building, Energy Management, Factory Optimization, Predictive Maintenance, Quality Control, Supply Chain Management, Remote Asset Management, Fleet Management, Logistics, Environmental Monitoring

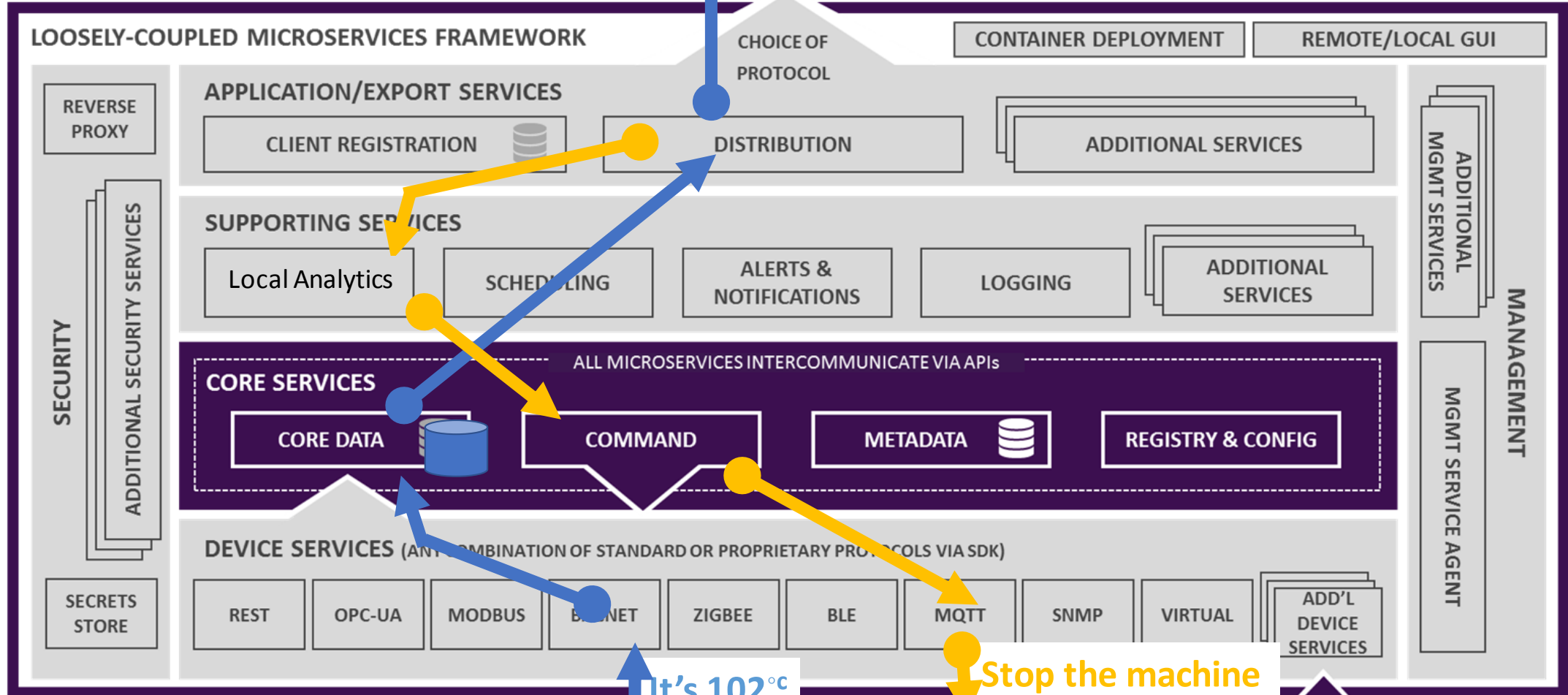
High-speed Process Control, Robotics, Safety Systems, Autonomous Vehicles

# EdgeX Primer - How it works

- A collection of a dozen+ micro services
  - Written in multiple languages (Java, Go, C, ... we are polyglot believers!!)
- EdgeX data flow:
  - Sensor data is collected by a **Device Service** from a thing
  - Data is passed to the **Core Services** for local persistence
  - Data is then passed to **Export Services** for transformation, formatting, filtering and can then be sent “north” to enterprise/cloud systems
  - Data is then available for edge analysis and can trigger device actuation through Command service
  - Many others services provide the supporting capability that drives this flow
- REST communications between the service
  - Some services exchange data via message bus (core data to export services and rules engine)
- Micro services are deployed via Docker and Docker Compose



“NORTHBOUND” INFRASTRUCTURE AND APPLICATIONS



It's 102°C

Stop the machine



“SOUTHBOUND” DEVICES, SENSORS AND ACTUATORS

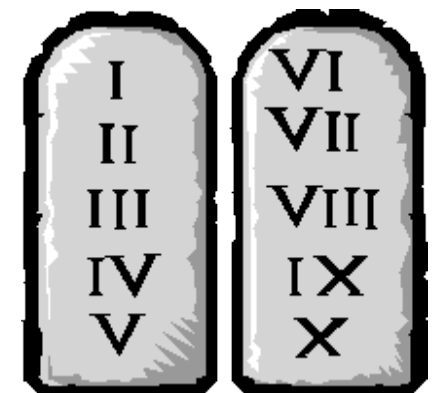
# EdgeX Micro Service Layers

- Contextually, EdgeX micro services are divided into 4 layers
- Crudely speaking, the layers of EdgeX provide a dual transformation engine
  - 1x - Translating information coming from sensors and devices via hundreds of protocols and thousands of formats into EdgeX
  - 2x - Delivering data to applications, enterprises and cloud systems over TCP/IP based protocols in formats and structures of customer choice



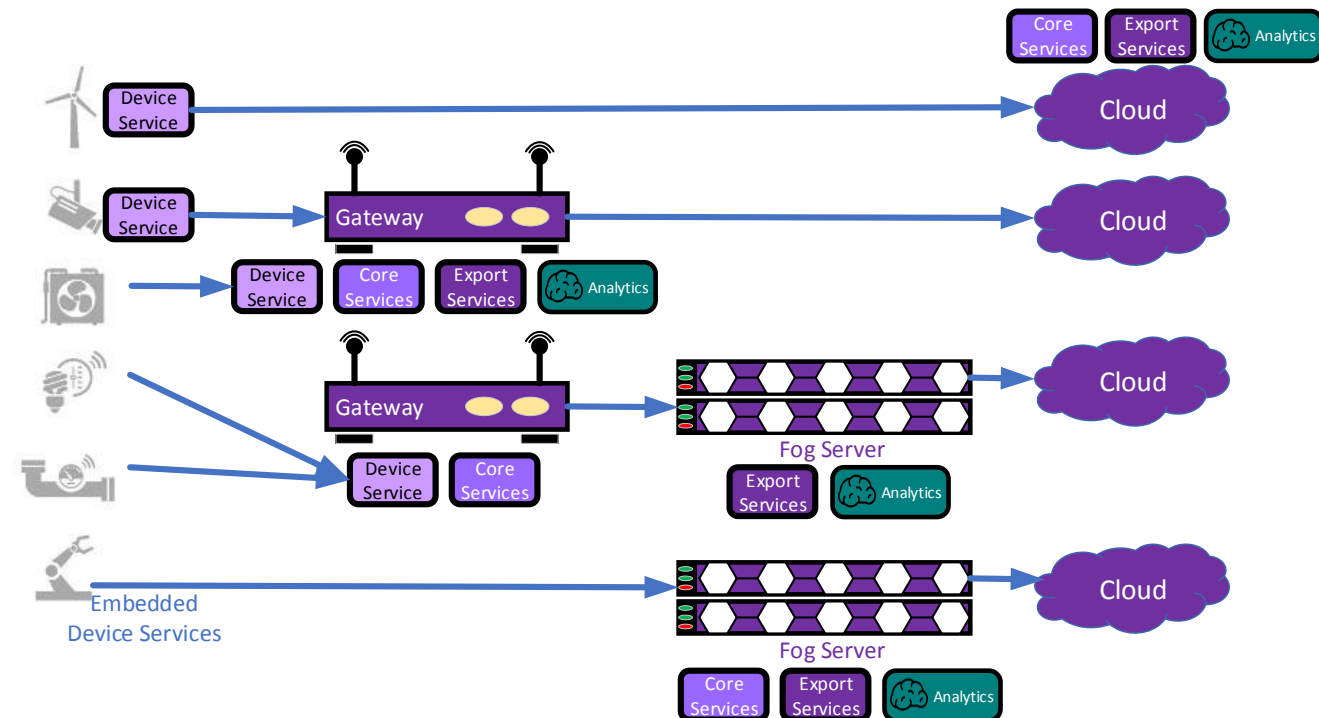
# EdgeX Architectural Tenets

- EdgeX Foundry must be **platform agnostic** with regard to hardware, OS, distribution/deployment, protocols/sensors
- EdgeX Foundry must be **extremely flexible**
  - Any part of the platform may be upgraded, replaced or augmented by other micro services or software components
  - Allow services to scale up and down based on device capability and use case
- EdgeX Foundry should provide “reference implementation” services but **encourages best of breed solutions**
- EdgeX Foundry must provide for **store and forward** capability (to support disconnected/remote edge systems)
- EdgeX Foundry must support and **facilitate “intelligence” moving closer to the edge** in order to address
  - Actuation latency concerns
  - Bandwidth and storage concerns
  - Operating remotely concerns
- EdgeX Foundry must **support brown and green device/sensor** field deployments
- EdgeX Foundry **must be secure and easily managed**



# EdgeX Enables Tiered Fog Deployments

- In today's IoT landscape, it is imperative to leverage compute, storage, network resources where every they live
- Loosely-coupled architecture enables distribution across nodes to enable tiered edge/fog computing
- Scope includes embedded sensors to controllers, edge gateways and servers
- Quantity and function of micro services deployed on a given node depends on the use case and capability of hardware





# Performance Targets

- The target is to run all of EdgeX on a Raspberry Pi 3 type of device
  - 1 GB RAM, 64bit CPU, at least 32GB storage space
- Additional “developer community” targets
  - Startup in 10 seconds or less (post OS boot)
  - Latency for one piece of data from data ingestion to actuation will be < 1 second
- Remaining OS and Hardware agnostic
  - Windows, Linux, \*nix, ...
  - Intel/Arm 64 (Arm 32 not officially supported yet but has been done)

<b>Current numbers</b>		
	Max	Avg
Memory Footprint <sup>1</sup>	250MiB	200MiB
CPU Utilization <sup>1</sup>	4.75%	2.39%
Startup time	15 sec	6 sec

on 8GB machine

	Size
Containerized	121 MB
Raw executables	86 MB

<sup>1</sup> Includes MongoDB, Consul services but not some security and system management services

# EdgeX Technology

- A majority of the micro services are written in Go Lang
  - Previously written in Java
  - Some Device Services written in C/C++
  - A user interface is provided in JavaScript
  - Polyglot belief – use the language and tools that make sense for each service
- Each service has a REST API for communicating with it
- Uses MongoDB to persist sensor data at the edge
  - Also stores application relevant information
  - Allows for alternate persistence storage (and has been done in the past)
- A message pipe connects Core Data to Export Services and/or Rules Engine
  - Uses ZeroMQ by default
  - Allow use of MQTT as alternate if broker is provided
- Uses open source technology where appropriate
  - Ex: Consul for configuration/registry, Kong for reverse proxy, Drools for rules engine,...



{ REST }



ØMQ



# Key Project Links

Access the code:

<https://github.com/edgexfoundry>

Access the technical documentation:

<https://docs.edgexfoundry.org/>

Access technical video tutorials:

<https://wiki.edgexfoundry.org/display/FA/EdgeX+Tech+Talks>

EdgeX Blog:

<https://www.edgexfoundry.org/news/blog/>

Join an email distribution:

<https://lists.edgexfoundry.org/mailman/listinfo>

Join the Rocket Chat:

<https://chat.edgexfoundry.org/home>

Become a project member:

<https://www.edgexfoundry.org/about/members/join/>

LinkedIn:

<https://www.linkedin.com/company/edgexfoundry/>

Twitter:

<https://twitter.com/EdgeXFoundry>

Youtube:

<https://www.youtube.com/edgexfoundry>

# What's with the 'X'?

- Fundamental goal of the EdgeX project is to provide a stable, product-quality open source foundation for interoperable commercial offers
- The 'X' in EdgeX allows the project name to be trademarked for use as a certification mark
- A certification program will be established in the project for commercial offerings to verify that key EdgeX interoperability APIs were maintained alongside proprietary value-add
- Initial program launch targeted for 'Delhi' release (~ Oct 2018) with ramp in 2019
- Stability for key elements (e.g. core APIs and certification process) is maintained through the EdgeX Technical Steering Committee (TSC) and clear versioning system
- Licensed under Apache 2.0, anyone can leverage the EdgeX code base as a foundation for their commercial offerings
- Can be a full EdgeX-compliant IoT platform, value-added plug-in micro service(s) or a services model

# Engagement Options

- Project is a technical meritocracy.
  - Anyone can contribute to or use the EdgeX Foundry code for free.
- Technical Steering Committee (TSC) and Working Group (WG) meetings are open to the public
- TSC and WG Chairs in addition to code committers and maintainers are voted in based on technical acumen and alignment to project tenets.
  - This ensures robustness and stability in the architecture, technology choices, roadmap and code base.
- Joining as a paid project member affords maximum influence over project direction

# Member Benefits

- Additional influence to shape the overall platform architecture to enable commercialization needs
- Recognition for Industry thought and technology leadership
- Marketing and networking within the EdgeX Project for business opportunities (effectively a vendor-neutral partner program)
- Discounted sponsorships at Linux Foundation and EdgeX Foundry-produced events (e.g. trade shows, hackathons, etc.)
- Learning and engagement

# EdgeX Foundry Governance Structure

EDGE X FOUNDRY MEMBER COMPANIES (60+)

## GOVERNING BOARD (GB)

*Composed of appointed and elected individuals; manages the business of the EdgeX Foundry.*

## TECHNICAL STEERING COMMITTEE (TSC)

*Leads the technical work of EdgeX Foundry. Oversees and aligns working groups.*

WG

WG

WG

WG

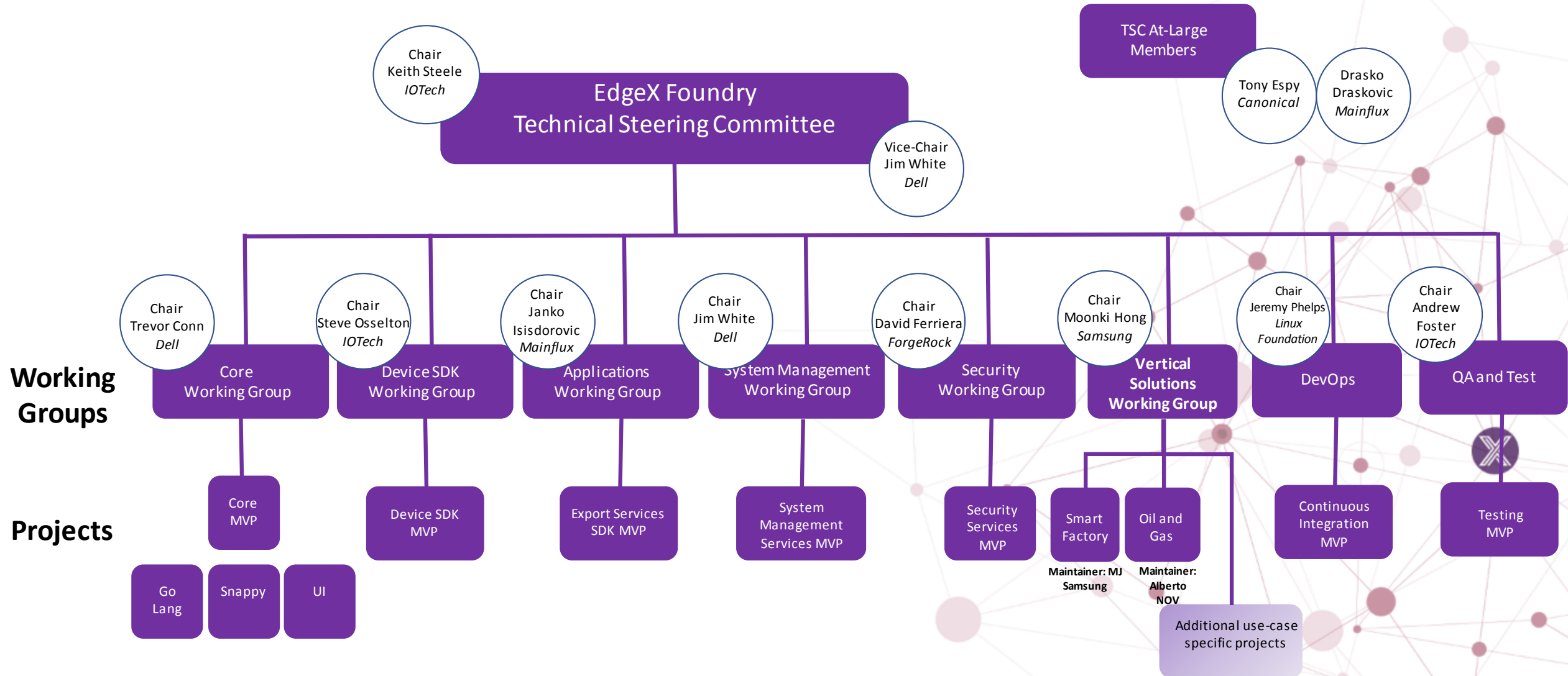
WG

## CERTIFICATION COMMITTEE

*Develops and oversees the certification program for EdgeX Certified components.*

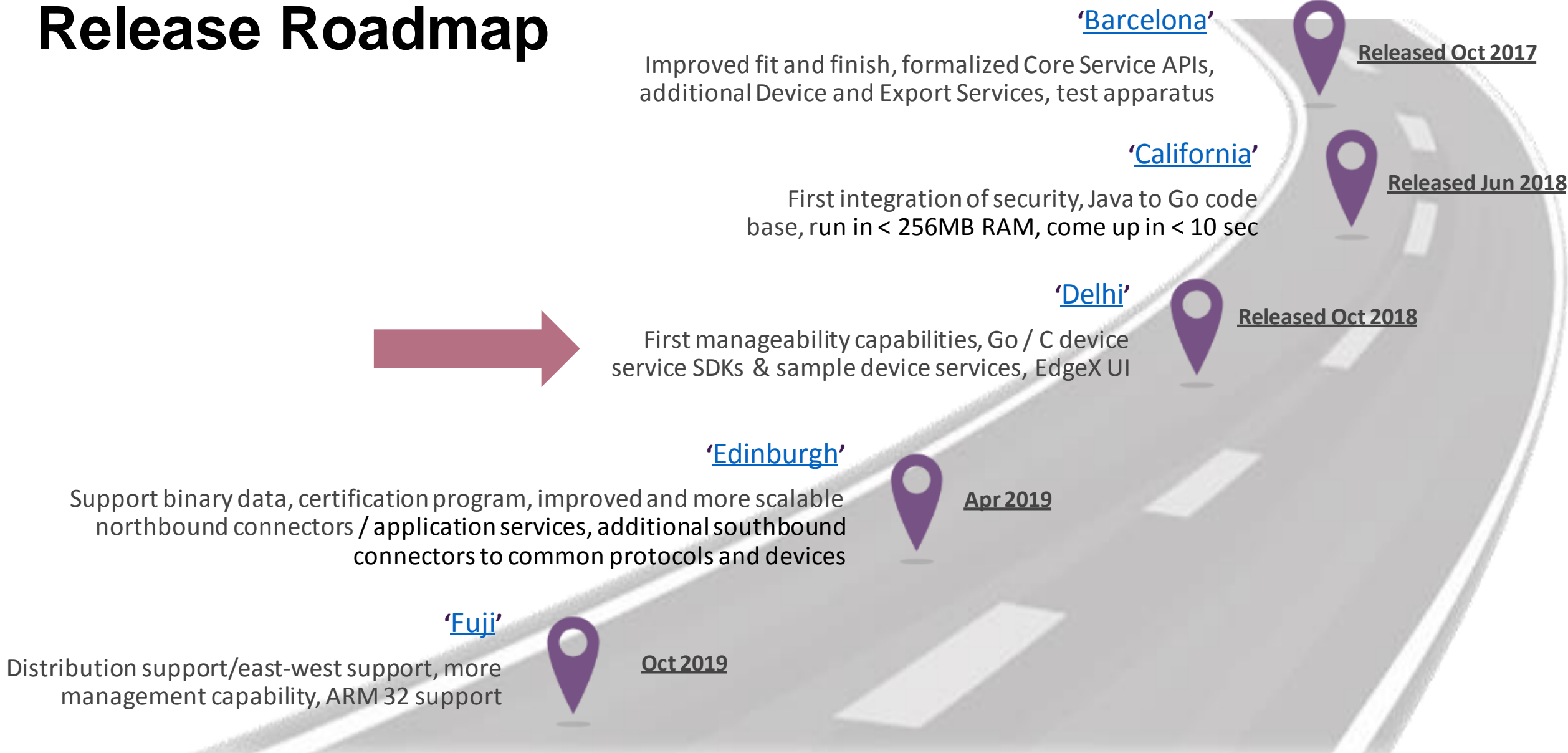
LF SUPPORT TEAM

# EdgeX Project Organization





# Release Roadmap



# Delhi Release - Major Themes & Objectives

- Released October 2018
- High level scope
  - Initial System Management APIs and agent
  - Device Service SDKs (Go/C) and some example device services
  - The next wave of security features (access control lists to grant access to appropriate services, and improved security bootstrapping, ...\_
  - Improve testing (better/more unit, complete black box testing)
  - Refactored and improved Go Lang micro services
  - An EdgeX UI suitable for demos and smaller installations

# Edinburgh Release – Major Themes & Objectives

- Releasing April 2019
- Ratified during EdgeX TSC Face-to-Face meetings in UK, Nov 2018
- High level scope
  - Improved on-boarding for EdgeX Users (docs, tutorials, dev kits, etc.)
  - Support of ingestion, use, export of binary data (via CBOR format)
  - Automate performance testing, automate security testing
  - Add many device services (improving out-of-the-box southbound connectivity)
  - Provide application services – a more scalable and flexible exportation capability (eventually replacing the existing export services)
  - Refactor database-using services to be more loosely coupled to the persistence mechanism (allow for use of alternative persistence stores and technologies in future releases)
  - Outline a certification program for micro service drop in replacements

# Fuji Release – Anticipated Major Themes & Objectives

- Releasing October 2019
- To be ratified during EdgeX TSC Face-to-Face meetings in Seoul, April 2019
- Anticipated high level scope
  - Better distribution support, initial east/west support (load balancing, service failover, dynamic workload allocation, etc.)
  - System management control plane extensions via alternate protocols
  - System management alerts/notifications
  - Support to securely provisioning new devices/sensors
  - Securing service to service communications with AuthN/AuthZ
  - Dynamic configuration, configuration testing
  - Improve application services and expanded north side connectivity
  - Official Arm 32 Support and Windows development support

EDGE X FOUNDRY™

Thank You

james\_white2@dell.com

