Virtualization: Implementing for Grid Operations

Wade P. Malcolm, P.E.

March 3, 2020

Open Energy Solutions Inc. (OES)

- The primary focus of OES is to facilitate advanced technology transfer through providing professional and development services for regulated and unregulated energy suppliers and their customers
- OES was founded in December 2016, and is headquartered in Santa Clara, California with offices in:
  - Spokane, WA
  - Belmont, NC
  - and additional staff located throughout the United States

Implementing Virtualization

- OpenDSP (Open Distributed Systems Platform – working name) is a collaborative effort led by utilities to develop a real-time operational technology (OT) platform
- OpenDSP characteristics:
  - Can manage the operation of both utility and customer assets allowing for new service and revenue opportunities
  - Leveraging distributed intelligence (DI) and grid edge interoperability facilitating interaction with all vendor equipment and software
  - Delivered as an Open Source core with a mix of proprietary and open extensions
  - Built upon other open source applications
- Creating an "Energy Operating System"
- Broad market support to share cost and risk

May 2019 T&D World

Avista Utilities and Duke Energy partner to create an energy operating system available to the entire utility industry.

By **Curtis Kirkeby**, Avista Utilities Inc., and **Stuart Laval**, Duke Energy Corp.

The electric utility industry is increasingly challenged by external drivers such as regulatory obligations and mandates as well as competitors who want to disintermediate utility customers from their current energy provider. Distribution system operator (DSO) models and aggregator participation are challenging the status quo for utility business models.

The utility industry must navigate these changes and help to shape the new business models while still providing safe, reliable and affordable energy to customers. At the same time, customer participation should be empowered, so there is reasonable influence on the type of resource consumed, the location of the resource, and who provides the energy. This is extremely challenging to support with a typical utility's portfolio of operating technologies.

Duke Energy Mount Holly, NC Microgrid Site.

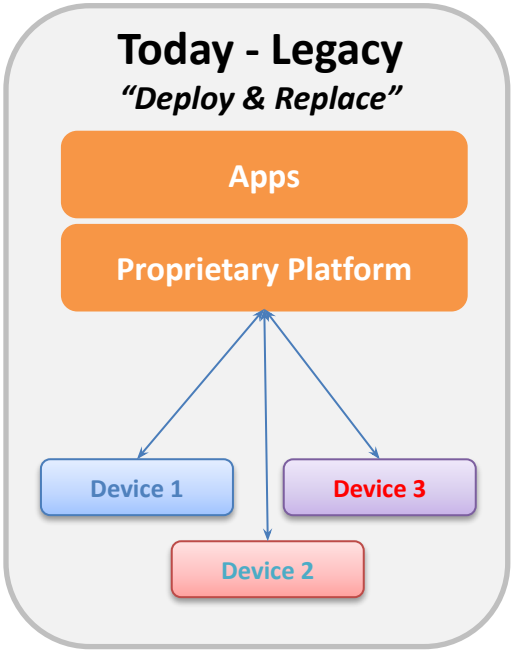
May 2019 | T&D World 49

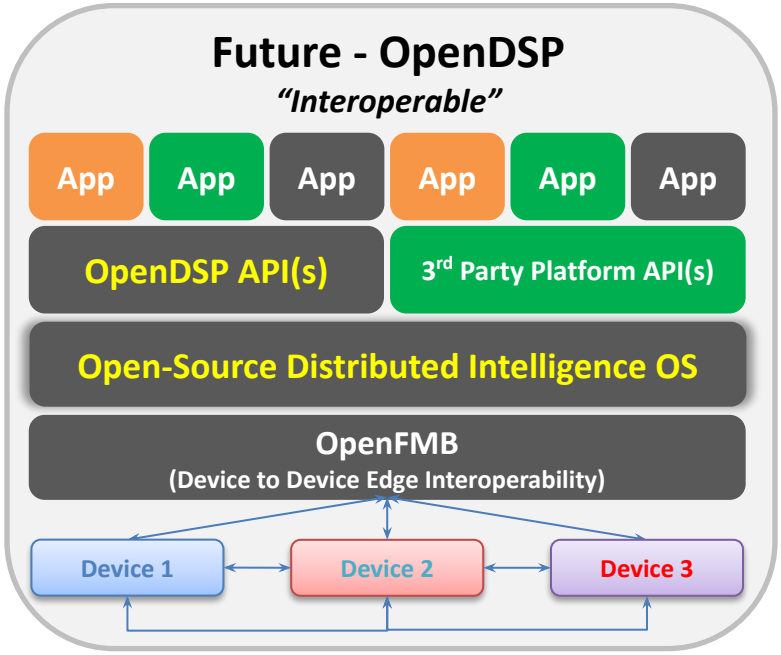
Also see: https://utilityanalytics.com/2019/06/utilities-collaborate-on-open-source-software/

Legacy vs OpenDSP Platforms

Legend

Vendor-specific | 3rd Party | Open-Source





"Analogies"

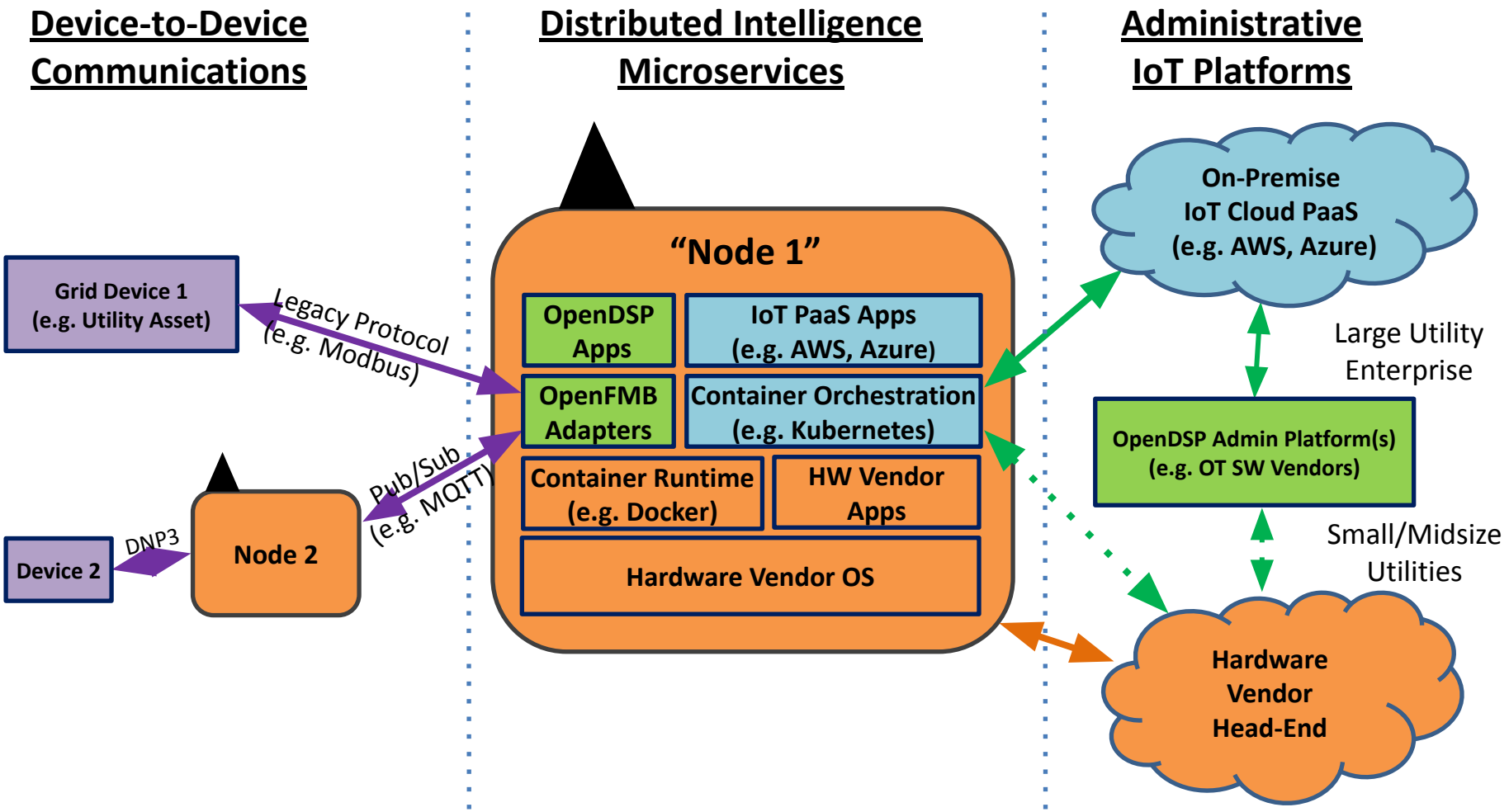
redhat. Google Play Linux android USB Enabling Connections™ API

Today's platforms and applications are typically proprietary and cannot talk to each other easily

The future is interoperable and open-source leading to greater value for all participants

SOURCES: DUKE ENERGY AND OES ANALYSES

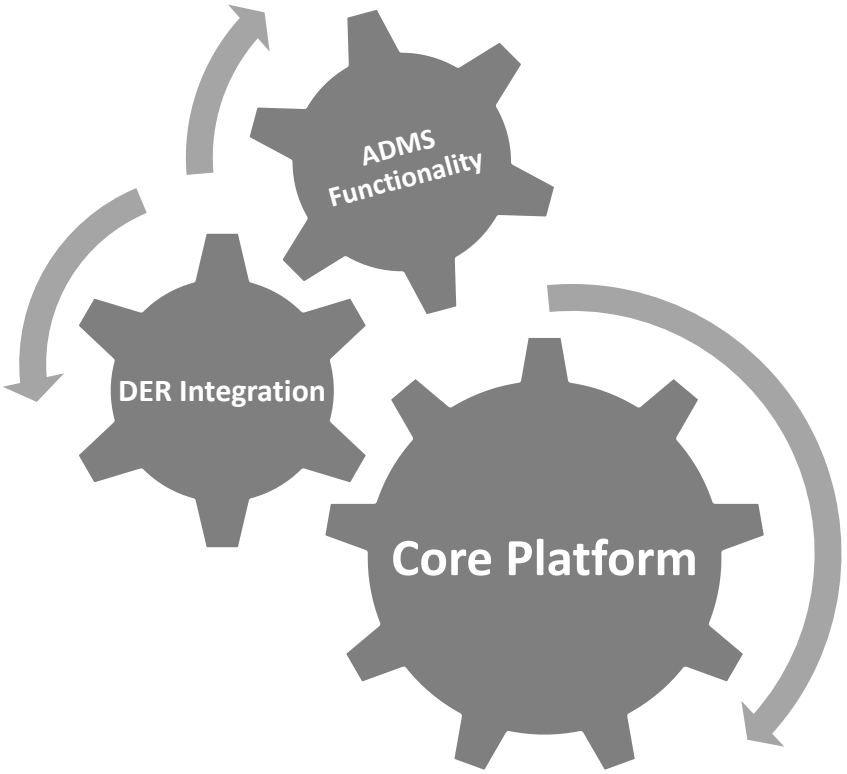
Co-existence of Multiple IoT Platforms



SOURCES: DUKE ENERGY AND OES ANALYSES

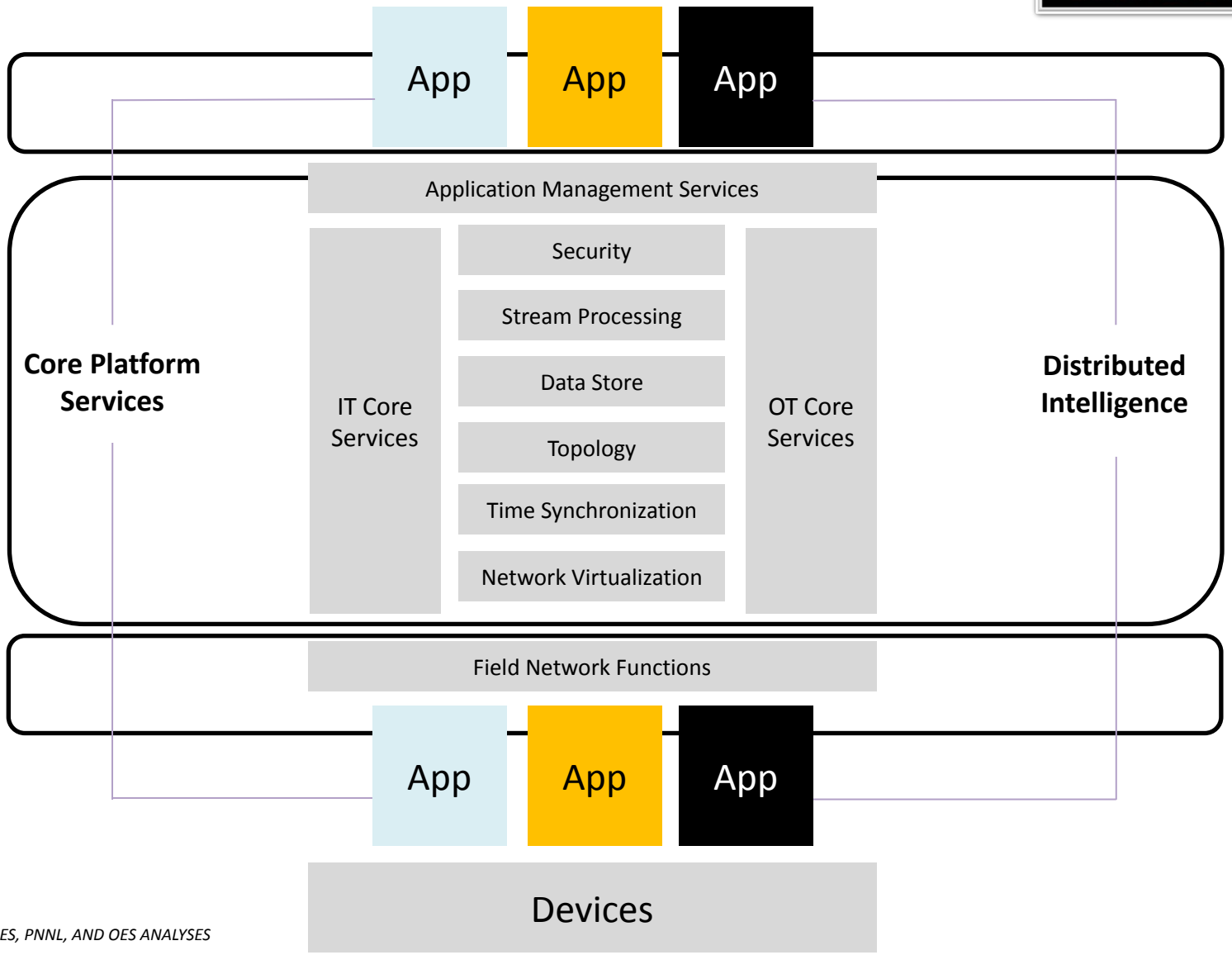
OpenDSP Initial Areas of Emphasis

- OpenDSP will be designed to support a broad array of energy related operations
- The initial use cases for demo will focus on:
  - DER Integration – Utilizing distributed intelligence to augment traditional approaches
  - ADMS Functionality – To augment and/or replace existing DSCADA, DMS or other operational systems



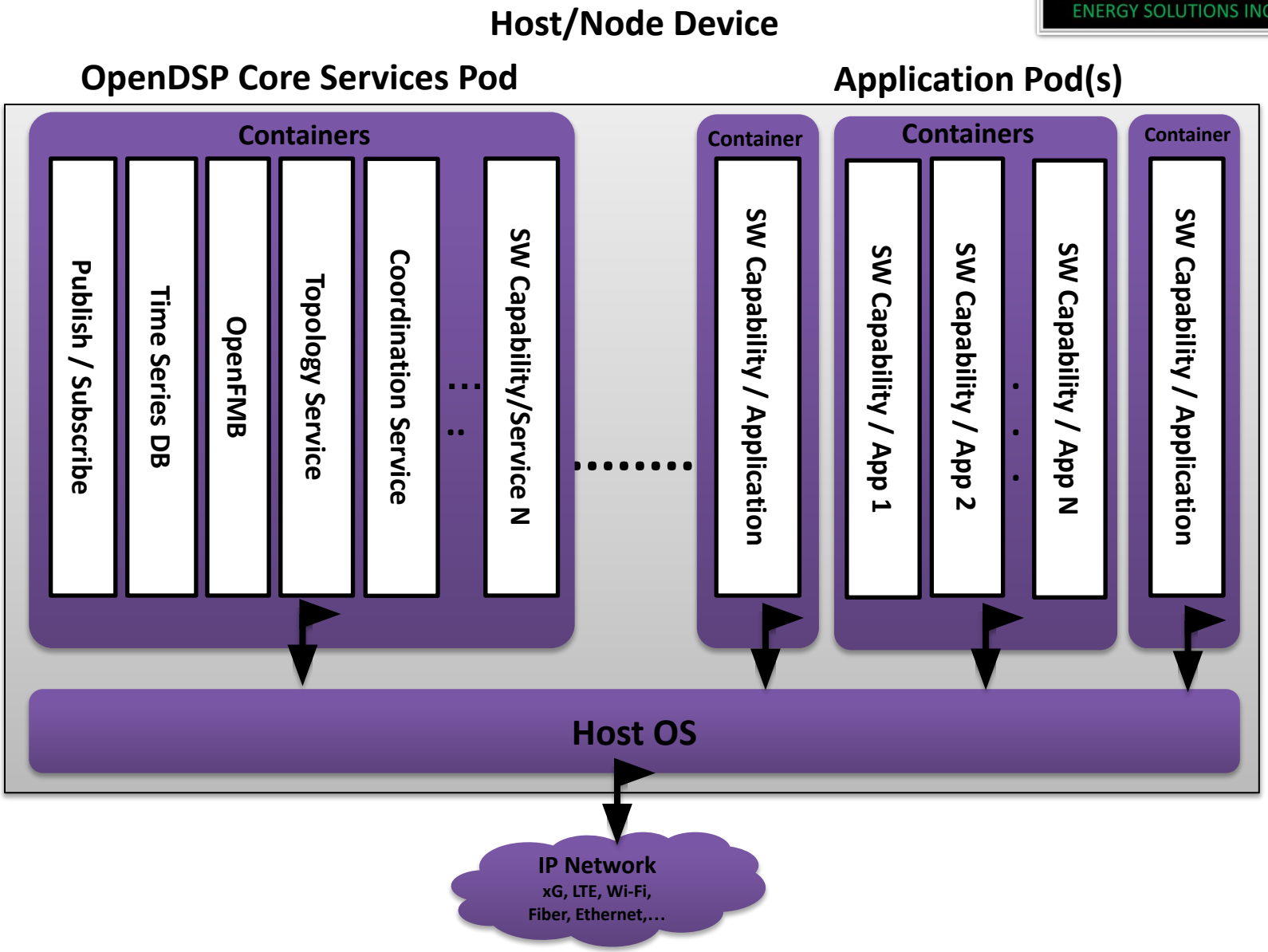
SOURCES: AVISTA UTILITIES, DUKE ENERGY AND OES ANALYSES

OpenDSP General Logical Architecture



SOURCES: AVISTA UTILITIES, PNNL, AND OES ANALYSES

OpenDSP Grid Node Architecture



OpenDSP System Architecture

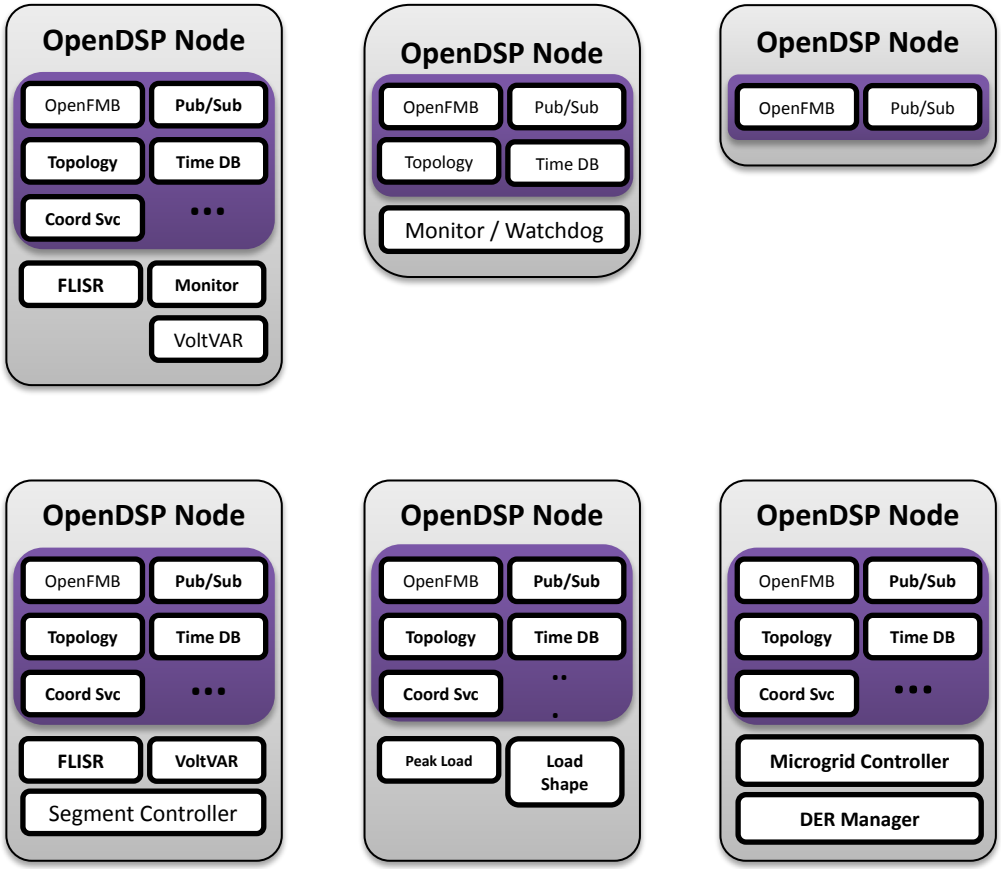
Central Config, Deploy, and View
Dynamic Variable Control!

Dynamic Node Configurations

OpenDSP Back Office "Genesis Node"
- OpenDSP Node Manager
- Deployment Management
- Topology Model
- Asset Management
- Integration Hub (CIM)
- Pub / Sub Node
- Security

OpenDSP Enabled Central Applications

ADMS	Outage
DERMS	AMI
PI	Other …



OpenDSP Concepts

- Bringing the IoT pattern to the grid (GoT)
- Incorporating / building on and around standards (e.g. OpenFMB, CIM, IEC61850, etc.)…
- Enable applications to run on any “smart” edge node / device
- Enable distributed topology (as designed / as operating)
- Enable pushing distributed intelligence closer to the edge
- Support multiple OT architectures from centralized to fully distributed
- Enable interoperability of grid devices
- Implement Laminar Coordination Framework (DOE & PNNL)
- Encourage grid application innovation (internal application stores)
- Building toward automated discovery of devices and capabilities (USB Pattern)

Virtualization Technologies Used

- Rancher / K3s
  - Utilizes Kubernetes to coordinate running containers between multiple discrete physical nodes
  - A fully compliant Kubernetes distribution built for IoT & edge computing
- Kubernetes
  - Orchestration software that provides an API to control how and where those containers will run
  - It allows you to run Docker containers and workloads and helps to tackle some of the operating complexities when moving to scale multiple containers, deployed across multiple servers
- Docker
  - Underlying container runtime and file format for automating the deployment of applications as portable, self-sufficient containers that can run in the cloud or on-premises

Sources:
https://en.wikipedia.org/wiki/Rancher_Labs
https://azure.microsoft.com/en-us/topic/kubernetes-vs-docker/

Virtualization Challenges for Grid Operations

- Incompatible “ecosystems”
- The rapid pace virtualization technology evolution
- The viability of commercial cloud offerings at the grid edge
- The “size” of virtualization technology and the realities of the grid edge
- General lack of applications

Thank You!