Ground System Architectures Workshop

Session 11C

# The Trajectory of the GSAW Cloud Computing Working Group: 10 Years and Counting

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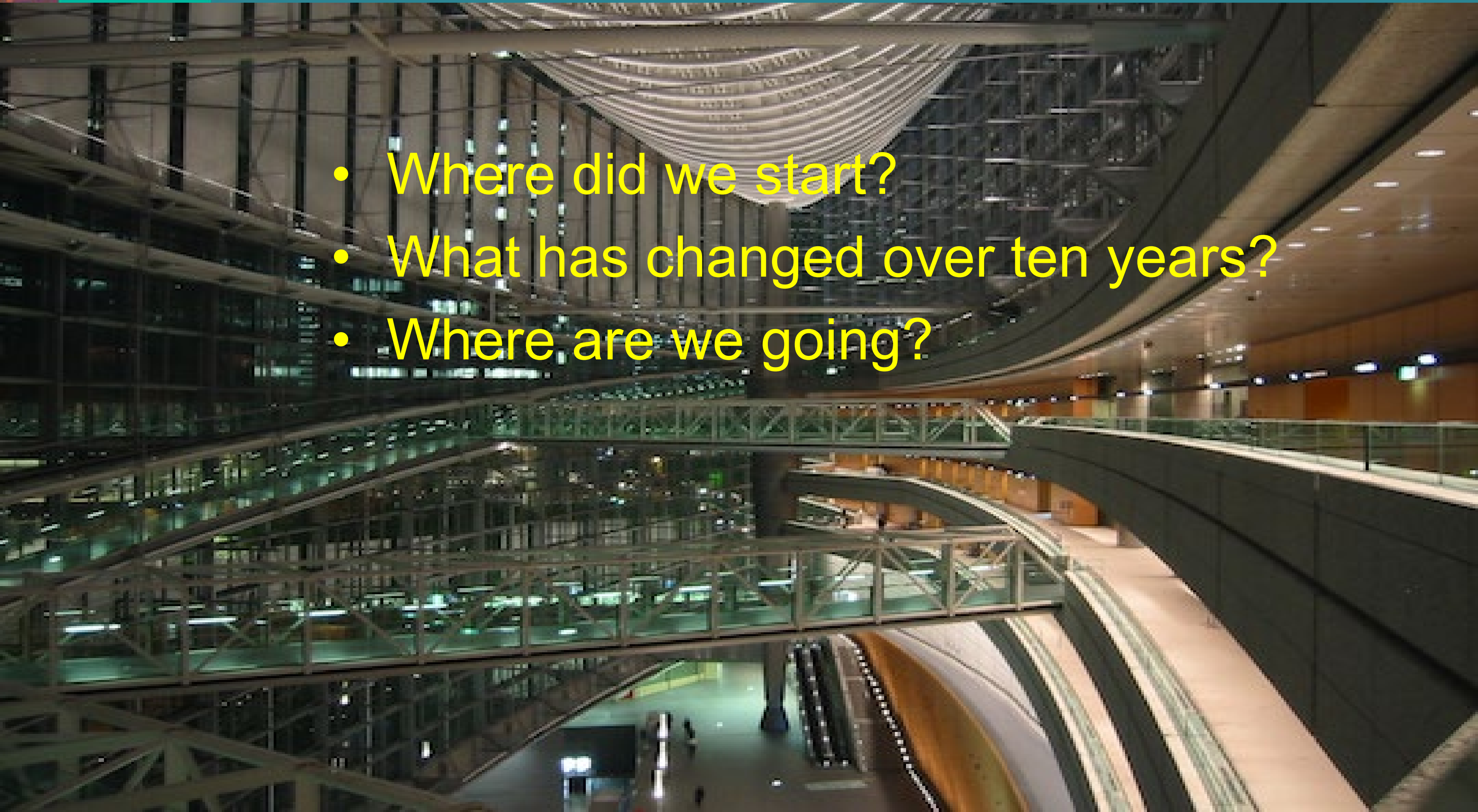
# We’ve Been at It for Ten Years!



- Where did we start?
- What has changed over ten years?
- Where are we going?

# A Very Short History

2011 (I)
- Business Case and strategy needs to be refined
- Cloud standards are needed

2012 (II)
- Private Clouds
- Distributed Clouds
- Crossing Trust Boundaries -- Inter-Clouds

2013 (III)
- Security and Trust
- Technology is not the only problem

2014 (IV)
- SLAs for cloud
- Distinction between Public and Private cloud

2015 (V)
- Use cloud where it make sense: cost, reliability, performance
- Issues: data security, governance, org. barriers

2016 (VI)
- Containers and Microservices
- Config. Management: Chef, Puppet, Ansible
- Service Migration: re-host, re-factor, re-build

2017 (VII)
- Big Data, Containers, Microservice Architectures
- Cloud Adoption/Migration

2018 (VIII)
- Ground systems will no longer be monolithic
- They will be conglomerates of open source tools, containers, micro-services, etc.
- Mission and organizational boundaries will software-defined

2019 (IX)
- First time "Big Data" officially in the title
- Expands workshop scope to data-centricity
- Established processes and policies can be impediments

# So Where Are We Going?

***Can We Identify Some Destinations?***

# Trends

- Diversification up the stack
  - Everything is on-demand -- even *Ground System-as-a-Service*
    - CSPs provide back-haul!
    - CSPs are already operating global Content Distribution Networks (CDNs) with huge back-bone networks connecting their data centers
- Cloud Migration should involve a refactoring of the system arch
  - Migration Approaches: Lift-n-Shift, Green Field, Re-factoring
  - Service Identification
  - Enable more of a uService approach
- System design is much more than just the plumbing
  - *Security Architecture* must be a first-class citizen in the design process
- Cloud Design Patterns
  - Many are *data-access-oriented*
  - Many depend on some type of *API Gateway* or *Policy Enforcement Point*

# Data-Centric Architectures: The NIST Big Data Reference Architecture

- Data does not "live in" any one application
- Data is available to all applications

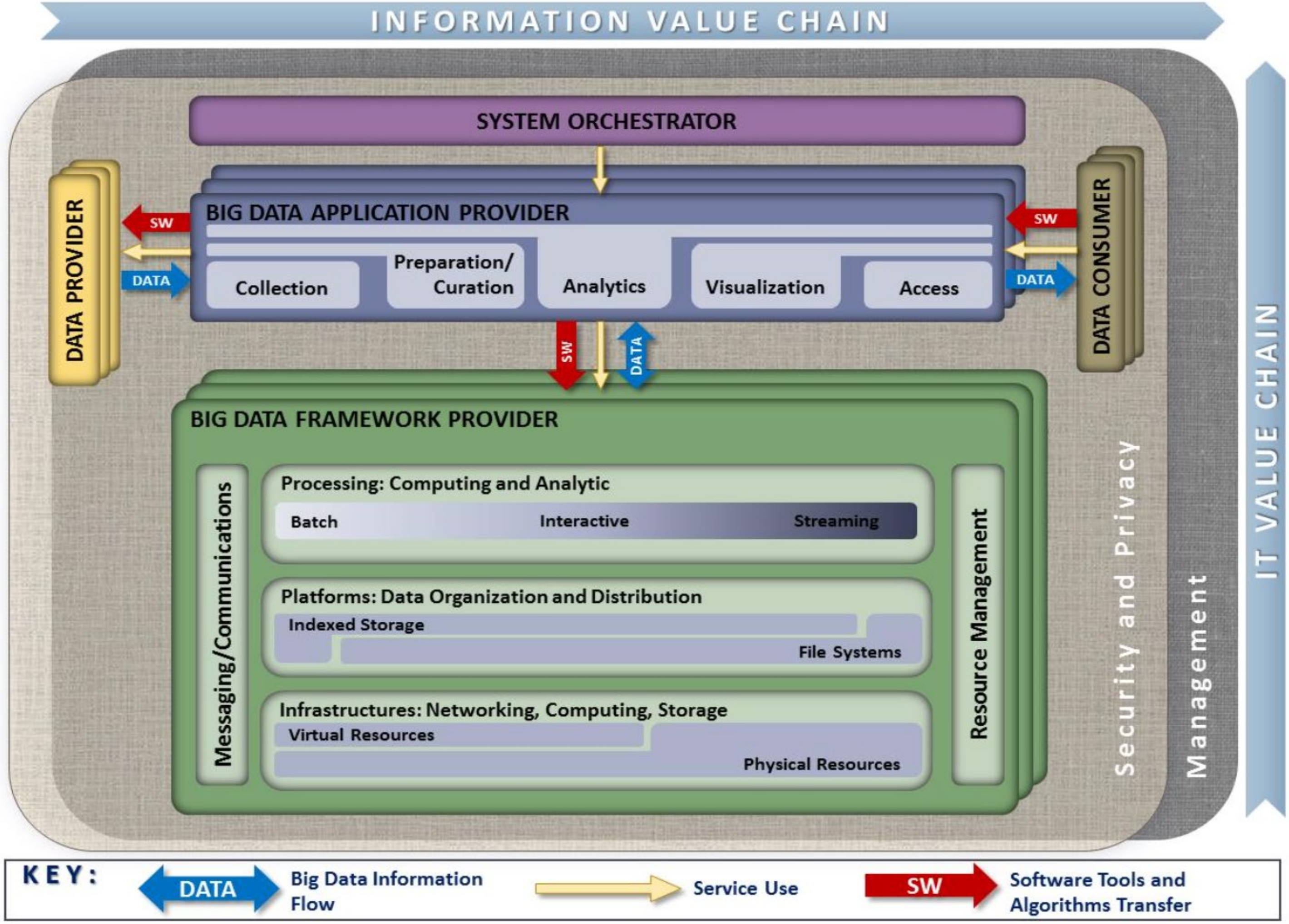


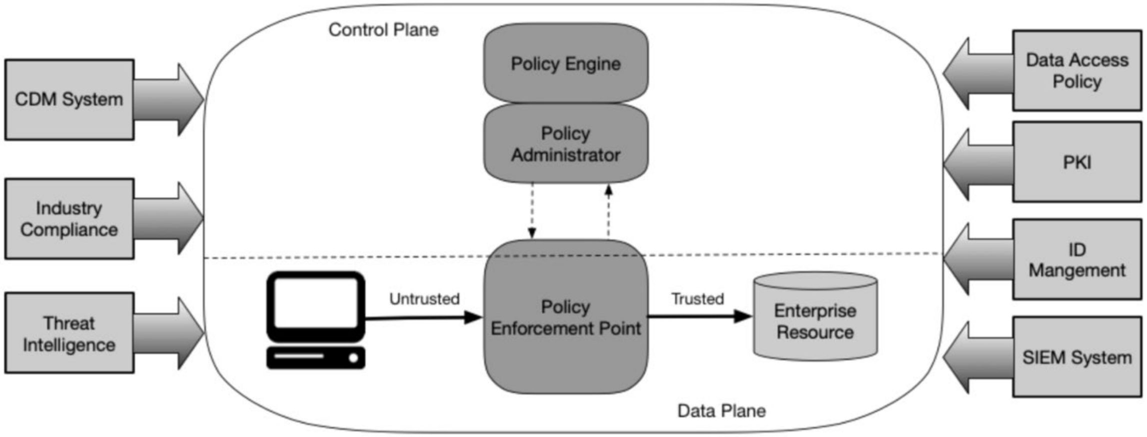
Figure 2 from *NIST Big Data Interoperability Framework*, NIST SP 1500, Version 2, Volume 6r1 (of nine volumes).

http://bigdataws.nist.gov

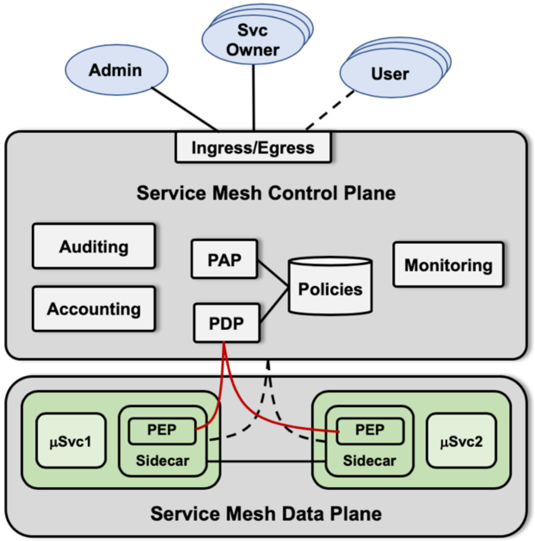
# Zero Trust Architectures and Microservice Mesh Architectures

- ZTAs based on minimizing *Trust Zones*
  - A Trust Zone is a zone of *implicit trust*

- uService Mesh Architecture is a promising ZTA approach
  - uServices are deployed in *side-cars* that include a PEP



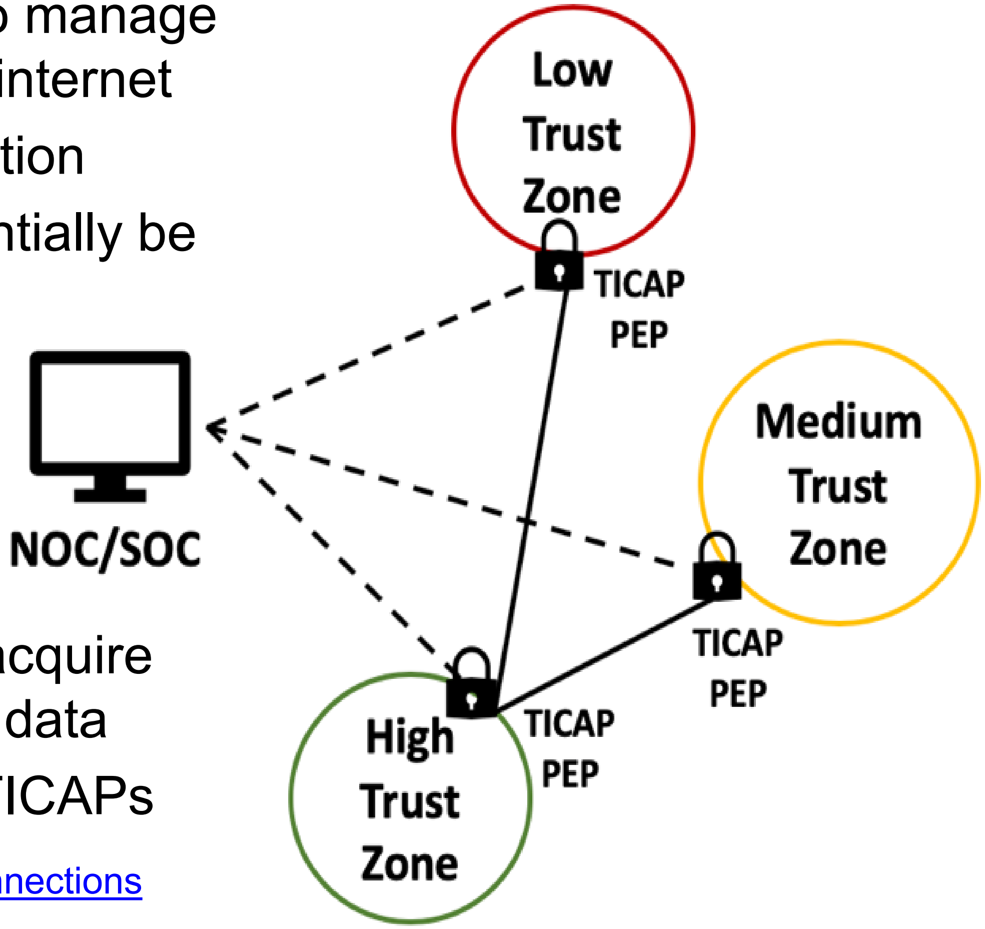
Rose, et al., *Zero Trust Architecture*, NIST SP 800-207, September 2019.



Chandramouli and Butcher, *Building Secure Microservice-Based Applications Using Service-Mesh Architecture*, Draft NIST SP 800-204A, January 2020.

# Trusted Internet Connections (TIC) TIC Access Points (TICAPs)

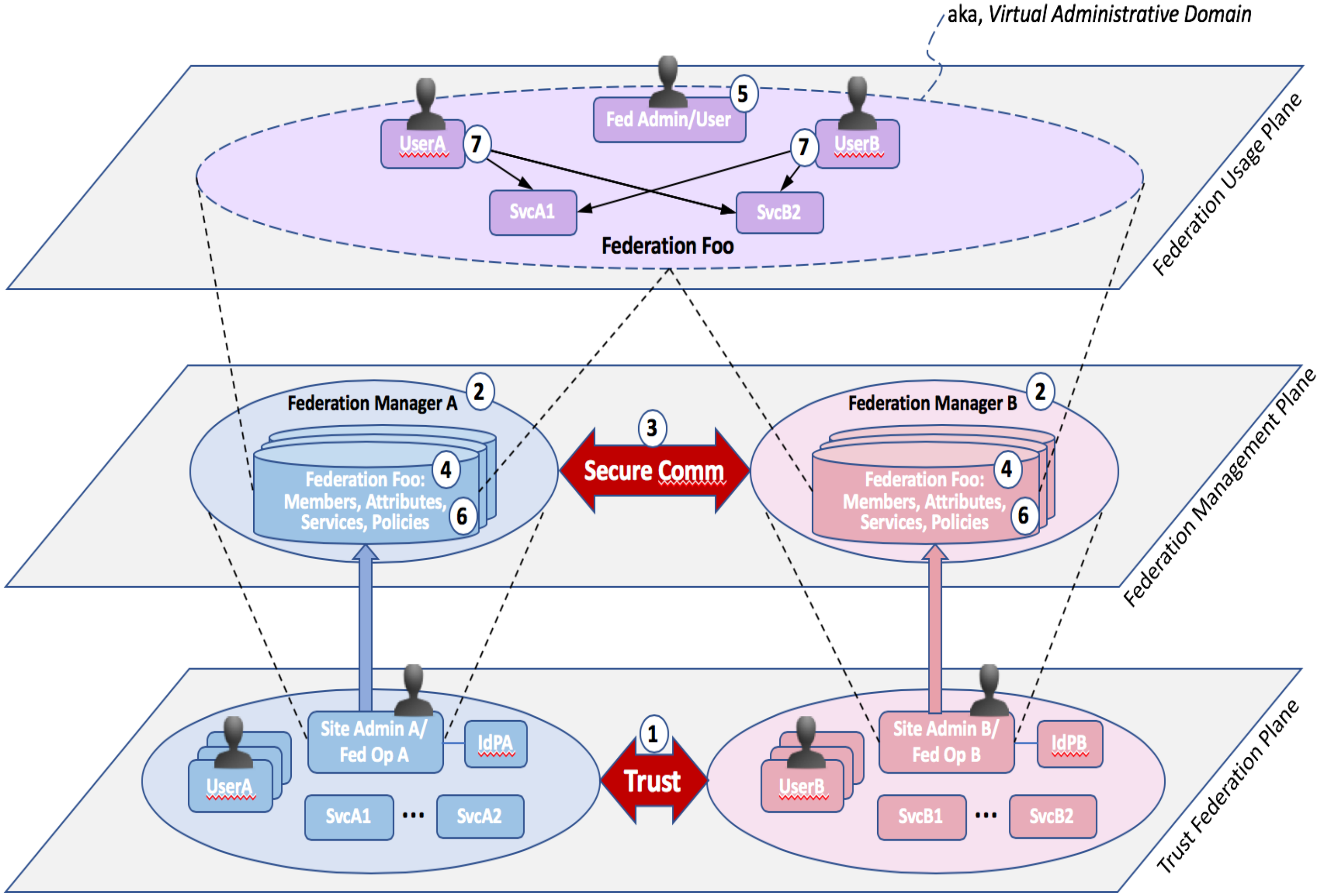
- TIC developed in pre-cloud era to manage how USG system connect to the internet
  - Based on hardware configuration
- TIC 3.0 being developed to essentially be *cloud-native*
  - TICAP *Policy Enforcement Points (PEPs)* will manage distributed *trust zones*
- Example: NOAA N-Wave
  - Global backbone network to acquire massive weather and climate data
  - Enters through five CONUS TICAPs



https://www.cisa.gov/trusted-internet-connections

# The NIST Cloud Federation Reference Architecture

- CFRA explicitly addresses managing *system boundaries*
- Central Concept: *Virtual Administrative Domains*
- Implementations can use *API Gateways*
- CFRA organizes the entire federation design space
- Identifies range of deployment and governance models



https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.500-332.pdf
Digital Object Identifier: https://doi.org/10.6028/NIST.SP.500-332

# Final Observations

As systems move to the cloud, all management and security boundaries will have to be *software-defined*

These boundaries will all be defined by how identity, credentials, roles, attributes, resource discovery and access policies are managed

These requirements are shared by many system design approaches

The organizational and economic issues will be more difficult than the technical issues

It's not a question of if -- but when and how