

# Digital IF Enabled SATCOM Gateway Site Architectures for Networking and Management Automation

Monday October 30, 2023

**James Carter**  
Network Engineer, PdM WESS

**A.J. Vigil, Ph.D., P.E.**  
Senior Scientist, System

**Dave Khalil**  
Lead Systems Engineer, PdM WESS

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

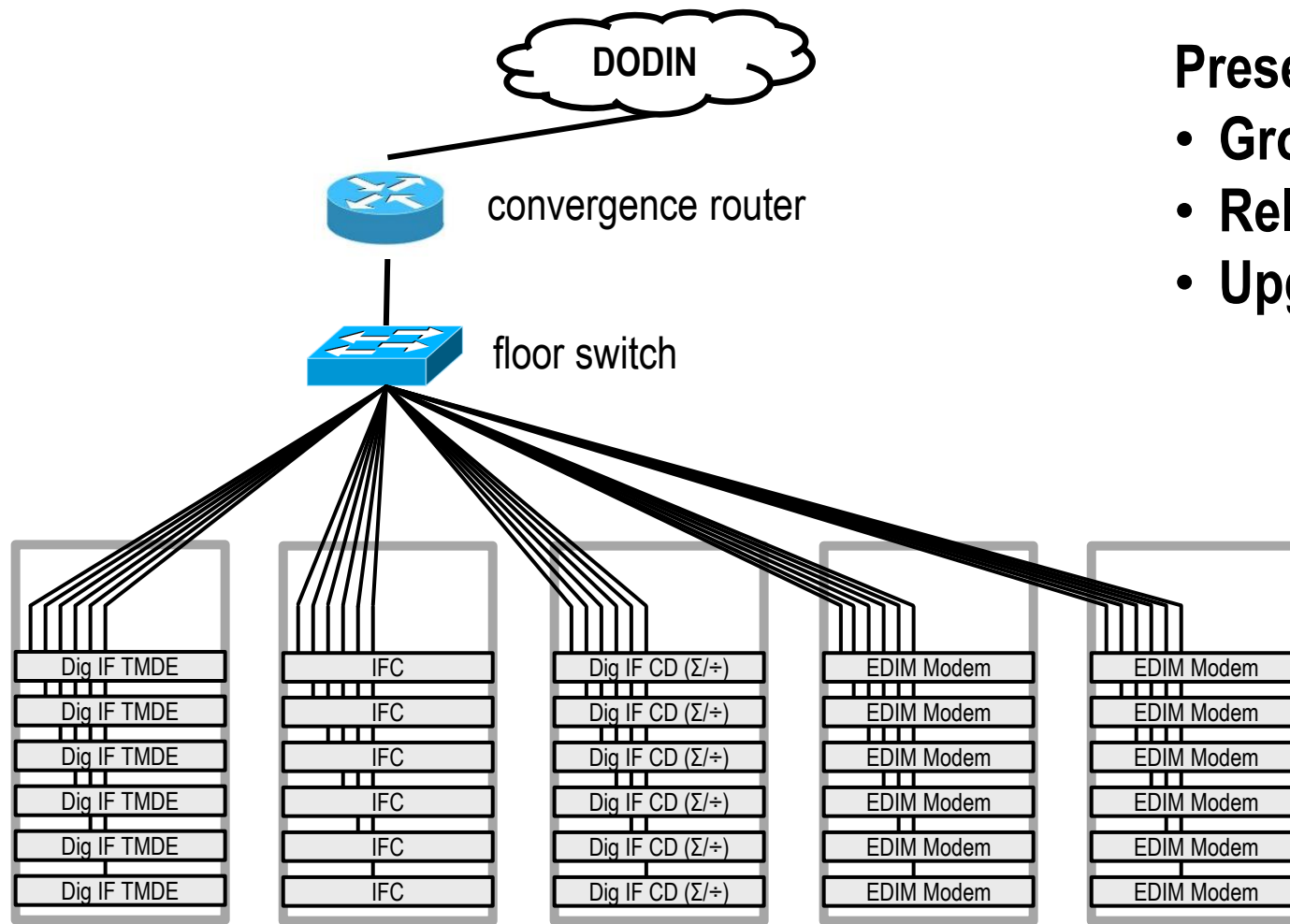
## DIFI PlugFest – Model for DOD SATCOM Gateways



|  | DIFI PlugFest   | DOD SATCOM Gateways  |
|--|---|--|
| <b>High Speed Switching Infrastructure</b> | “No swapping cables”  | Digital IF needs to be deployed into a preexisting network architecture.     |
| <b>M&amp;C Automation</b>                  | Abstract user interface;<br>Easy multicasting;<br>No command line switch mgmt | Digital IF needs to be deployed into preexisting M&C automation.             |
| <b>Both</b>                                | “Couldn’t have finished that week without them”                               | Both are prerequisites for Digital IF. Digital IF does not happen otherwise. |

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Networking Approach: Single Switch as a Starting Point



### Present Architecture Limits:

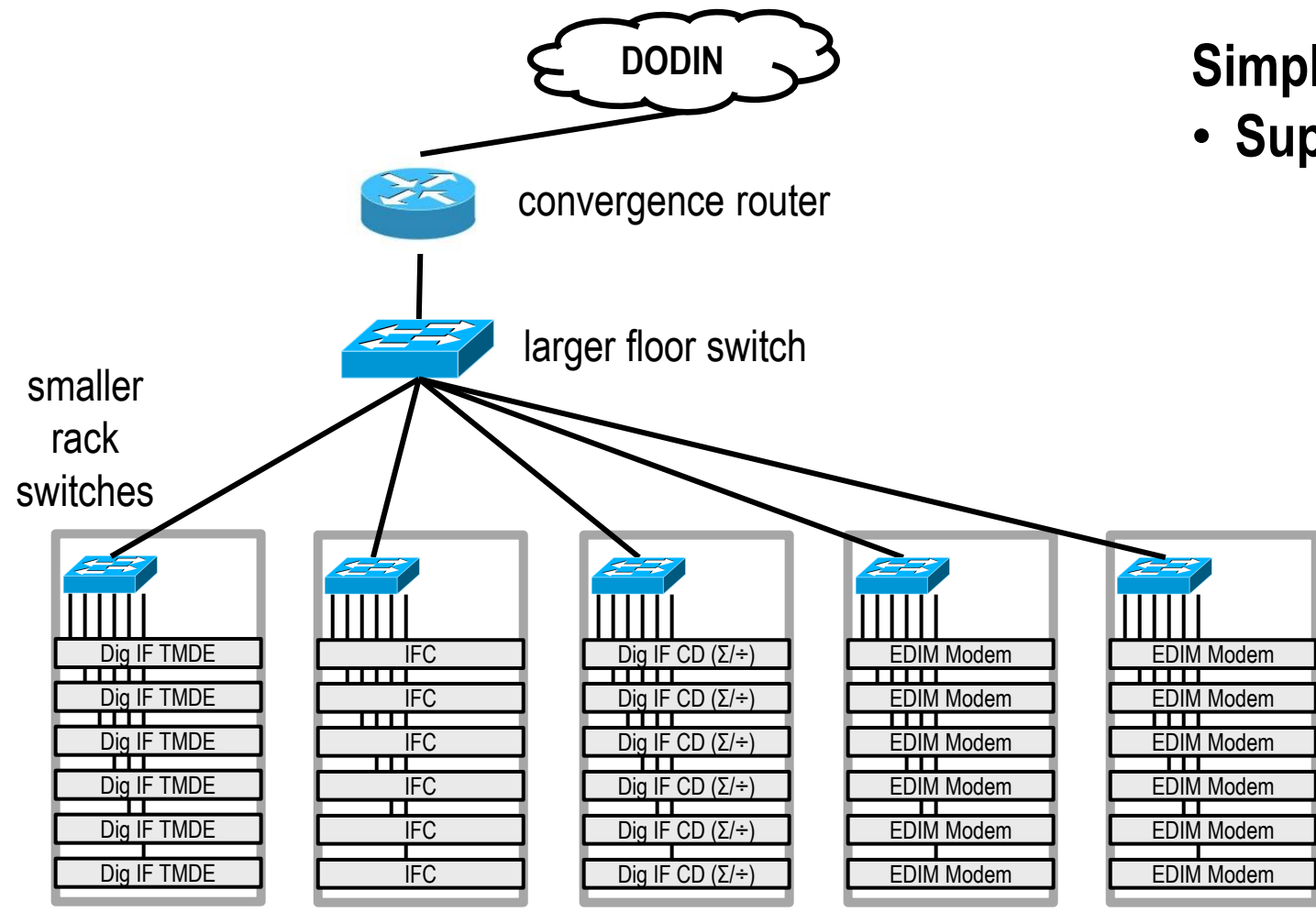
- Growth
- Reliability
- Upgrades without ASIs

\*Digital IF equipment functions are notional as indicated

**Present architecture does not yet support growth or reliability**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Networking Approach: Hierarchical Architecture to Grow With



**Simple Hierarchical Architecture:**

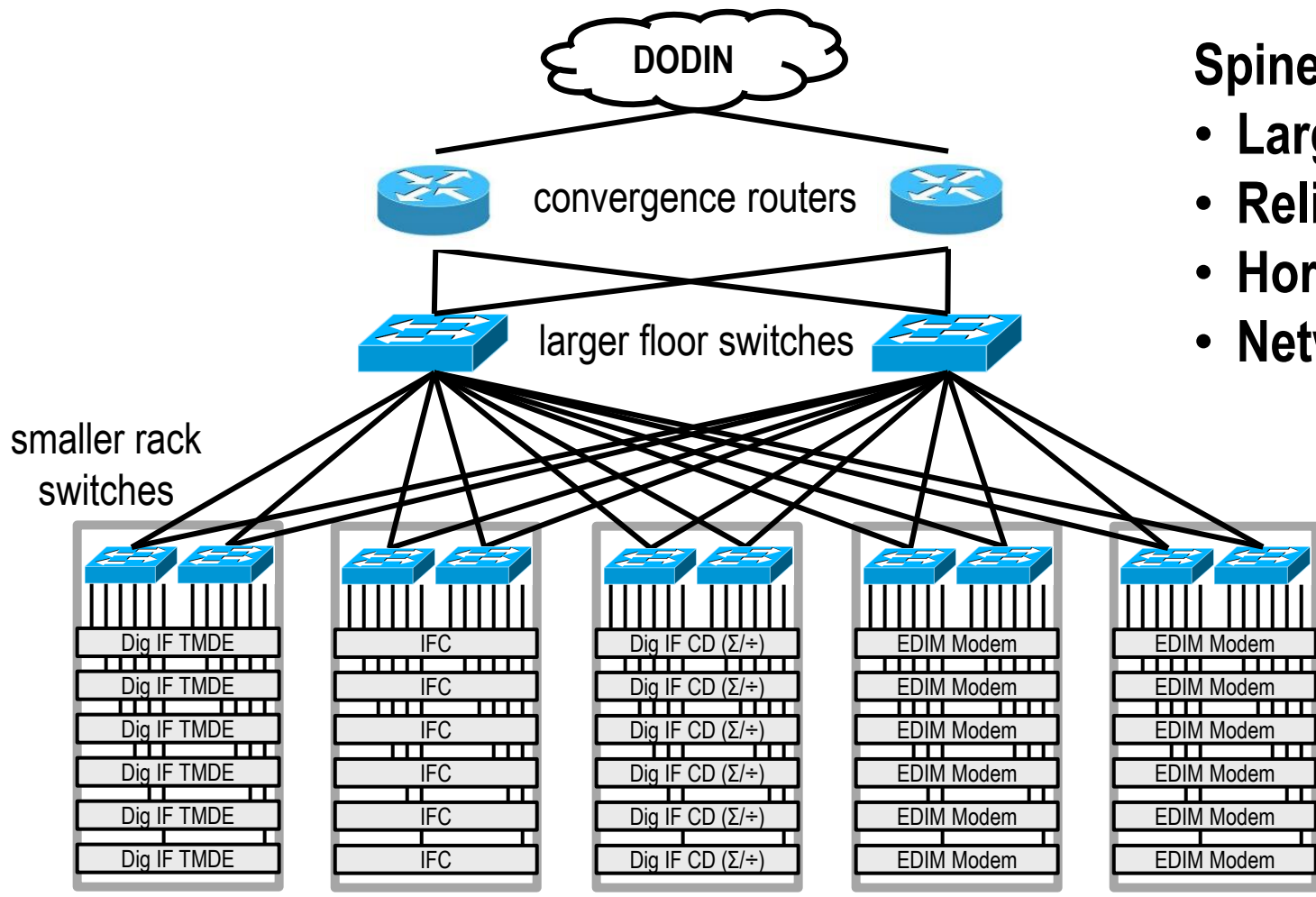
- Supports Larger Networks

\*Digital IF equipment functions are notional as indicated

**Simple hierarchical architecture supports growth, but not reliability**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Networking Approach: Spine-Leaf Architecture for Resilience & Reliability



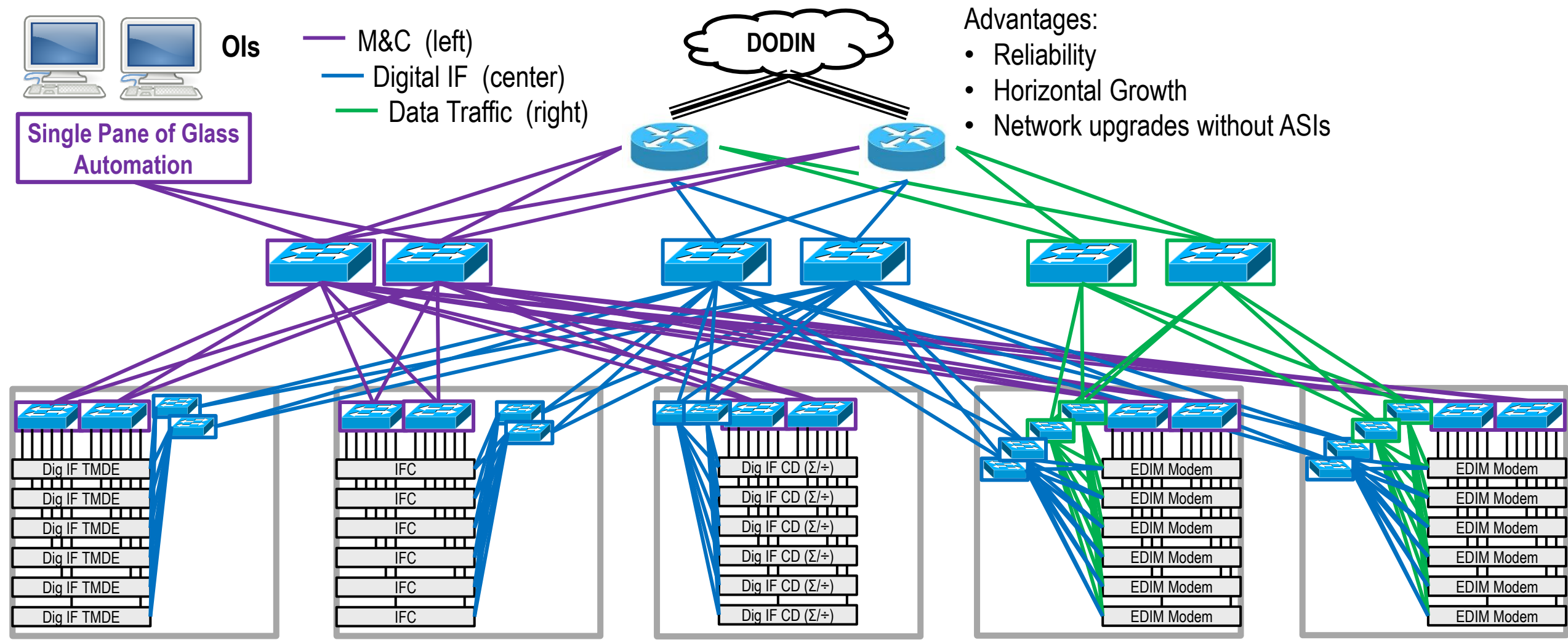
- Spine-Leaf Architecture Supports:**
- Larger Networks
  - Reliability
  - Horizontal Growth
  - Network upgrades without ASIs

\*Digital IF equipment functions are notional as indicated

**Spine-leaf architecture can support growth, reliability, and cybersecurity**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Networking Approach: Cybersecurity via Spine-Leaf Network Isolation



**Isolation of M&C, Data Traffic, & Digital IF Networks for Cybersecurity; Each Spine-Leaf for Capacity and Reliability**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## DOD SATCOM Gateway Networking Concept



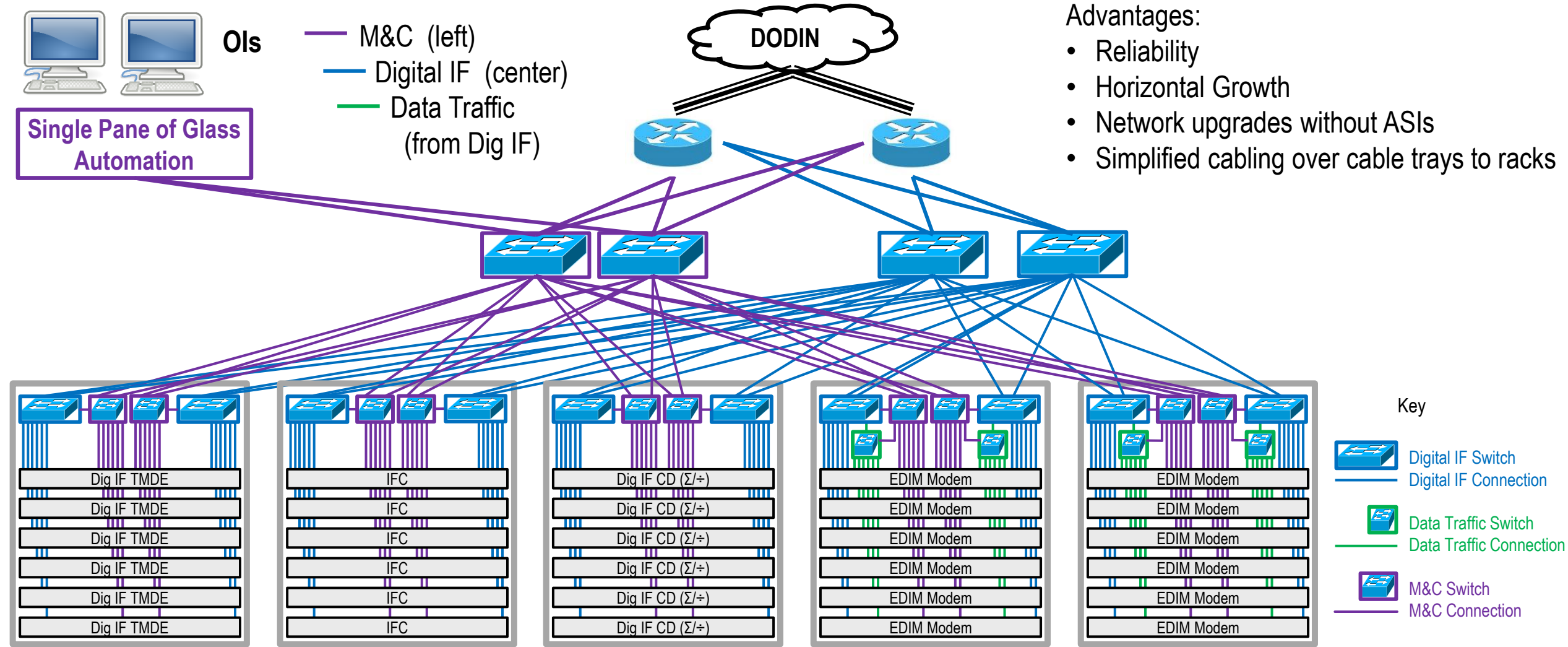
OIs

Single Pane of Glass Automation

- M&C (left)
- Digital IF (center)
- Data Traffic (from Dig IF)

Advantages:

- Reliability
- Horizontal Growth
- Network upgrades without ASIs
- Simplified cabling over cable trays to racks



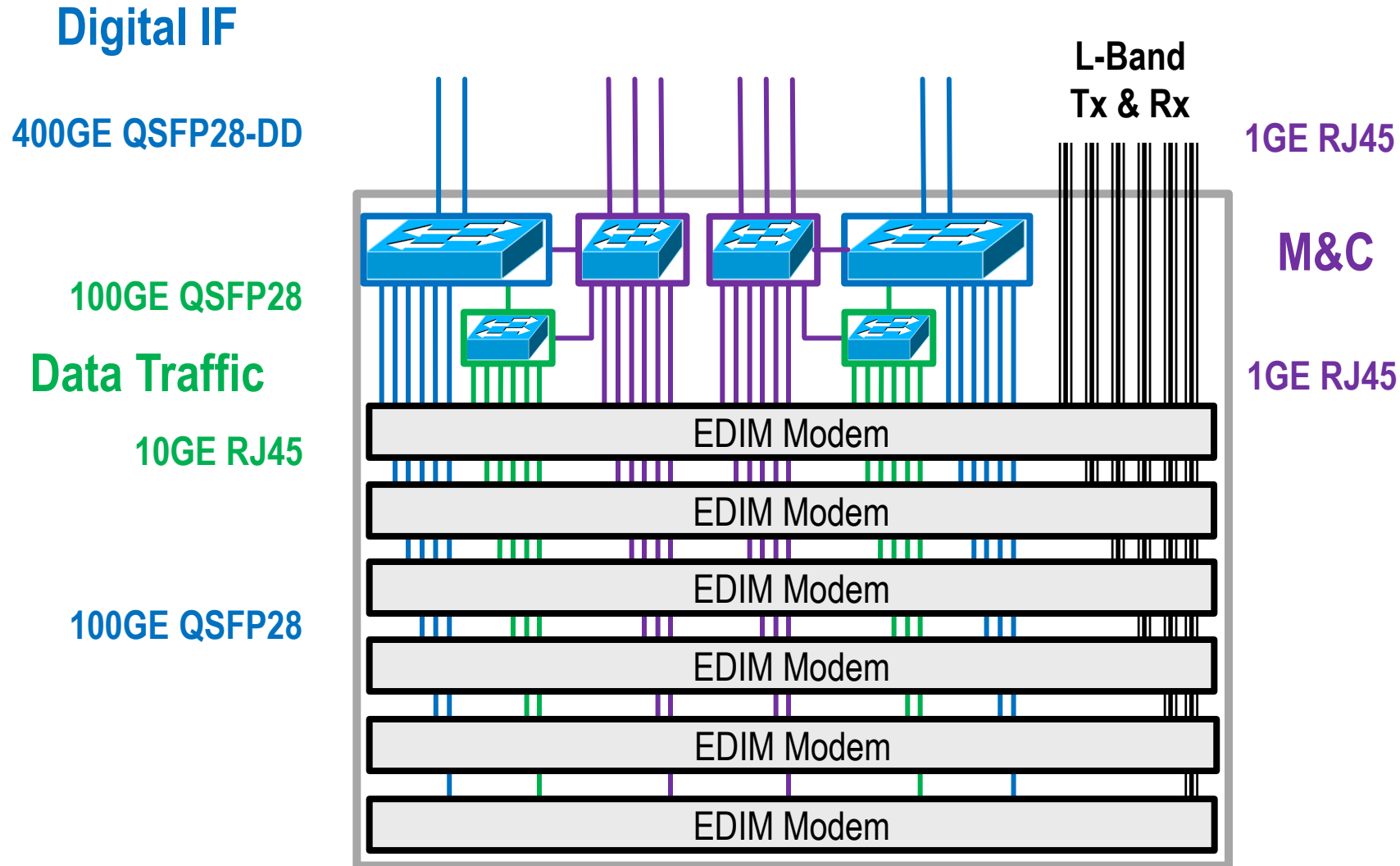
Key

- Digital IF Switch
- Digital IF Connection
- Data Traffic Switch
- Data Traffic Connection
- M&C Switch
- M&C Connection

### Army SATCOM Gateway Target Digital IF Architecture

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Representative Modem Rack Concept





# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

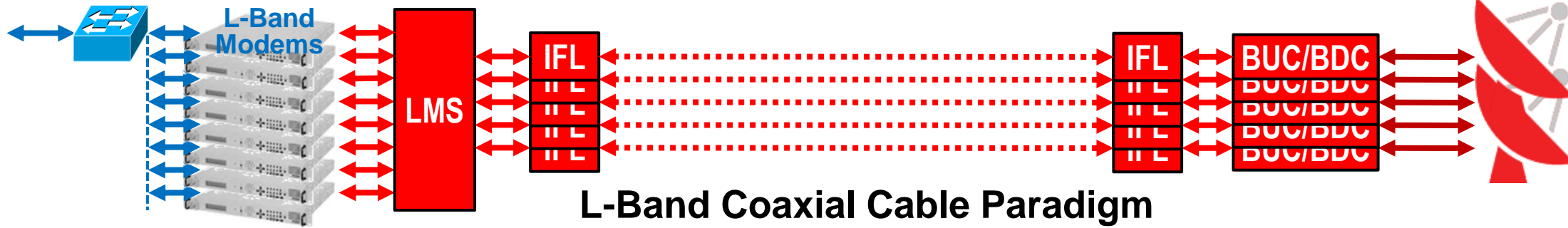
## Migration from L-Band to Digital IF Infrastructures



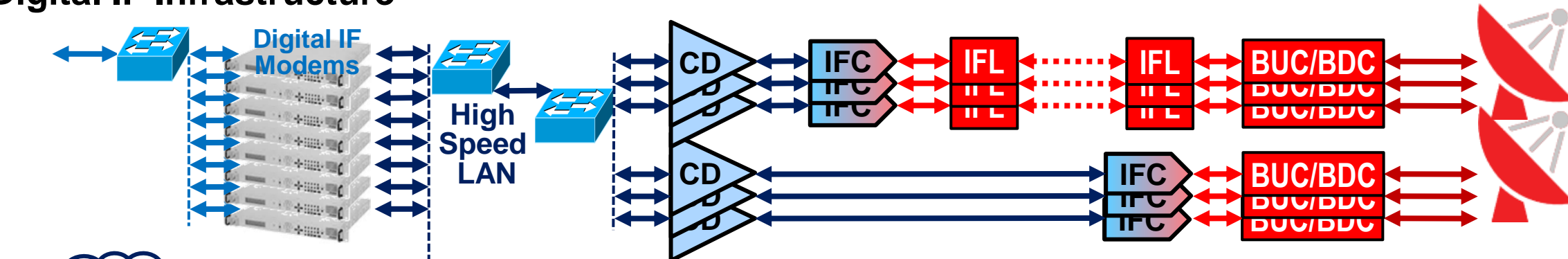
### EQUIPMENT BUILDING

### ANTENNA PEDESTALS

#### L-Band Infrastructure



#### Digital IF Infrastructure



#### High Speed Data Center Paradigm

→ Power, cooling, timing, floor space, staffing, networking, cybersecurity, automation

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Stairstep Approach to Management Automation



\* Developed with guidance and assistance of the staff at Northwest SATCOM Gateway

### Scenario Planning

Conflict Scenarios

### Enterprise Management

Enterprise Management via NMS & Operator Interfaces (OIs)  
centralized management of multiple SATCOM gateways & satellites

### Site Management

Site Network Management System (NMS) a.k.a. Site Network Management Software, and OIs

1. Comprehensive M&C tool for site operators
2. Aggregation tool for Enterprise NMS

### Equipment Management

Equipment Management System (EQMS) & OIs  
by equipment suite or manufacturer:  
modems, switches, Digital IF combiner/dividers, IF converters at the L-Band edge

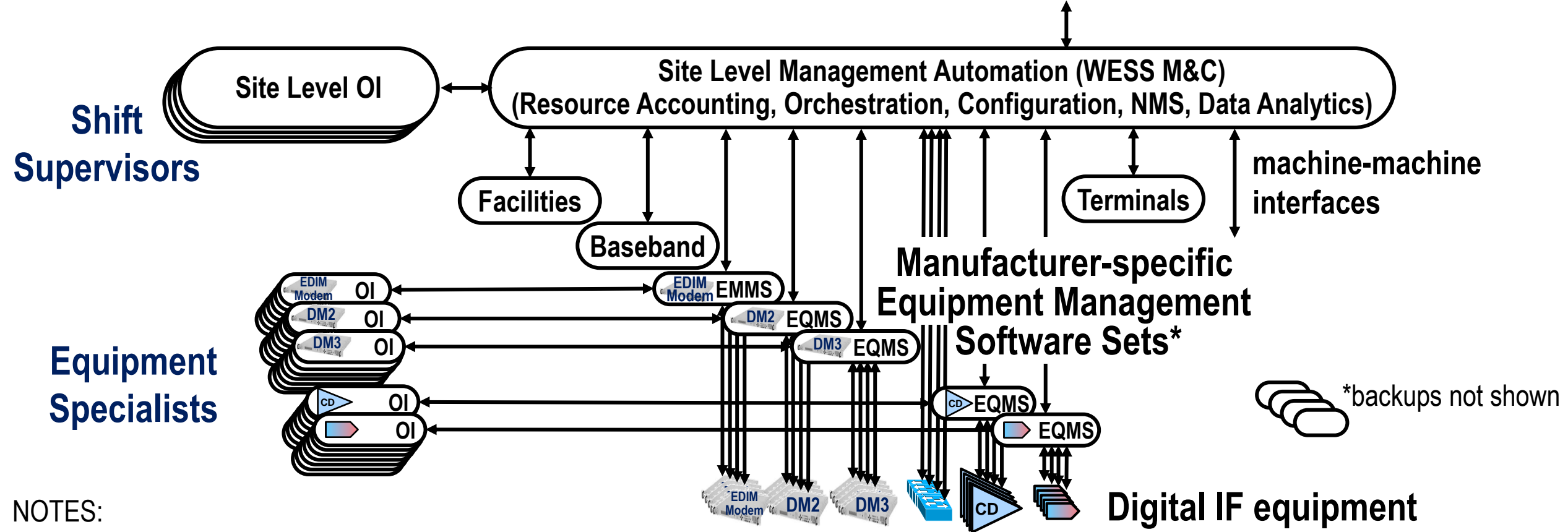
**DOD SATCOM automation, one step at a time**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Site Level M&C



Northbound to the Enterprise



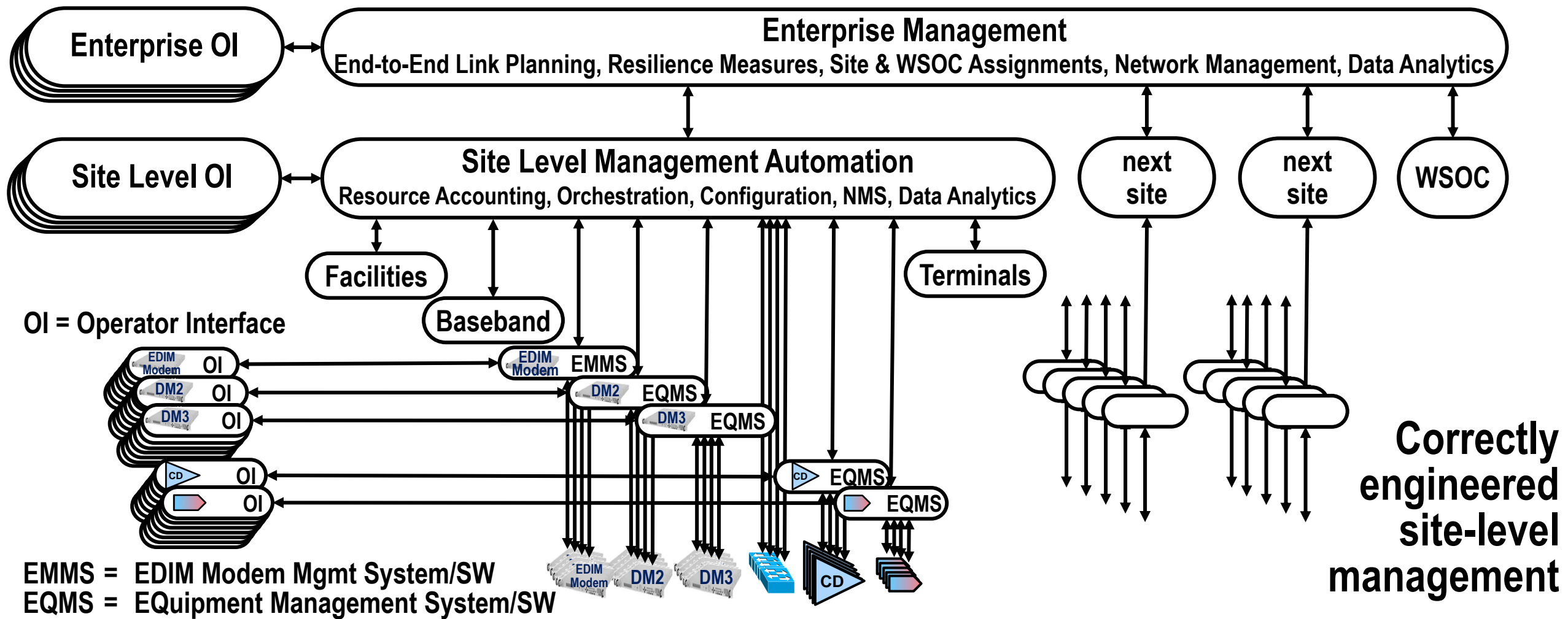
- NOTES:
- Management nodes are intended to run on servers
  - All are “virtualization ready” for virtual modems, switches & combiner/dividers

\*EQMS = Equipment Management System / SW  
i.e. SW management nodes

**Hierarchical architecture for comprehensive site management**

# DOD SATCOM Gateway – Digital IF Networking and M&C Automation

## Enterprise Management Concept



**Site level management to enable enterprise management and SATCOM as a service**



- **High Speed Digital IF Networking**
  - Hierarchical for capacity and to simplify installation
  - Spine-leaf for reliability
  - Network separation for cybersecurity
  - Sized for growth
- **Site Management Automation**
  - Single application, single sign-on, single “pane of glass”
  - Resource management, mission scheduling & orchestration, configuration, mission management, data analytics, Northbound enterprise interface
- **Both**
  - Lead Digital IF introduction
- **Facilities → Data Center Paradigm**
  - Power, cooling, timing, floor space, staffing, networking, cybersecurity, automation



- James Carter      Network Engineer, PdM WESS  
    ■ 703-639-8735      [james.r.carter6.civ@army.mil](mailto:james.r.carter6.civ@army.mil)
  
- Dave Khalil      Lead Systems Engineer, PdM WESS  
    ■ 703-806-9255      [dahesh.a.khalil.civ@army.mil](mailto:dahesh.a.khalil.civ@army.mil)
  
- A.J. Vigil, Ph.D., P.E.      Senior Scientist, Technical Lead, PdM WESS  
    ■ 407-281-5659      [aj.vigil@system.com](mailto:aj.vigil@system.com)