

# The Art of Open-Standard System Architecture For Military Ground Vehicles

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Modular, Non-proprietary  
and Interoperable!!,  
**BUT....Unusable!!**



**Too quick to solution; NO architectural thinking!!**

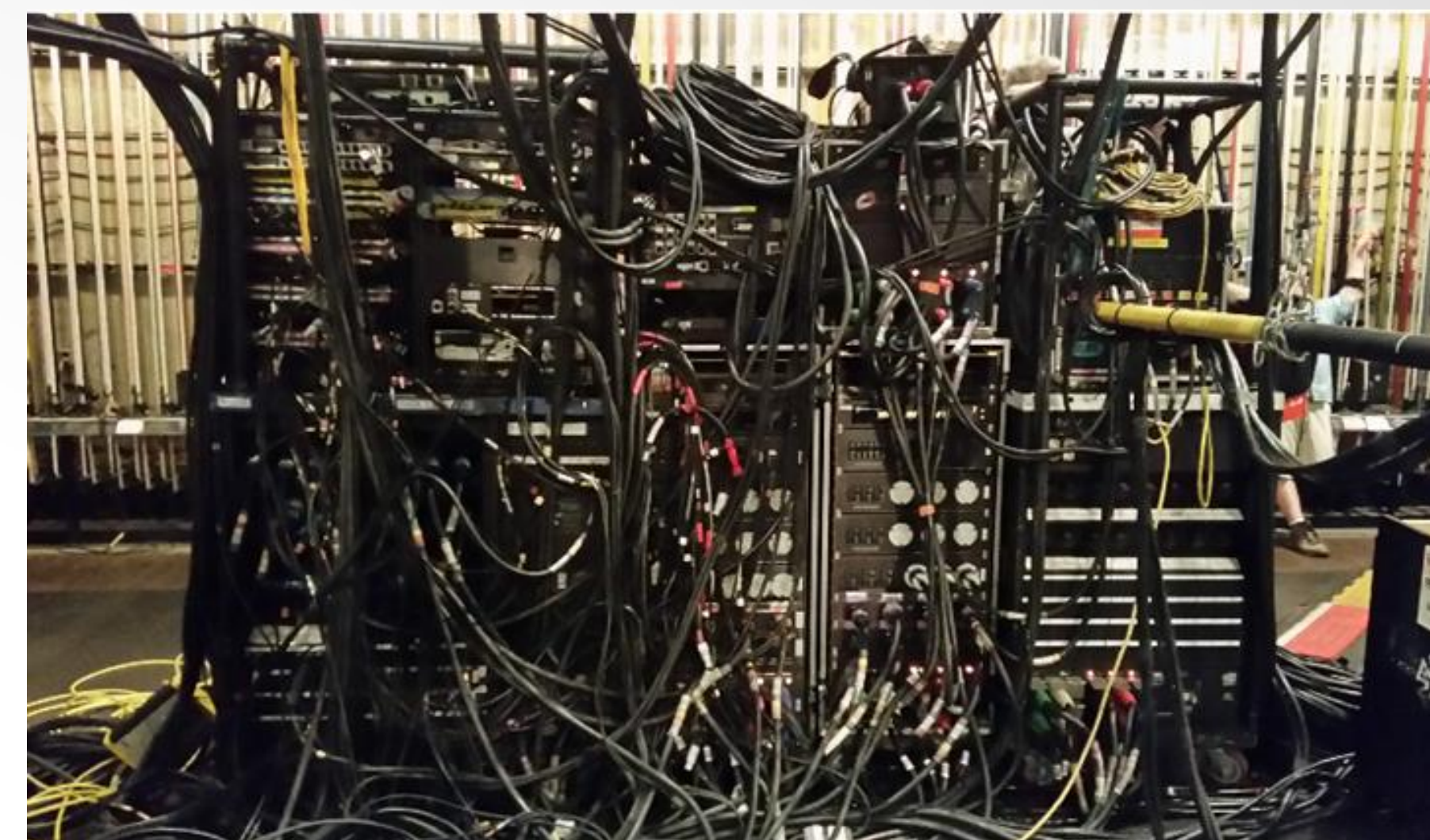
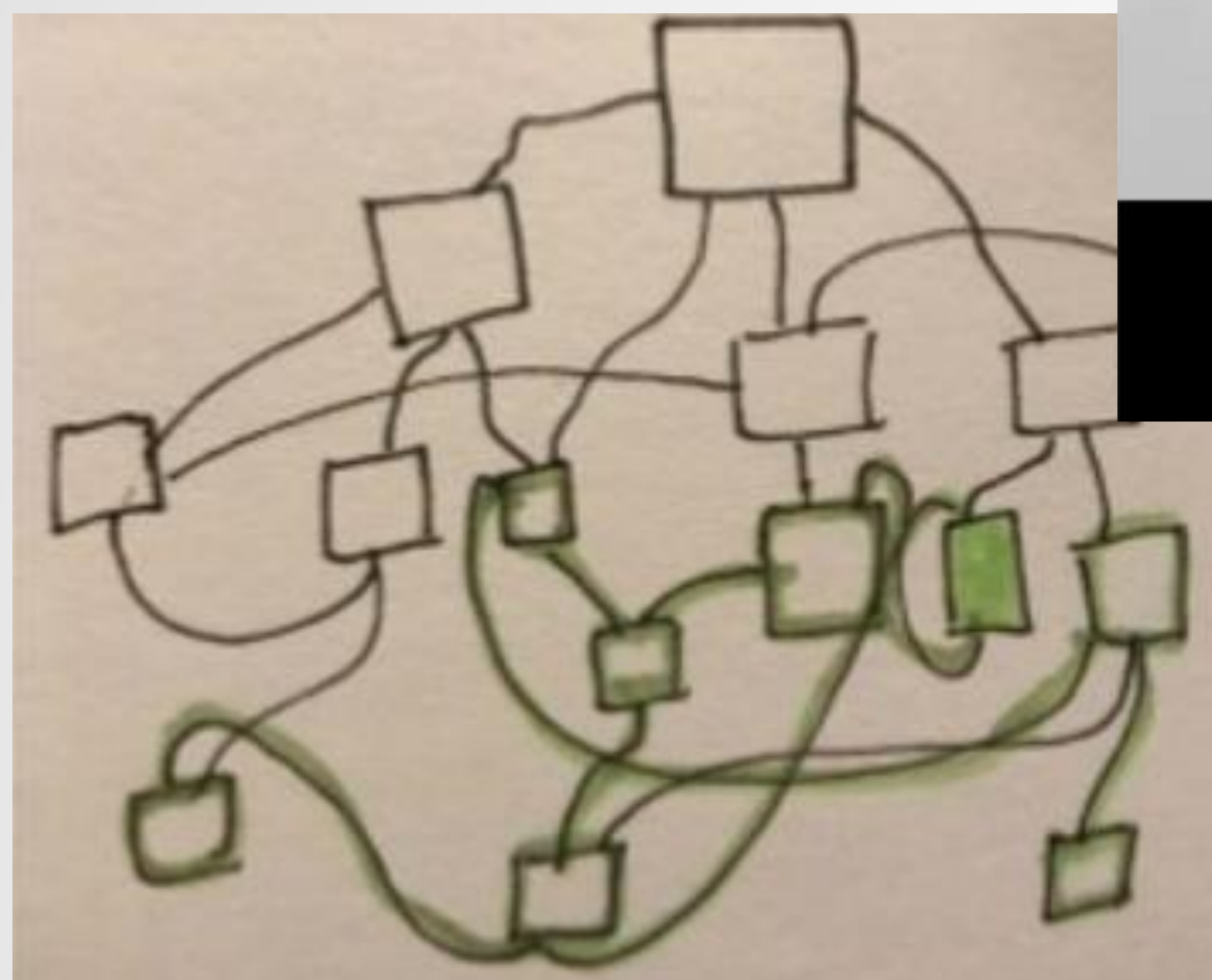


# MODULAR OPEN SYSTEMS APPROACH

When I wrote this code,  
only God & I understood what it did.



Now...  
only God knows.



## Issues without a well-thought Architecture!

Image Sources: Various Online Sources

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# AGENDA

## MODULAR OPEN SYSTEMS APPROACH

- Open-Standard System Architecture (OSSA)
- Next Gen Military Ground Vehicles – New Strategy
- Purpose of this Paper
- A Correct-Perspective On The Art Of OSSA
- The Symptoms And Impacts Of A Misconstrued OSSA

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# WHAT IS AN OSSA

## MODULAR OPEN SYSTEMS APPROACH

1. A Recipe for building non-proprietary (open) and modular systems
2. Consists of the following items
  - A. Non-proprietary technical specifications and interface definitions
  - B. Processes for building and operating the systems
  - C. Domain specific data model(e.g., military ground vehicles)
  - D. Abstract building blocks of software and hardware components
    - a. Cohesive system functions w/ interfaces
    - b. Interface definitions per open standards
      - i. Constrained by a domain specific data model

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# NEXT GEN MILITARY GROUND VEHICLES – NEW STRATEGY

## MODULAR OPEN SYSTEMS APPROACH

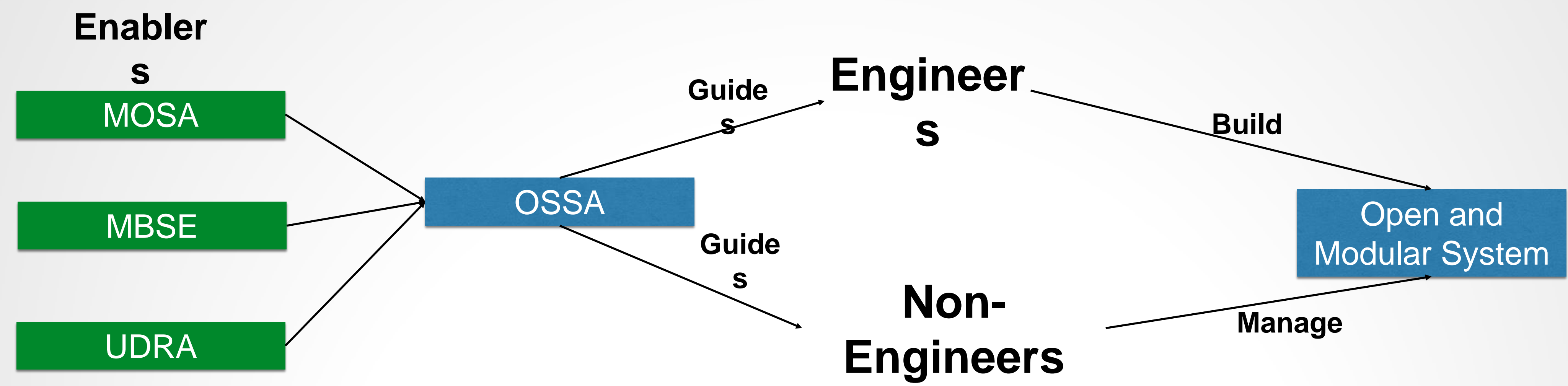
1. Use of OSSA
2. Apply
  - A. Modular Open Systems Approach (MOSA) principles
  - B. Model Based Systems Engineering (MBSE)
  - C. Unified Data Reference Architecture (UDRA)

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# WHAT IS AN OSSA w/ MOSA, MBSE, and UDRA

MODULAR OPEN SYSTEMS APPROACH



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# PURPOSE OF THIS PAPER

## MODULAR OPEN SYSTEMS APPROACH

1. A Correct-Perspective on the OSSA
2. Articulate the problems of a misconstrued OSSA
3. Describe Some Symptoms of a misconstrued OSSA

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# A CORRECT PERSPECTIVE OF OSSA

## MODULAR OPEN SYSTEMS APPROACH

1. **The Team Structure, a Clean Beginning\***
2. System Architecting Approach
3. **OSS Architecture Decisions\***
4. **A Clear System Level Data Model\***
5. A Functional Architecture and its Allocation to OSSA elements
6. **Selecting Open Standards\***
7. Cybersecurity and Safety Allocations
8. Logical and Physical system components
9. **Using OSSA in the System Development Cycle\***

**\* Topics to be discussed; for the rest refer to the full paper**

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# THE TEAM STRUCTURE – CLEAN BEGINNING

A culture change required across stakeholders; should be model-aware

Architect as a team w/ a common vision

Combine all MBSE and SMEs technical concerns

Full system engineering & DoD acquisition processes awareness

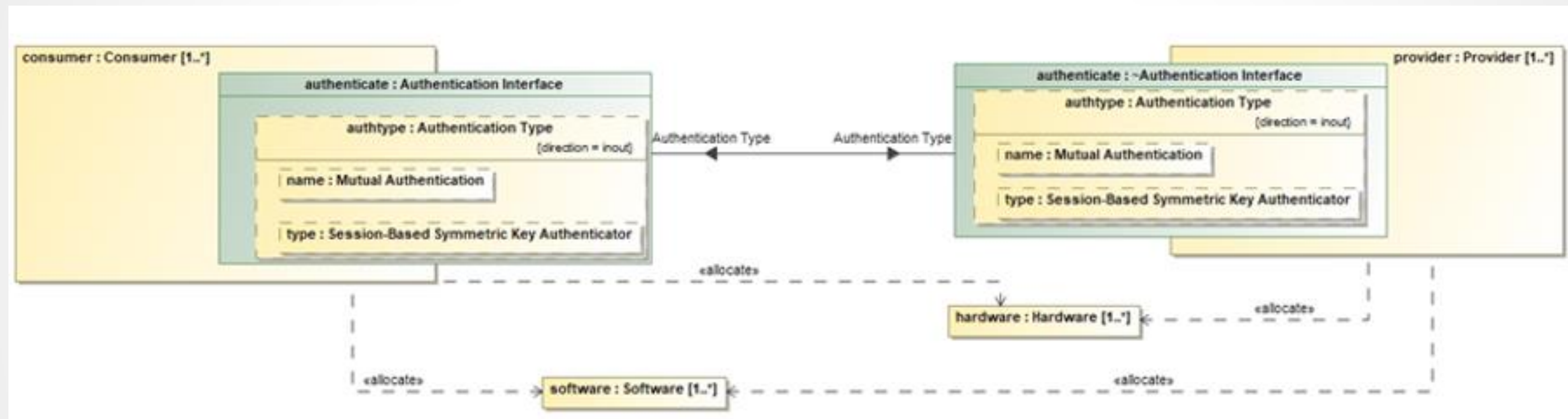


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# OSS ARCHITECTURE DECISIONS - ORNAMENTS

1. Influences the non-functional characteristics of a system – e.g., modularity, security, reliability, safety, or maintainability
2. Describes an architecturally significant design problem - many potential technical solutions
3. Common vision for system designs – Reduces surprises during integration



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# SYSTEM LEVEL DATA MODEL

## MODULAR OPEN SYSTEMS APPROACH

1. Domain specific abstract data elements defined, organized and documented
2. Future Airborne Capability Environment (FACE) Standard - Conceptual (Observable), Logical (measurable), Physical (implementation) E.g.; Vehicle's speed, mts/s, double (64-bit precision data)
3. A context for interoperable & open interfaces between system components
4. The data via interfaces is constrained to the data model

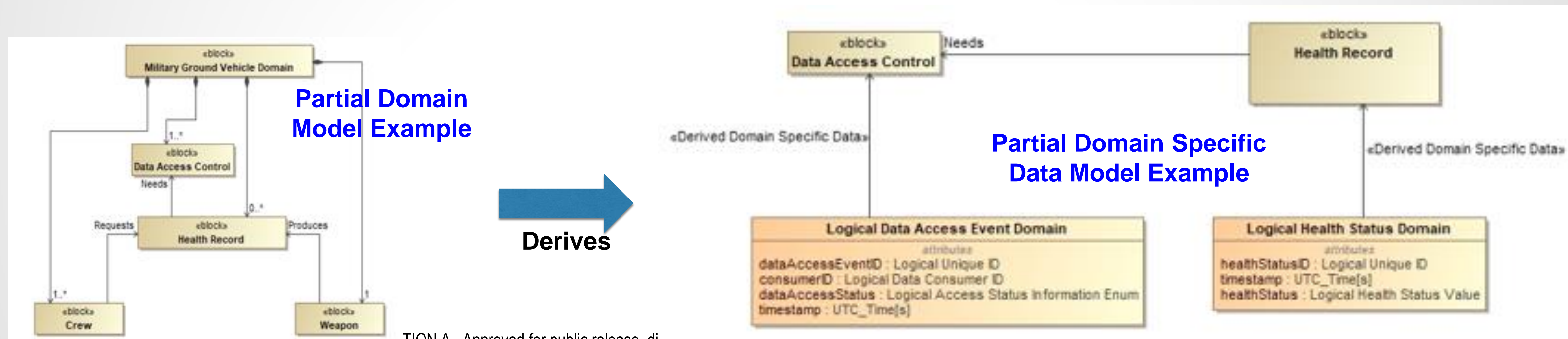


FIGURE A. Approved for public release, distribution unlimited. OF 020 7 020 7



# OPEN STANDARDS SELECTION

## MODULAR OPEN SYSTEMS APPROACH

1. Develop OSSA first - understand all possible system-level problem spaces
2. Then, select applicable open standards to solve system level concerns such as interoperability, network, cybersecurity, safety, and modularity
3. Helps evolving the OSSA and standards separately by reducing the impacts of changing standards outside the context of OSSA
4. Do not select wrong standards preemptively  
Adds unnecessary constraints to the design

Costly system development and wrong technical data assertions



# SYSTEM DEVELOPMENT CYCLE

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1. Use OSSA as a guiding tool throughout the system development cycle
2. OSSA model facilitates the stakeholders to conduct simulations of the risk areas and uncover all fixable errors prior to production

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# SYMPTOMS OF A MISCONSTRUED OSSA

1. Incorrect use of MBSE and OSSA is Used as Documentation Only – No guiding principles
2. Missing OSSA Decisions and Lack of a Data Model – No common vision; complex system
3. Lack of Functional Architecture and its Allocations – Duplicate functions; non-cohesive
4. Lower Degree of Modularity – more unique components; difficult to maintain/scale
5. Lack of System level Safety and Cybersecurity Allocations – Not holistic
6. Lack of Synchronization of Top-down and bottom-up architecting approaches – Increased technical debts; lower degree of modularity
7. Preemptive Open standards selection and flow down as requirements – unnecessary complications





**Misconstrued  
OSSA**



**Clear and Complete  
OSSA**

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# CONCLUSION – CLEAR OSSA

## MODULAR OPEN SYSTEMS APPROACH

1. Enables building highly scalable and cost-effective military ground vehicles
2. Reduces the complexity in the system development lifecycle with the accurate employment of
  - Shared vision and Data model
  - Functional architecture
  - Open-standard based interfaces
  - Modularity/modular boundaries, and
  - Well-allocated safety and cyber strategies at the system level

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# Questions??

## MODULAR OPEN SYSTEMS APPROACH

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