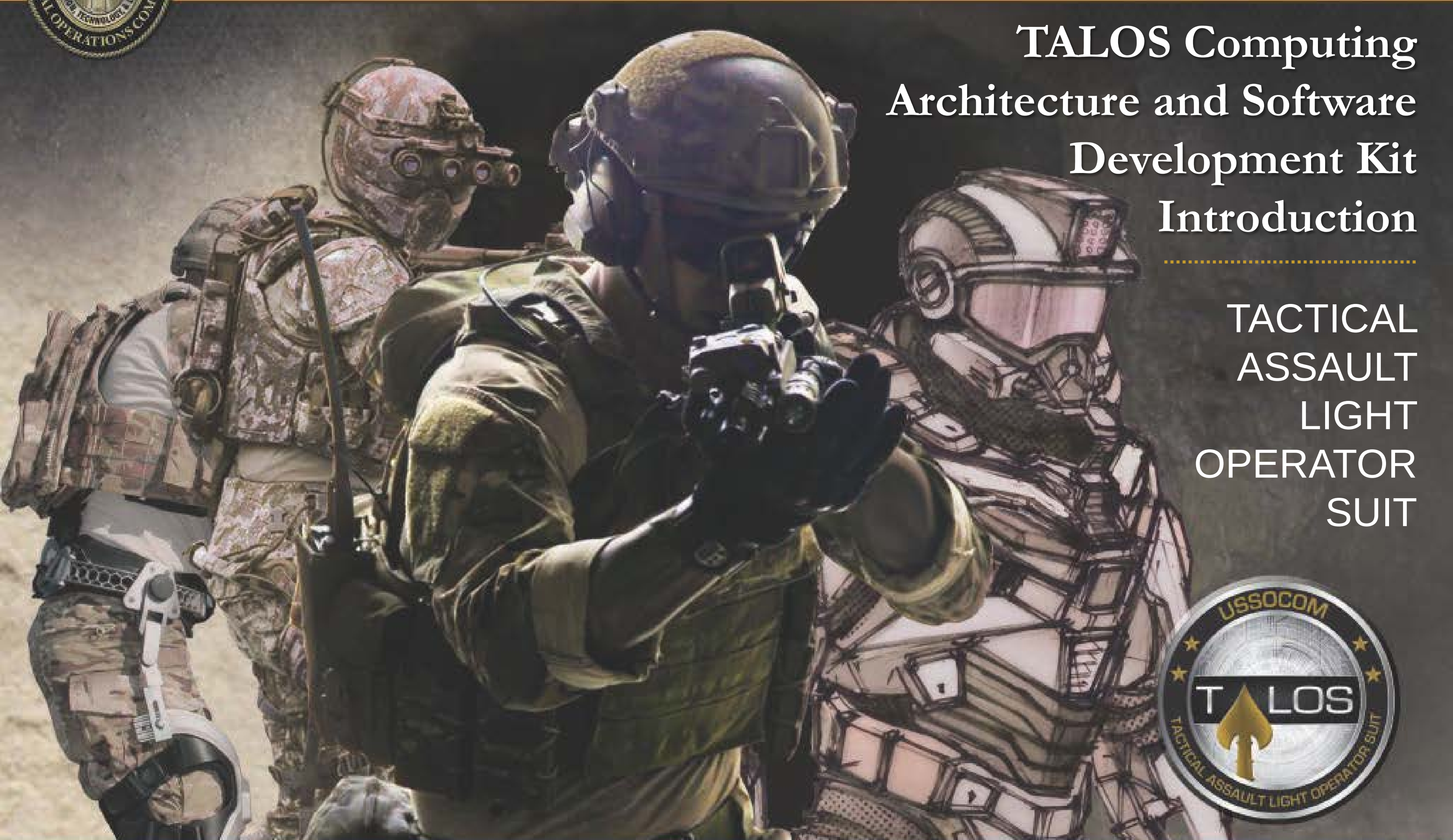
SPECIAL OPERATIONS FORCES INDUSTRY CONFERENCE

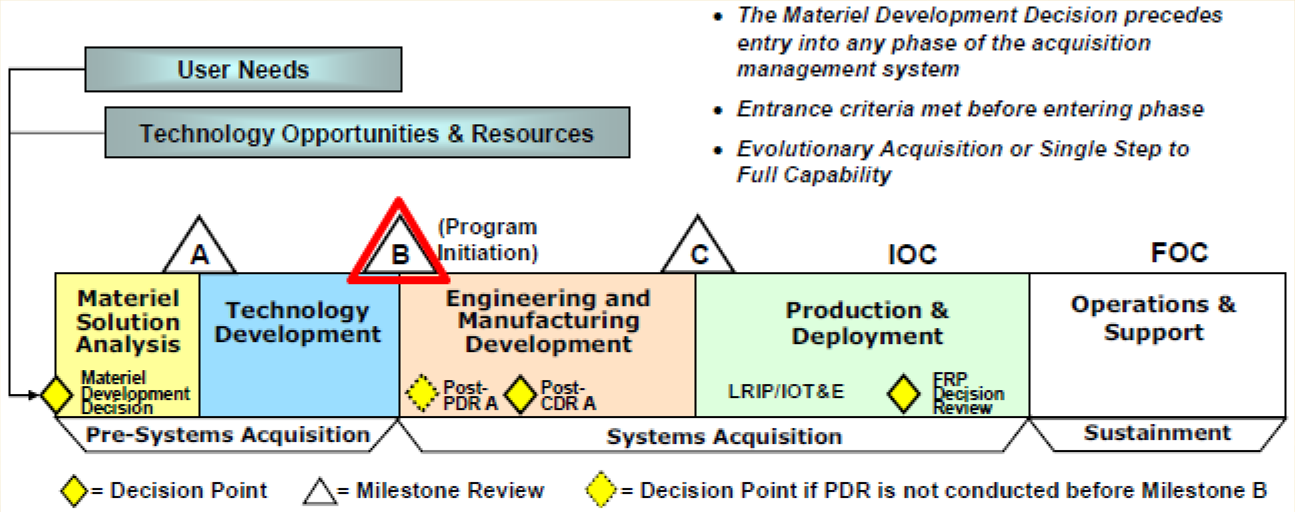
TALOS Computing Architecture and Software Development Kit Introduction

TACTICAL ASSAULT LIGHT OPERATOR SUIT



TACTICAL ASSAULT LIGHT OPERATOR SUIT

PERSPECTIVE AND PHILOSOPHY



Leverage all existing solutions possible to achieve Milestone B “Prototype”

Minimize technical risk

Keep it simple, the minimally sufficient solution is best

Invent nothing that is not required to achieve technical intent

ARCHITECTURAL DRIVERS

- Survivability (availability, redundancy, failover, and reliability)
- Interoperability
- Adaptability/Modifiability
- Extensibility/Scalability
- Modularity (at odds with integrated design and Size, Weight, and Power (SWAP) constraints)
- Security

DESIGN PHILOSOPHY

- Open
- Process at the edges
- Data reduction
- Common services
- Priorities
- Mission Modes
- Diagnostics
- Hardware Security Module (HSM) support

TERMINOLOGY

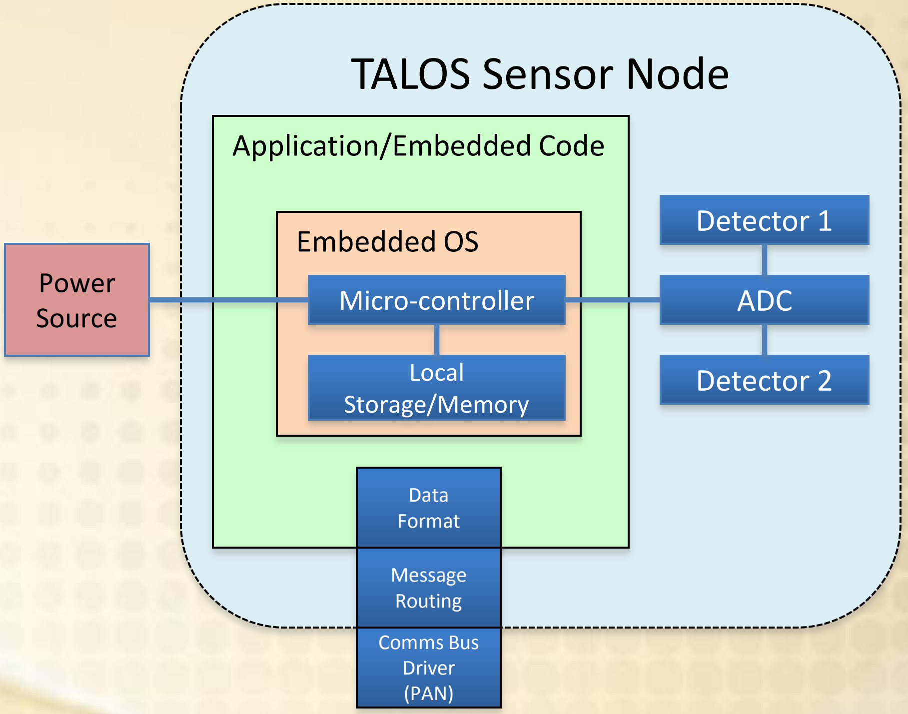
- **Node** – physical component in one location on the suit
- **Sensor node** – small, embedded, interchangeable sensor package connected to suit network, no/minimal Operating System (OS)
- **Sensor gateway** – sensor data aggregator to support common messaging
- **Compute node** – multiple Central Processing Units (CPUs) and OS's (current plan is 2, primary and backup)
- **Service** – common computing capability shared by multiple applications/services
- **Sensor service** – common computing service to sample, digitize, and publish sensor data on suit network
- **Processing service** – software capability running on compute node(s), optionally driven by a rules engine, managing information delivery and display
- **High availability –** mechanisms to ensure fail over, load balancing, and priority/quota enforcement, relative to current mission mode

HARDWARE DIRECTION

- Overall goal: baseline final hardware as late as possible
- Heterogeneous (x86 and Advanced RISC Machines) processors
- Must run Android Apps (may be ported to minimal Linux OS)
- 2 compute nodes – primary and backup
- 4-8 multicore CPU's per node
  - Modular, replace processing card with storage
  - Additional backup "go bag" for data logging and comms
- Small form factor PC and high core graphics processing units are current targets
- Virtualized environment, can support limited dedicated OS if required
- GigE or 10GigE switched, *wired* network
  - Potentially open to integration of wireless components also
- Designing to support significant video processing

SENSOR NODES

- Generic model for sensor integration
- Multiple detector elements per physical sensor node possible
- Micro controller with embedded OS
- Pub/sub architecture using common message system
- Plug and play registration of sensor nodes



VIRTUALIZATION

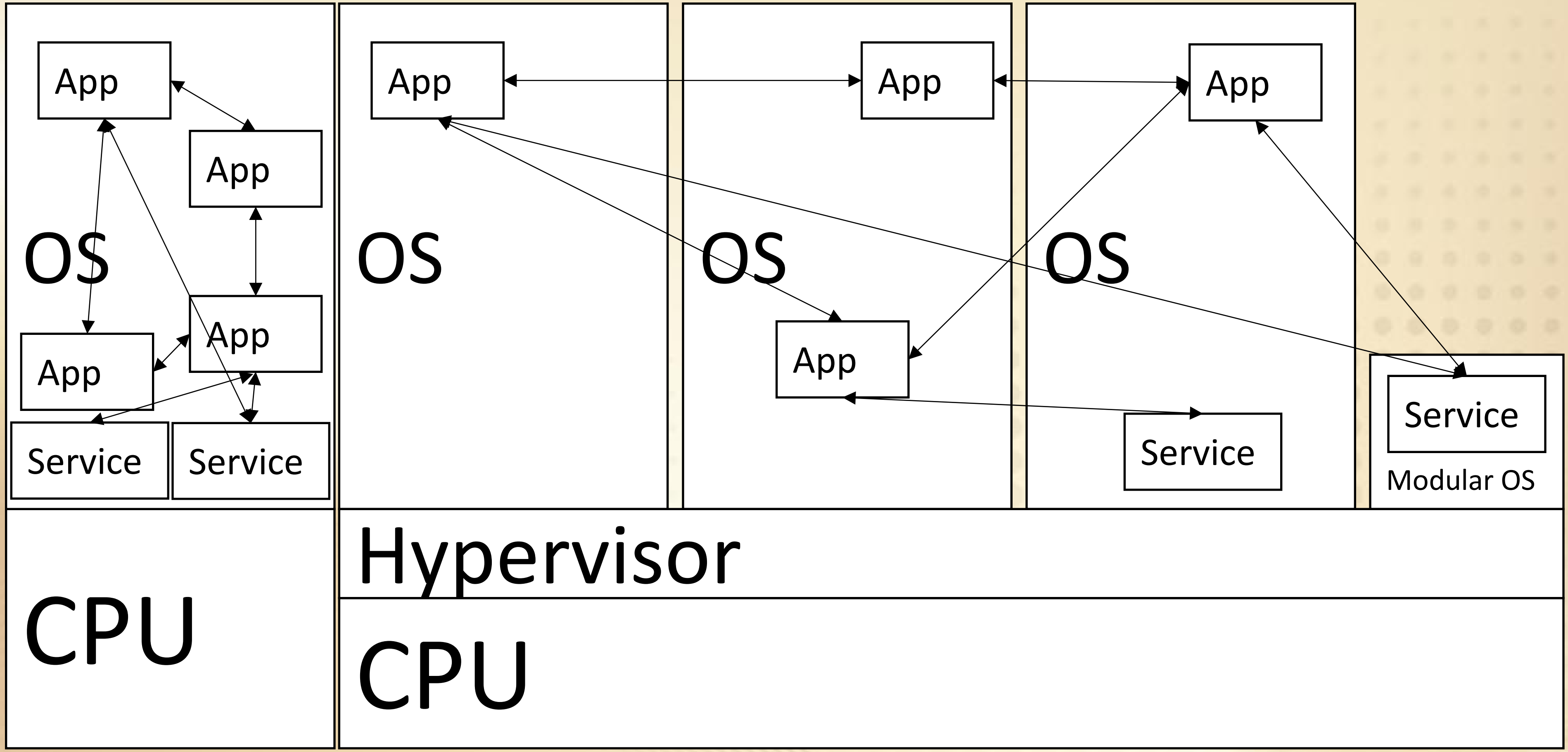
Evaluating three approaches

1. Non-virtualized - Single OS per CPU
   - Lowest complexity
   - Requires custom high availability (HA) solution
   - Could introduce security and stability challenges
2. Traditional VMs (heavyweight)
   - Additional complexity
   - Data center HA solutions directly apply
   - "Sandboxing" increases security and stability
   - VM size still big
3. Modular OS
   - Same benefits as option 2, but also…
   - Purpose built, highly optimized VM
   - Much smaller size, increased performance, efficiency, and HA support

Final solution may be a mix of all 3

Goal: All common services in Modular OS

VIRTUALIZATION APPROACHES



MESSAGING, INTERFACES, AND API

- Common messaging library key to service interaction and interoperability
  - Protocol buffers over nanomsg
  - Provided via lib_talos and the SDK
  - .proto files and nanomsg interaction semantics define the ICD
  - Example (log message):

```
package talos.net;
message LogStatement {
        required string sender = 1;
        required int32 logLevel = 2;
        required int64 time = 3;
        required string data = 4;
}
```

- lib_talos provides
  - nanomsg semantics and socket set up abstraction
  - System logging abstraction
  - Service registration/authentication/discovery abstraction
  - Command channel establishment and abstraction
  - Implemented in C with minimal dependencies
  - C++ and Java libraries/bindings in development
  - Other languages expected, implemented as required

CODE MANAGEMENT

- Open source libraries forked at https://github.com/SEI-AMS
  - https://github.com/SEI-AMS/nanomsg
  - https://github.com/SEI-AMS/protobuf
  - https://github.com/SEI-AMS/protobuf-c
  - https://github.com/SEI-AMS/osv
  - https://github.com/SEI-AMS/cppnanomsg
- Build environment
  - Cmake
  - Linux
  - Compatible C/C++ Environment

APPLICATIONS

Example application types:

- System health and status reporting
- Operator health and status reporting
- Team health and status reporting
- Communications system control and interaction
- Moving map services
- Threat identification, tagging, and tracking
- Blue/grey force situational awareness monitoring
- Targeting
- Sensor management
- Terrain analysis
- 3D visual fusion (e.g. terrain overlay, route visualization)
- Intelligence gathering (e.g. audio, video, images, sensor sampling)

Evaluation of existing GOTS apps, gaps, overlaps, etc. during 2015 RPE
FY16 – Heavy focus on application porting and development

CONFIGURATION CONTROL AND CONTRIBUTING

- External developers expected and welcome
- Establishing collaboration portal (access restricted and authenticated)
  - Git repository
  - Build server
  - Collaboration wiki
  - Documentation repository
- Need to identify and standardize external system interfaces
- Heavy emphasis on standardized
  - Interface definitions
    - Message formats
    - Interaction mechanisms
  - Application priority, criticality, and quota enforcement
    - As applicable to differing mission modes

LOOKING AHEAD

- SOFIC – initial availability of SDK and lib_talos
- 2015 RPE – focus on:
  - Existing app survey
  - Service development
  - Mapping engine
  - Display alternatives
  - High Availability (HA) and load experimentation
  - Operator interface (HCI) collaboration
- Remainder of FY15
  - Initial implementation of all core services
  - Initial identification of all required applications
  - Full establishment of development collaboration capability and test labs
- FY16 – year of the application
  - Continued refinement of supporting services, infrastructure, and HA
- FY17 – year of integration and testing
  - Application refinement, integration, and initial field trials

THANK YOU

Questions and Comments…