

Using Architecture to build a defensible ICS

SANS ICS SUMMIT 2021

Agenda

1. What is Security Architecture
2. Planning Security Architecture Activities
3. Establishing Security Architecture Activities
4. Upkeep of Security Architecture
5. Next Steps

/whois
@beLarge



Operational Technology Security Lead at CyberCX

Cyber Security Specialist who has worked across IT and OT in Cyber Security & Network Engineering roles for just under 15 years

An infrastructure tourist & cyber security architecture enthusiast

Experience in Rail, Electricity Generation, Aviation, Emergency Services and Consulting

Vice Chair of the Queensland Branch of the Information, Telecommunications and Electronics Engineering (ITEE) College of Engineers Australia

Bach Eng (Telecomms) and Master Business (Applied Finance)

GRID, SCF, CCNP/CCDP(Lapsed), Cyber Security Foundation+Practitioner (ALC)

What is Architecture?

From the Sliding Scale of Cyber Security

Rob M Lee states “Architecture refers to the planning, establishing, and upkeep of systems with security in mind. Ensuring that security is designed into the system provides a foundation upon which all other aspects of cyber security can build.” (p5)

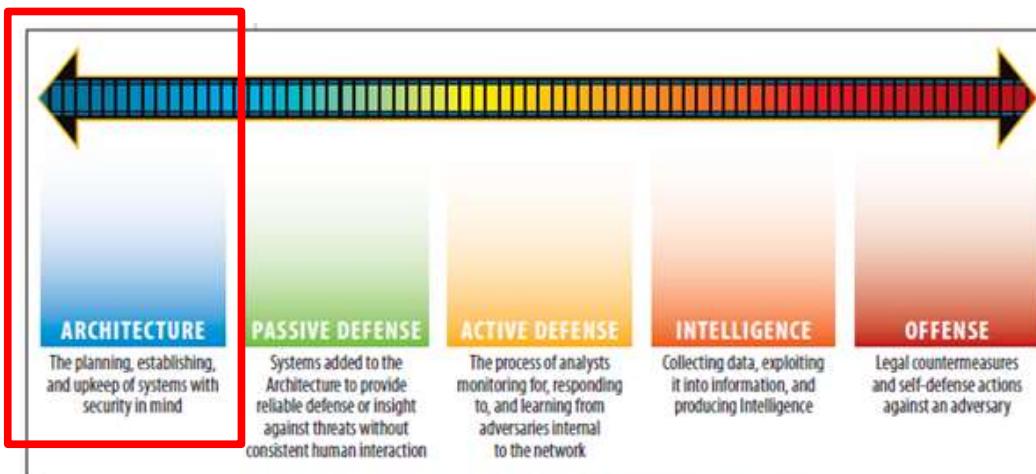


Figure 1. The Sliding Scale of Cyber Security

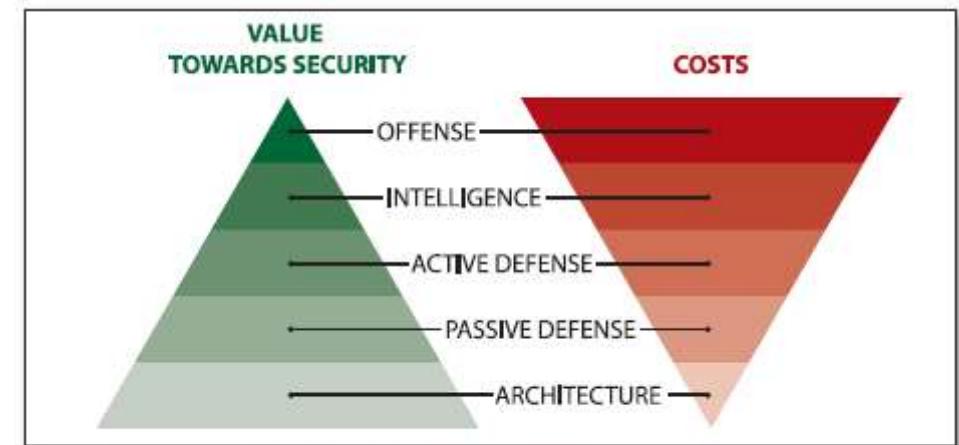


Figure 2. Value Towards Security (Left) vs. Cost (Right)

From the Draft C2M2 v2

Term	Definition
cybersecurity architecture	How cybersecurity practices and controls are structured and implemented to maintain the confidentiality, integrity, and availability of the organization's assets and services.
enterprise architecture	The design and description of an enterprise's entire set of IT and OT: how they are configured, how they are integrated, how they interface to the external environment at the enterprise's boundary, how they are operated to support the enterprise mission, and how they contribute to the enterprise's overall security posture.
network architecture	A framework that describes the structure and behavior of communications among IT and/or OT assets and prescribes rules for interaction and interconnection.

From the Draft C2M2 v2 (cont.)

The ARCHITECTURE Domain Objectives and Practices:

1. Establish	1. Establish and Maintain Cybersecurity Architecture Strategy and Program	
MIL1	MIL1	2. Implement Segmentation as an Element of the Cybersecurity Architecture
2. Implement	3. Implement Application Security	
MIL2	MIL1	MIL1 No practice
3. Implement	MIL2	MIL2 a. Software delivery and deployment processes are established and maintained to support the protection of data-at-rest and data-in-transit (ASSET-2c)
4. Implement	MIL3	MIL2 b. The security architecture includes controls (e.g., data loss prevention tools, physical data exfiltration controls) to manage the transmission of data within and between systems based on security requirements (ARCHITECTURE-1e)
5. Manage	MIL3	MIL3 c. Key management infrastructure (i.e., key generation, key storage, key destruction, key update, and key revocation) are established and maintained to support the protection of data-at-rest and data-in-transit
	MIL3	MIL3 d. Cryptographic controls are established and maintained to support the protection of data-at-rest and data-in-transit as required in the cybersecurity architecture
	MIL3	MIL3 e. The cybersecurity architecture includes controls (e.g., data loss prevention tools, physical data exfiltration controls) to manage the transmission of data within and between systems based on security requirements (ARCHITECTURE-1e)
	MIL3	MIL3 f. The cybersecurity architecture includes protections for all data-at-rest (i.e., on-premise and cloud-based file storage and databases) for selected data categories (ASSET-2c)
	MIL3	MIL3 g. The cybersecurity architecture includes protections for all data-in-transit (e.g., within internal networks, across network boundaries, and external traffic, including cloud solutions) for selected data categories (ASSET-2c)
	MIL3	MIL3 h. Data protections are tested (e.g., controls validation) according to organization-defined triggers (e.g., time elapsed, changes to system architecture, changes to threat environment)
	MIL3	MIL3 i. The cybersecurity architecture includes protections against unauthorized changes to software, firmware, and information (due to errors or malicious activity)

Source - <https://apps.dtic.mil/sti/citations/AD1078768>

ESA vs Security Solution Architecture

Enterprise Security Architecture (ESA)

Should work with the business to define security strategy and justification

Defines the enterprise wide security artefacts such as:

- Architectural Principles
- Attributes Modelling (SABSA)
- Domain Model
- Trust Models
- Pattern Repositories

Run the Architectural Review Board (ARB).

Security Solution Architecture

A key pivot role between the whole of enterprise and delivering projects

Focuses on producing solution designs that address cyber security requirements as per the enterprise methodology

More than likely part of the projects team.

Some good material in NIST NICE (<https://www.nist.gov/itl/applied-cybersecurity/nice/nice-framework-resource-center>)
Worker Roles Enterprise Architect (SP-ARC-001) and Security Architect (SP-ARC-002)

Planning activities

UNDERSTAND THE BUSINESS, UNDERSTAND YOUR SYSTEMS,
UNDERSTAND YOUR REQUIREMENTS

SABSA

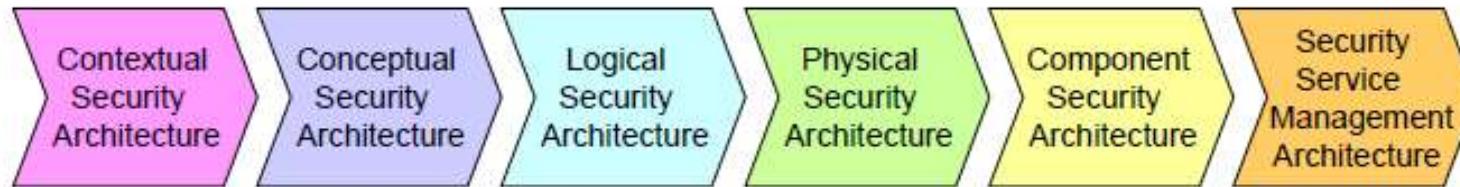
The Sherwood Applied Business Security Architecture (SABSA) is a Security Architectural framework that can provide business justification for cyber security efforts.

	ASSETS (What)	MOTIVATION (Why)	PROCESS (How)	PEOPLE (Who)	LOCATION (Where)	TIME (When)
CONTEXTUAL ARCHITECTURE	Business Decisions	Business Risk	Business Process	Business Governance	Business Geography	Business Time Dependence
CONCEPTUAL ARCHITECTURE	Business Knowledge & Risk Strategy	Risk Management Objectives	Strategies for Project Assurance	Roles & Responsibilities	Domain Framework	Time Management Framework
LOGICAL ARCHITECTURE	Information Assets	Risk Management Policies	Process Maps & Services	Entity & Trust Framework	Domain Maps	Calendar & Timetable
PHYSICAL ARCHITECTURE	Data Assets	Risk Management Practices	Process Mechanisms	The Builder's View	ICT Infrastructure	Process Schedule
COMPONENT ARCHITECTURE	ICT Components	Risk Management Tools & Standards	Process Tools & Standards	Personnel Mgmt. Tools & Standards	Locator Tools & Standards	Step Timing & Sequencing Tools
SERVICE MGMT ARCHITECTURE	Service Delivery Management	Operational Risk Management	Process Delivery Management	Personnel Management	Management of Environment	Time & Performance Management

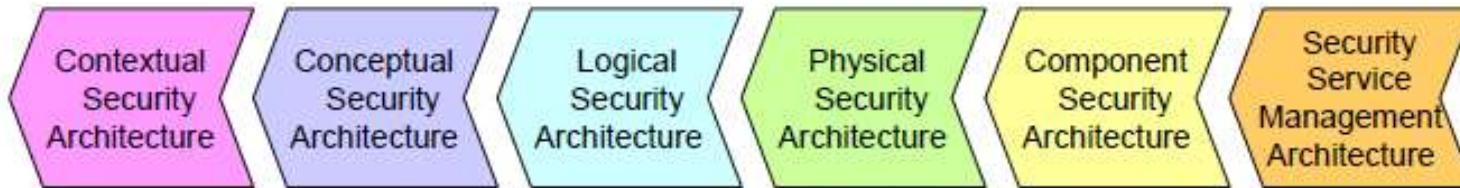
SABSA (cont.) – Two Way Traceability

The SABSA Matrix also provides two-way traceability:

- Completeness: has every business requirement been met? The layers and matrix allow you to trace every requirement through to the components that provide a solution.



- Business Justification: is every component of the architecture needed? When someone questions 'Why are we doing it this way?' the rationale is plain by tracing back to the business requirements that drive the specific solution.



SABSA (cont.) – Domain Modelling

A domain is “*A set of elements subject to a common security policy defined and owned by a single security policy authority*”

A Logical Domain:

- A Line of Business
- A logical classification (such as Information Sensitivity)
- A community of users (e.g. a department)

A Physical Domain:

- A set of physical elements (e.g. Same Physical Location or Tech Layer) subject to a common security policy

Cyber Security Capabilities

Thinking in security capabilities is a key concept as it is the bridge between the Conceptual ESA Approach and the Security Solution Architecture – example capabilities:

C2M2 (ESA)	ISA/IEC 62443 (Logical and Component)	NIST 800-82 (Component)
Cyber Security Program Management <ul style="list-style-type: none">• Network Security Architecture• Network Security Segmentation	FR1 – Identity and Authentication Control (IAC)	System and Communications Protection (SC) <ul style="list-style-type: none">• SC-2 Application Partitioning• SC-7 Boundary Protection
Situational Awareness <ul style="list-style-type: none">• Perform Logging• Perform Monitoring	FR3 – System Integrity (SI)	Access Control (AC) <ul style="list-style-type: none">• AC-2 Account Management
Event and Incident Response, Continuity of Operations (IR) <ul style="list-style-type: none">• Detect Cyber Security Events• Escalate Cybersecurity Events and Declare Incidents	FR5 – Restrict Data Flows (RDF)	Configuration Management (CM) <ul style="list-style-type: none">• CM-2 Baseline Configuration
Threat and Vulnerability Management <ul style="list-style-type: none">• Identify and Respond to Threats• Reduce Cybersecurity Vulnerabilities	FR6 – Timely Response to Events (TRE)	Media Protection (MP) <ul style="list-style-type: none">• MP-1 Media Access• MP-7 Media Use

Establishing activities

HOW TO BUILD IN CYBER SECURITY THROUGHOUT THE LIFE
CYCLE OF THE SYSTEM

Knapp's 3x3 Model

From Knapp & Samani's *Applied Cyber Security and the Smart Grid*

Considers the location and the component layer.

This is a simple visual model to communicate control placement and to help identify any blind spots

	Data	SCADA	Device Network
Network	Enterprise Applications & Data	SCADA Applications & Production Data	Controller Logic
Endpoint	Enterprise Network	SCADA / Operations Network	Device Networks
Enterprise	Enterprise Endpoints	SCADA Servers, Process HMI	Process Controllers, Device HMI, IED

Zones & Conduits

From ISA/IEC 62443 -

A Zone is defined as “*a grouping of logical or physical assets based upon risk or other criteria such as criticality of assets, operational function, physical or logical location, required access, or responsible organization.*”

A Conduit is defined as “*a logical grouping of communication channels that share common security requirements connecting two or more zones.*”

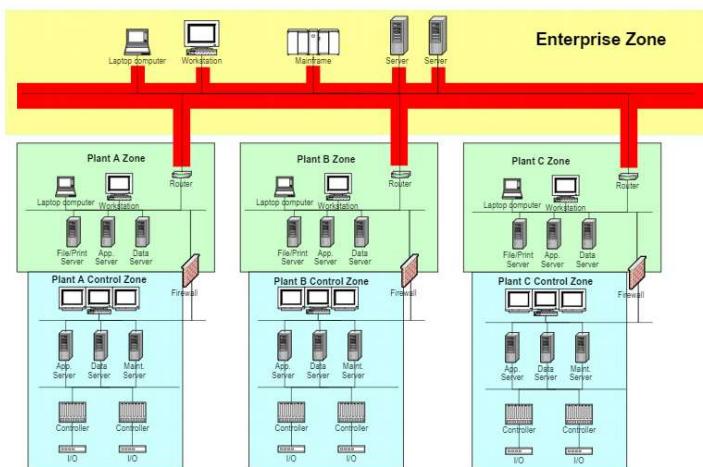


Figure 21 – Enterprise Conduit

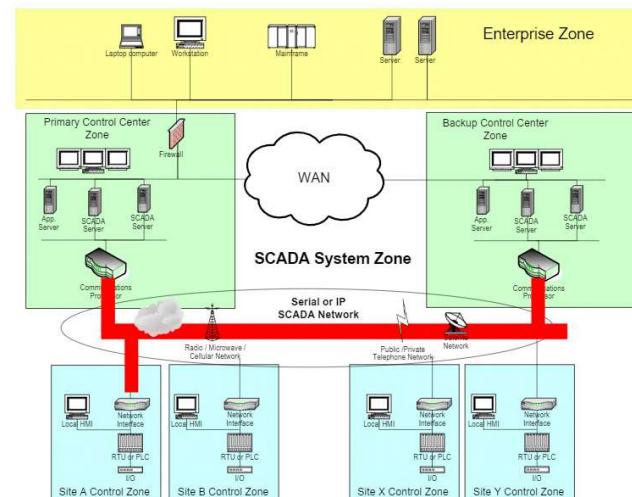


Figure 22 – SCADA Conduit Example

Controls – NIST 800-82

A key reference document that outlines:

- Overview of Industrial Control Systems
- ICS Risk Management and Assessment
- ICS Security Program and Deployment
- ICS Network Architecture
- Application of Security Controls to ICS
- Excellent Appendix Material
 - Sources of Threat Sources, Vulnerabilities and Incidents
 - Current Activities in ICS
 - ICS Security Capabilities and Tools
 - ICS Overlay (800-53 Applied to ICS)



The document provides an excellent pick list for:

- Security Controls with ICS Specific Recommendations and Guidance
- Library of Threats and Vulnerabilities

Controls – ISA/IEC 62443

62443-3-3 Provides Control Recommendations –

Foundational Requirements

FR 1 – Identification and Authentication Control (IAC)

FR 2 – Use Control (UC)

FR 3 – System Integrity (SI)

FR 4 – Data Confidentiality (DC)

FR 5 – Restricted Data Flow (RDF)

FR 6 – Timely Response to Events (TRE)

FR 7 – Resource Availability (RA)

Also has the concept of System Requirements (SR) and Requirement Enhancements (RE)

Controls – ISA/IEC 62443 (cont.)

For example, for FR 5 – Restricted Data Flow

SRs and REs	
FR 5 – Restricted data flow (RDF)	9.3 SR 5.1 – Network segmentation
SR 5.1 – Network segmentation	9.3.1 Requirement The control system shall provide the capability to logically segment control system networks from non-control system networks and to logically segment critical control system networks from other control system networks.
RE (1) Physical network segme	9.3.2 Rationale and supplemental guidance Network segmentation is used by organizations for a variety of purposes, including cyber security. The main reasons for segmenting networks are to reduce the exposure, or ingress, of network traffic into a control system and reduce the spread, or egress, of network traffic from a control system. This improves overall system response and reliability as well as provides a measure of cyber security protection. It also allows different network segments within the control system, including critical control systems and safety-related systems, to be segmented from other systems for an additional level of protection.
RE (2) Independence from non-networks	
RE (3) Logical and physical isolation of critical networks	
SR 5.2 – Zone boundary protection	9.3.3 Requirement enhancements (1) Physical network segmentation The control system shall provide the capability to physically segment control system networks from non-control system networks and to physically segment critical control system networks from non-critical control system networks. (2) Independence from non-control system networks The control system shall have the capability to provide network services to control system networks, critical or otherwise, without a connection to non-control system networks. (3) Logical and physical isolation of critical networks The control system shall provide the capability to logically and physically isolate critical control system networks from non-critical control system networks.
RE (1) Deny by default, allow b	
RE (2) Island mode	
RE (3) Fail close	

Visibility – Dragos CMF

A lot of effort is invested in Identification and Protection activities, but often Detection is overlooked.
“Prevention is Ideal, but Detection is a Must.”

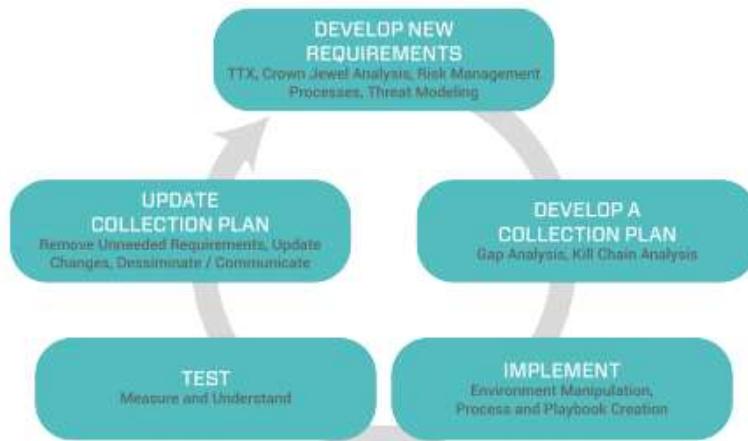


Figure 1: CMF Development and Improvement Model

	CONTROL CENTER	CONTROL CENTER	CONTROL CENTER	TRANSMISSION SUBSTATION	TRANSMISSION SUBSTATION
ASSET TYPE	Windows Human Machine Interface	Data Historian	Network Monitoring Appliance	Windows Human Machine Interface	Remote Terminal Units
DATA TYPE	Windows Event Logs	Alarms	Alerts	Windows Event Logs	Syslog
QUESTION TYPE (KILL CHAIN PHASES)	Exploration, Installation, Actions on Objectives	Actions on Objectives	Internal Reconnaissance, Command and Control, Delivery, Actions on Objectives	Exploitation, Installation, Actions on Objectives	Installation, Actions on Objectives
FOLLOW-ON COLLECTION	Registry Keys	Set Points and Tags	Packet Capture	Registry Keys	Controller Logic
DATA STORAGE LOCATION	Enterprise SIEM	Local	Enterprise SIEM	Local	Local
DATA STORAGE TIME	60 Days	120 Days	30 Days	30 Days	7 Days

Figure 2: Sample CMF of a Hypothetical Electric Company

Supply Chain and Procurement Advice

One of the most difficult challenges, but consider the below documents for support & advice

Department of Homeland Security:
Cyber Security Procurement
Language for Control Systems

September 2009

 Homeland Security

Control Systems Security Program
National Cyber Security Division



**Cybersecurity
Procurement Language
for Energy Delivery Systems**

April 2014

 Energy Sector Control Systems Working Group (ESCSWG)



Source - <https://us-cert.cisa.gov/ics/Recommended-Practices>

Supply Chain and Procurement Advice (cont.)

Department of Homeland Security:
Cyber Security Procurement
Language for Control Systems

September 2009



Control Systems Security Program
National Cyber Security Division



2. SYSTEM HARDENING

System hardening refers to making changes to the default configuration of the operating system (OS), software applications, and required third-party software to reduce vulnerabilities.

2.1 Removal of Unnecessary Services

Unnecessary services and programs are often installed on network devices.

2.1.1 Basis

Unused services in a host operating system that are left enabled are typically not monitored because these services are not used for control systems operation and maintenance shall be enabled to limit the attack surface.

2.1.2 Language Guidance

Often, networked devices ship with a variety of services enabled and programs/utilities pre-installed. These range from system diagnostics to common utilities. Many of these services have well-known vulnerabilities. Various attacks have been crafted to exploit these services to gain information leading to compromise the system.

Any program that offers a network service that "listens" on specific a port or combination of ports shall be disabled. On a Transmission Control Protocol (TCP)/Internet Protocol (IP) combination of IP address and TCP or User Datagram Protocol (UDP) port, activity is simply disabling or removing any services or programs, which may be used to exploit the system.

Port scans are the normal method of ensuring existence of required services. A port scan shall be run before the FAT with a representative, final configuration. All input/output (I/O) ports need to be scanned for UDP and TCP before the FAT and again prior to the SAT. Port scans can rarely be used in cases, scanners will disrupt operations.

2.1.3 Procurement Language

Post-contract award, the Vendor shall provide documentation detailing system services, scripts, configuration files, databases, and all other software configurations, including revisions and/or patch levels for each of the components of the control system.

The Vendor shall provide a listing of services required for any computer system applications or required to interface the control system application ports and services required for normal operation as well as any other port required for emergency operation. The listing shall also include an explanation of cross-service dependency. The vendor shall verify that the listed service is necessary for operation.

The Vendor shall verify and provide documentation that all services are required.

The Vendor shall provide, within a pre-negotiated period, appropriate and/or workarounds to mitigate all vulnerabilities associated with the proposed level of system security.

operation and maintenance of the control system prior to the FAT. The vendor shall provide documentation on what is removed and/or disabled. The software to be removed and/or disabled shall include, but not be limited to:

1. Games
2. Device drivers for network devices not delivered
3. Messaging services (e.g., MSN,^b AOL IM)
4. Servers or clients for unused Internet services
5. Software compilers in all user workstations and servers except for development workstations and servers
6. Software compilers for languages that are not used in the control system
7. Unused networking and communications protocols
8. Unused administrative utilities, diagnostics, network management, and system manager
9. Backups of files, databases, and programs used only during system development
10. All unused data and configuration files
11. Sample programs and scripts
12. Unused document processing utilities (Microsoft Word, Excel, PowerPoint, Adobe Acrobat, OpenOffice, etc.).

2.1.4 FAT Measures

The Vendor shall verify that the Purchaser requires the results of cyber security scans (with a vulnerability and active port scan, with the most current signature files) run on the control system prior to the FAT. This assessment is then compared with an inventory of the required patching status, and documentation, to validate this requirement. Other measures provided by the vendor include:

1. The Vendor shall provide for each networked device or class of device (e.g., server, workstation, switch) the following configuration documentation lists:
 - a. Network services required for the operation of that device. Indicate the service name (e.g., TCP and UDP) and port range
 - b. Dependencies on underlying operating system services
 - c. Dependencies on networked services residing on other network devices
 - d. All the software configuration parameters required for proper system operation
 - e. Certified OS, driver, and other software versions installed on the device
 - f. Results found by the vulnerability scans with mitigations affected.
2. The Vendor shall install firmware updates available for the computer or network device from the system manufacturer at the time of installation and provide documentation.
3. The Vendor shall provide a summary table indicating each communication path required by the system. Include the following information in this table:

h. Product Disclaimer

References herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof.

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- a. Source device name and media access control (MAC) and/or IP address
- b. Destination device name and MAC and/or IP address
- c. Protocol (e.g., TCP and UDP) and port or range of ports.

4. The Vendor shall perform network-based validation and documentation steps on each device:
 - a. Full TCP and UDP port scan on Ports 1–65535. This scanning needs to be completed during a simulated "normal system operation."

2.1.5 SAT Measures

The Vendor shall compare the results of cyber security scans run on the system, as a primary activity of the SAT, with an inventory of the required services, patching status, and required documentation. At the conclusion of the SAT and before cutover or commissioning, the above cyber security scans (with the most current signature files) must be run again.

2.1.6 Maintenance Guidance

Document the system operating system and software patches as the system software evolves to allow traceability and to verify no extra services are reinstated. Anytime the system is upgraded, it is recommended that system vendors rerun appropriate subsets of the FAT on the baseline system before delivery to the purchaser.

2.1.7 References

North American Electric Reliability Corporation (NERC) CIP-007-1 R2, "Ports and Services," Cyber Security—Critical Infrastructure Protection, June 1, 2006.

ANSI/ISA-99.00.01, Security for Industrial Automation and Control Systems Part 1: Terminology, Concepts, and Models, Section 5.¹

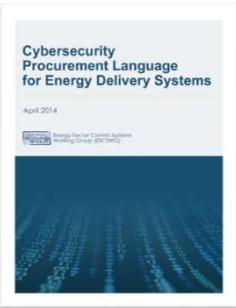
ISA-99.00.02 (DRAFT), Security for Industrial Automation and Control Systems: Part 2: Establishing an Industrial Automation and Control Systems Security Program, Sections 5.3, B.14, C.3.

National Institute of Standards and Technology (NIST)¹—Special Publication 800-42, "Guideline on Network Security Testing."

2.1.8 Dependencies

None. This topic is stand-alone.

Supply Chain and Procurement Advice (cont.)



3. THE SUPPLIER'S LIFE CYCLE SECURITY PROGRAM

The Supplier's life cycle security program is an important consideration in the procurement process. Vulnerabilities frequently result from architecture, design, weaknesses, and vulnerabilities in hardware, software, and firmware coding, as well as in bundled third-party products. Many energy delivery system security vulnerabilities are the direct result of writing software with inadequate attention to secure coding practices that reduce the risk of successful deliberate and persistent malicious attacks. Life cycle security programs provide a structured way for developing robust products with fewer weaknesses and vulnerabilities or finding and remediating them before software and systems are delivered and installed in the Acquirer's environment. Supplier post-production support is critical for maintaining secure software and systems, including remediating newly discovered vulnerabilities and ensuring that spare parts can be replaced with genuine parts. Validating that hardware, software, or firmware has been delivered as it was ordered and shipped—without being tampered with or otherwise modified—is also important. After a product has been removed from service, the disposal of that product provides opportunities for the compromise of information and configurations that the Acquirer or Supplier may deem sensitive.

3.1 Secure Development Practices

Secure product development practices are a set of processes integrated into the system development life cycle (SDLC) that reduce the security risks of the overall product. These practices help to develop more robust hardware, software, and firmware with fewer weaknesses and vulnerabilities, as well as identify and remediate weaknesses and vulnerabilities before implementation. Secure development practices ensure that security is integrated into all phases of the SDLC and is considered a key component of system development.

Baseline procurement language:

- 3.1.1. The Supplier shall provide summary documentation of its secure product development life cycle including the standards, practices (including continuous improvement), and development environment (including the use of secure coding practices) used to create or modify Supplier-provided energy delivery system hardware, software, and firmware. If applicable, the Supplier shall document how the most critical application security weaknesses (including OWASP Top 10 or SANS Top 25 Most Dangerous Software Errors) are addressed in the Supplier's SDLC.
- 3.1.2. As specified by the Acquirer, the Supplier shall identify the country (or countries) of origin of the procured product and its components (including hardware, software, and firmware). The Supplier shall identify the countries where the development, manufacturing, maintenance, and service for the product are provided. The Supplier shall notify the Acquirer of changes in the list of countries where product maintenance or other services are provided in support of the procured product. This notification shall occur within [a negotiated time period] prior to initiating a change in the list of countries.

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3.1.3. The Supplier shall provide a Quality Assurance program and validate that the software and firmware of the procured product have undergone Quality Control testing to identify and correct potential cybersecurity weaknesses and vulnerabilities. This testing shall include fuzz testing, static testing, dynamic testing, and penetration testing. The Supplier shall use positive and appropriate negative tests to verify that the procured product operates in accordance with requirements and without extra functionality, as well as monitor for unexpected or undesirable behavior during these tests. This testing may be done by the Supplier or an independent entity. The Supplier shall provide summary documentation of the results of the testing that includes unresolved vulnerabilities and recommended mitigation measures.

3.1.4. The Supplier shall provide summary documentation of its coding reviews, including defect lists and plans to correct identified vulnerabilities.

3.1.5. The Supplier shall communicate security-related technical issues with a single technical point of contact (e.g., a company support email address or a company support phone number), as specified by the Acquirer. The Supplier shall communicate with the Acquirer within [a negotiated time period] (see Section 3.3.3). This is not intended for non-technical contract-related issues.

3.1.6. The Supplier shall provide documentation of all input validation testing including, but not limited to, measures for prevention of command injection, Structured Query Language (SQL) injection, directory traversal, Remote File Include, Cross-Site Scripting (XSS), and buffer overflow.

3.1.7. The Supplier shall provide a contingency plan for sustaining the security of the procured product in the event the Supplier leaves the business (e.g., security-related procedures and products placed in escrow).

3.1.8. The Acquirer shall have the right to request documentation of the Supplier's implemented cybersecurity program, including recent assessment results or conduct periodic [at a negotiated frequency and scope] on-site security assessments at the Supplier's facilities. These on-site security assessments may be conducted by an independent third party, at the discretion of the Acquirer.

3.2 Documentation and Tracking of Vulnerabilities

When security vulnerabilities are discovered in hardware, software, and firmware, the timely application of corrective actions and/or mitigation steps can reduce the likelihood that adversaries will be able to exploit these vulnerabilities in energy delivery systems. Some of these vulnerabilities may be publicly disclosed before the Supplier can develop remedies; others may be kept from disclosure until remedies are available.

Security breaches may also affect the cybersecurity of the procured product. Such breaches may involve a compromise of security involving the Supplier's organization, or any organization involved in the product's supply chain. Security breaches may result in the loss of sensitive product design

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Case Studies

SCADA REFERENCE AND DCS REFERENCE

SCADA Reference – Railway System

Railways operate many Industrial Control Systems (ICS) and Asset Protection Systems, examples such as –

1. Safety Critical Railway Signalling Systems
2. Safety Critical Power Supervisory Systems
3. Wayside Asset Protection Systems
4. Voice and Radio Telecommunication Systems

Some requirements

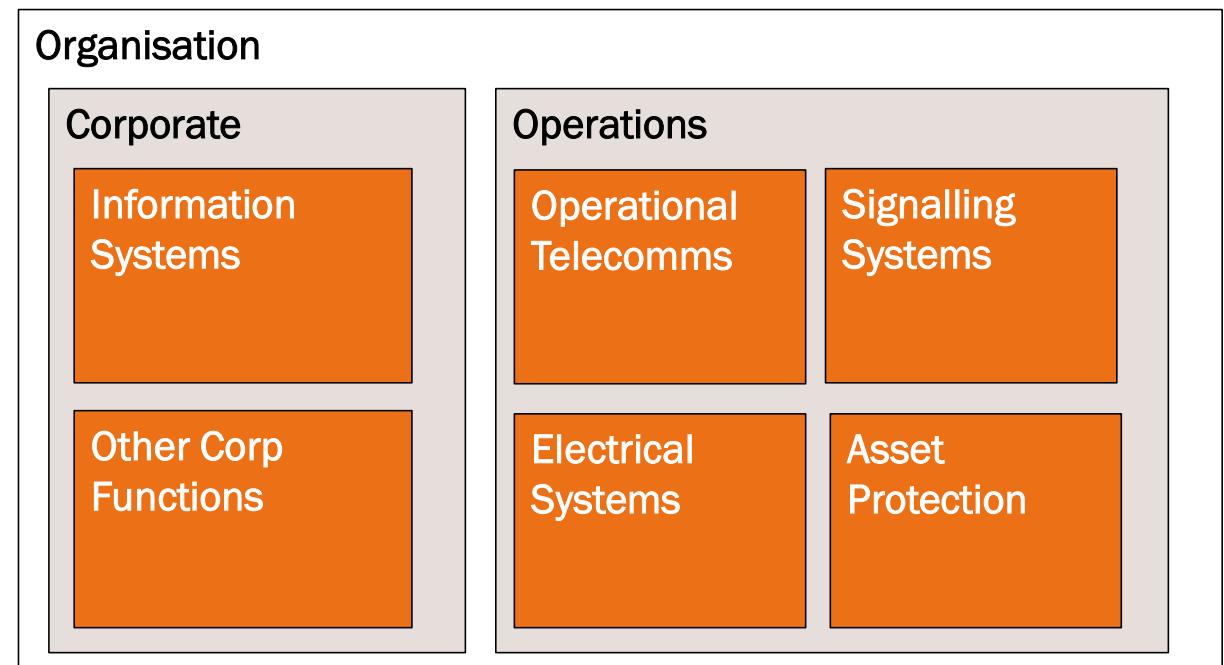
1. A common network to transport both Information and Operational Technology Systems that can segregate and segment services
2. Build a system that is flexible to be carried across Private Optical Fibre, Microwave Transmission Systems, Carrier Data Services and even Satellite Systems
3. High Availability
4. Cost Effective

SCADA Reference – Railway System (cont.)

Domain Model – The Conceptual View – ESA View

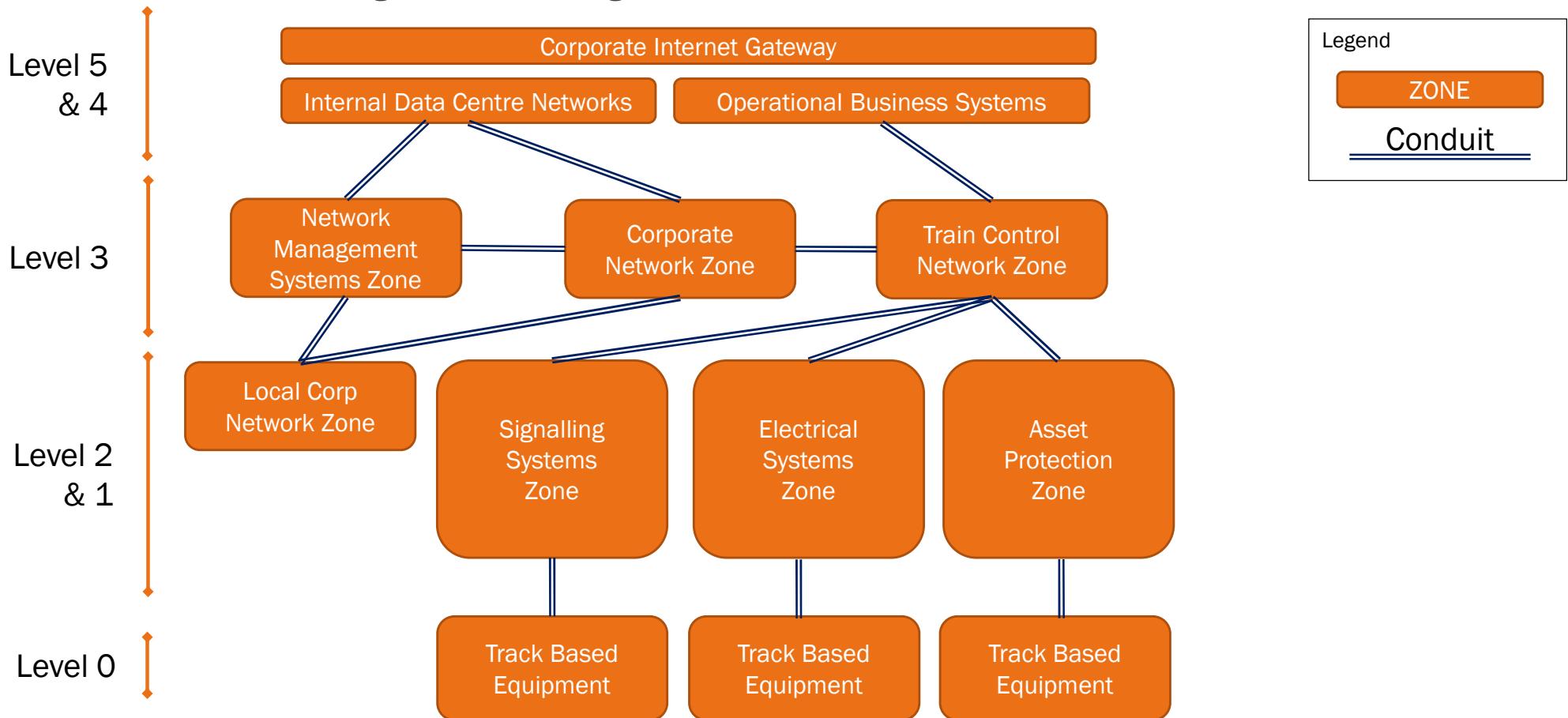
This helps the Enterprise Security Architect:

- Define Policy Domains and Policy Authorities
- Understand the interaction between domains, which will drive Security Capability Selection



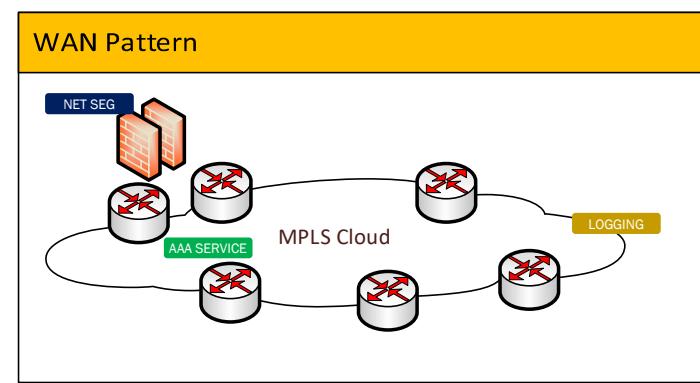
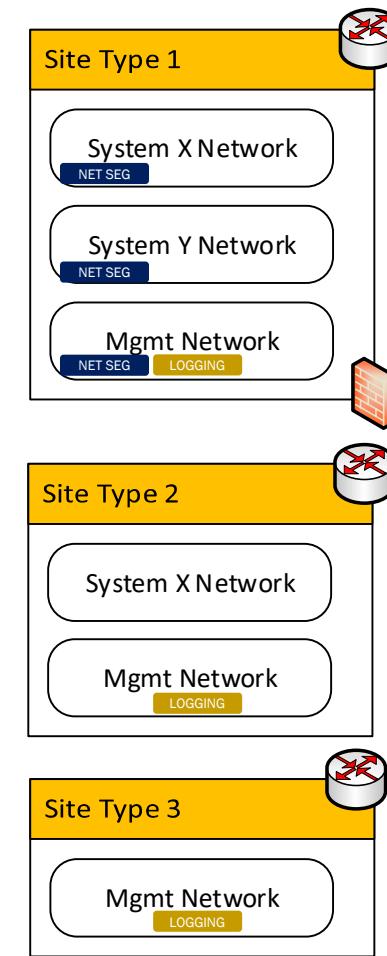
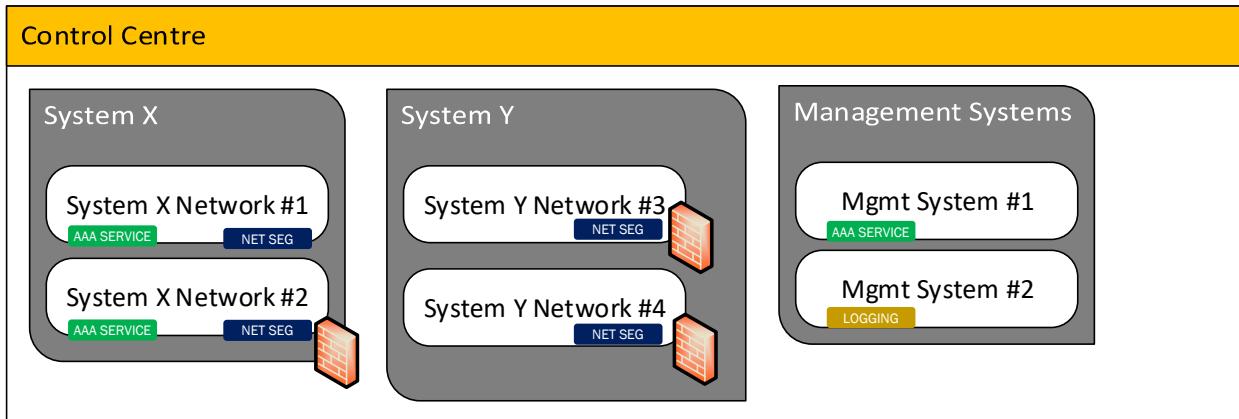
SCADA Reference – Railway System (cont.)

Zones and Conduits - Logical – The Designers View



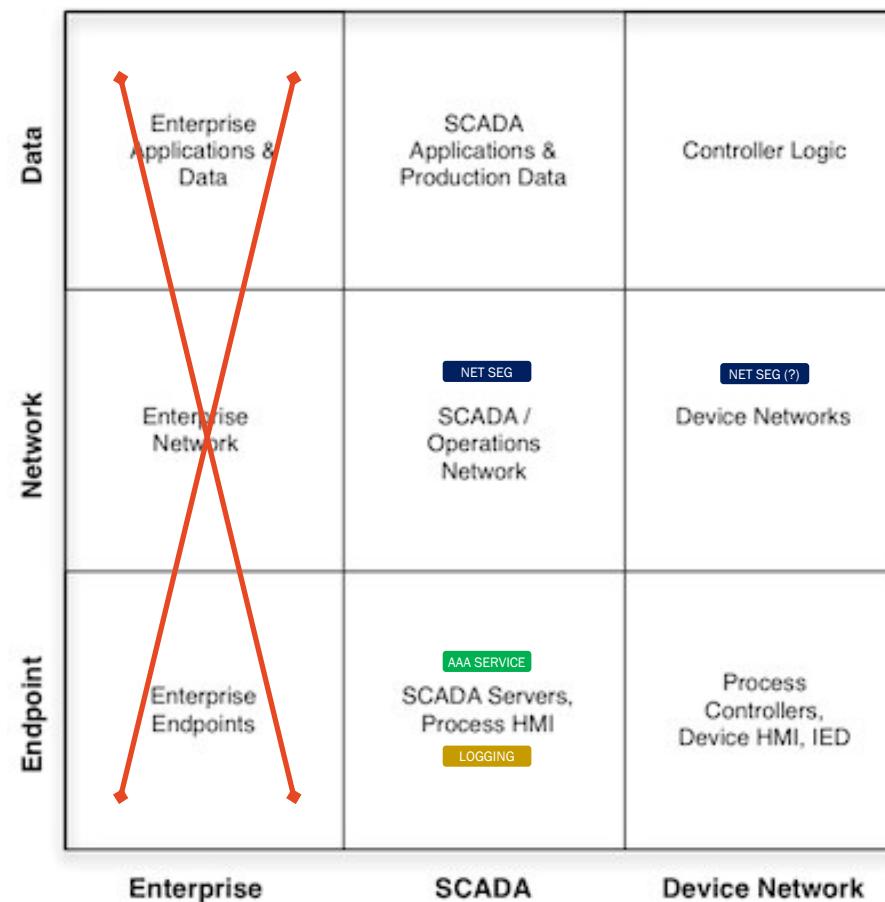
SCADA Reference – Railway System (cont.)

Example Physical Architectures – The Builders View



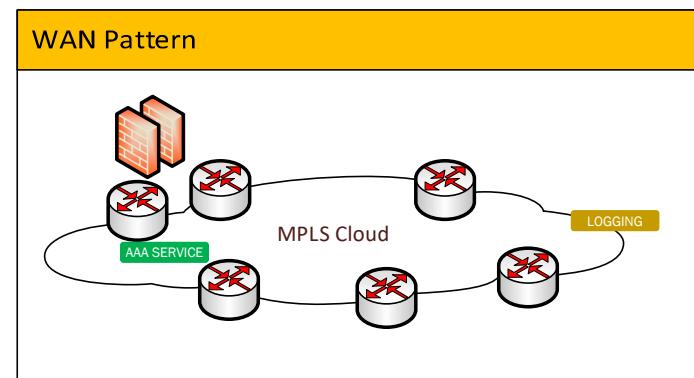
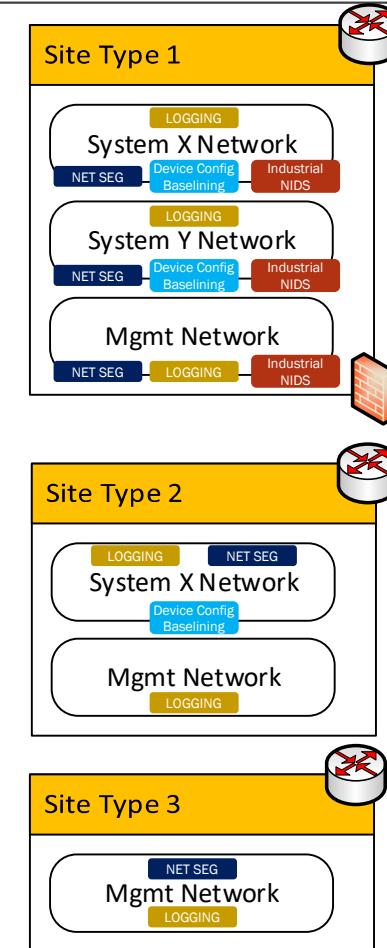
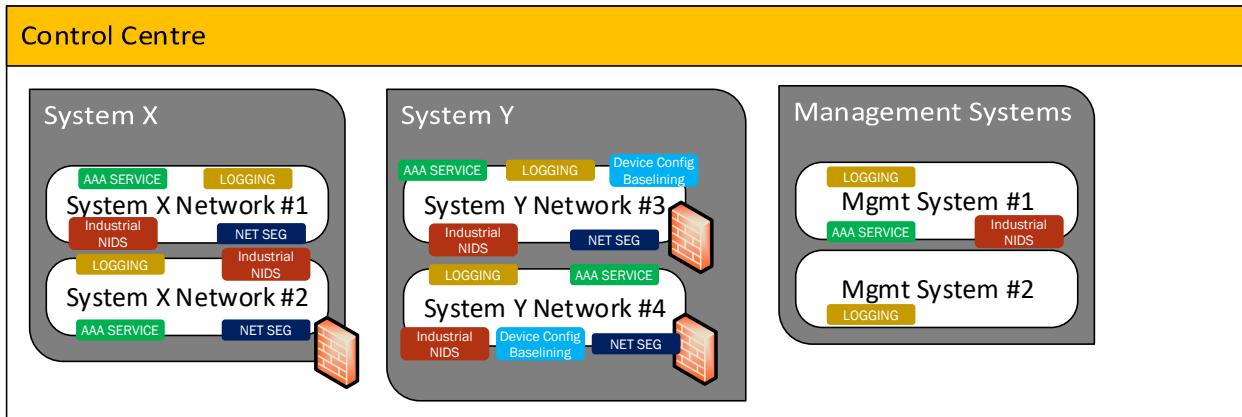
SCADA Reference – Railway System (cont.)

Review - Consider Knapp's 3x3



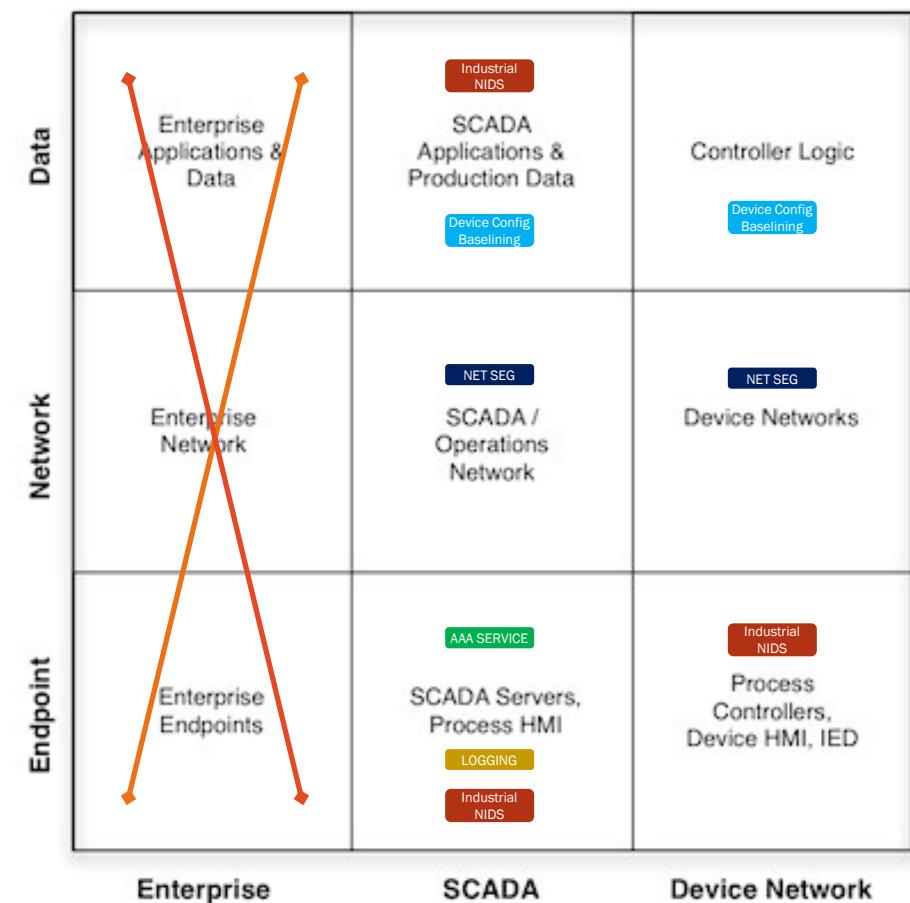
SCADA Reference – Railway System (cont.)

Example Physical Architectures – The Builders View



SCADA Reference – Railway System (cont.)

Review - Consider Knapp's 3x3



DCS Reference – Electricity Generation

A Coal Fired Power Station is a large, complicated and interconnected Process. A Power Station has many sub systems:

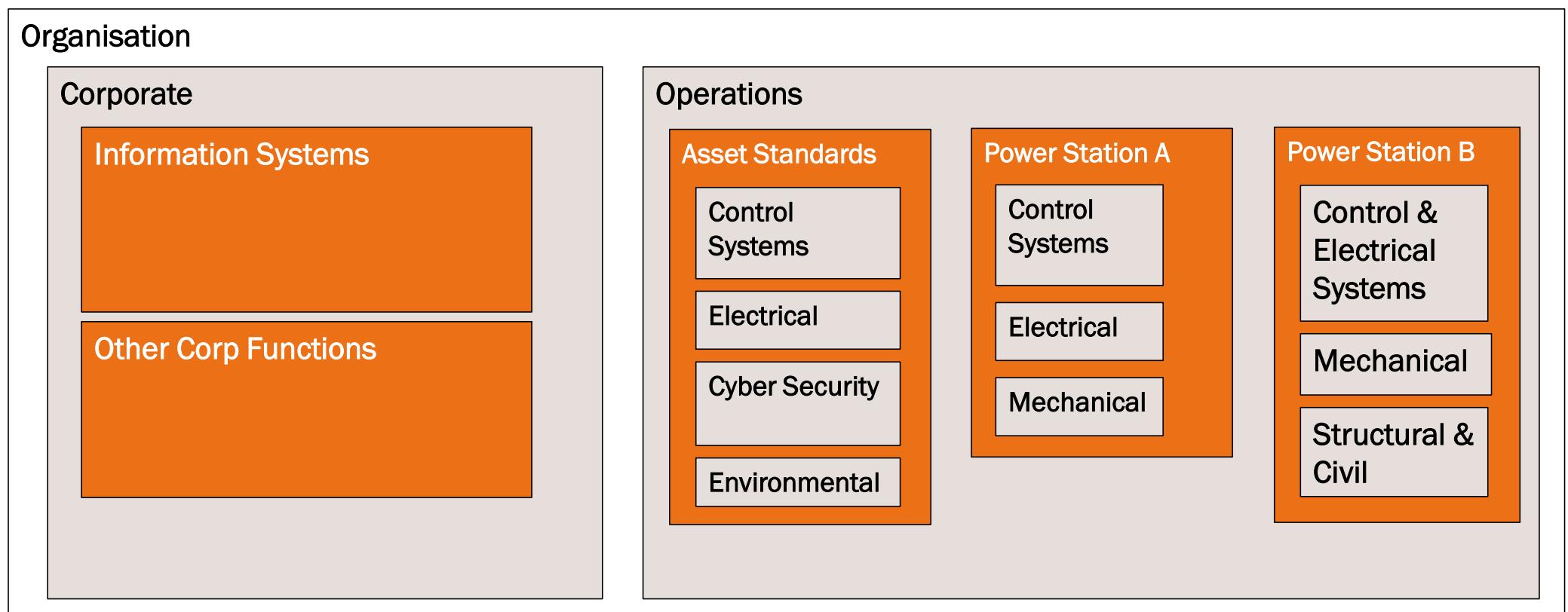
1. Air & Fuel
2. Steam Cycle
3. Electrical Generation Equipment
4. Water Chemistry Systems
5. Balance of Plant (BoP) - Station Equipment

Requirements

1. You have to work within the Vendor's Distributed Control System (DCS) approved standards or risk support issues
2. Build an integrated Control and Monitoring System
3. Is probably within a small contained geographic region, so LAN Networking & Security services are a critical sub system
4. Availability is especially critical for Energy
5. You need to consider a secure method of allowing the DCS vendor to have access to the system for telemetry and remote support
6. You need to expose process data to enable real time business decisions

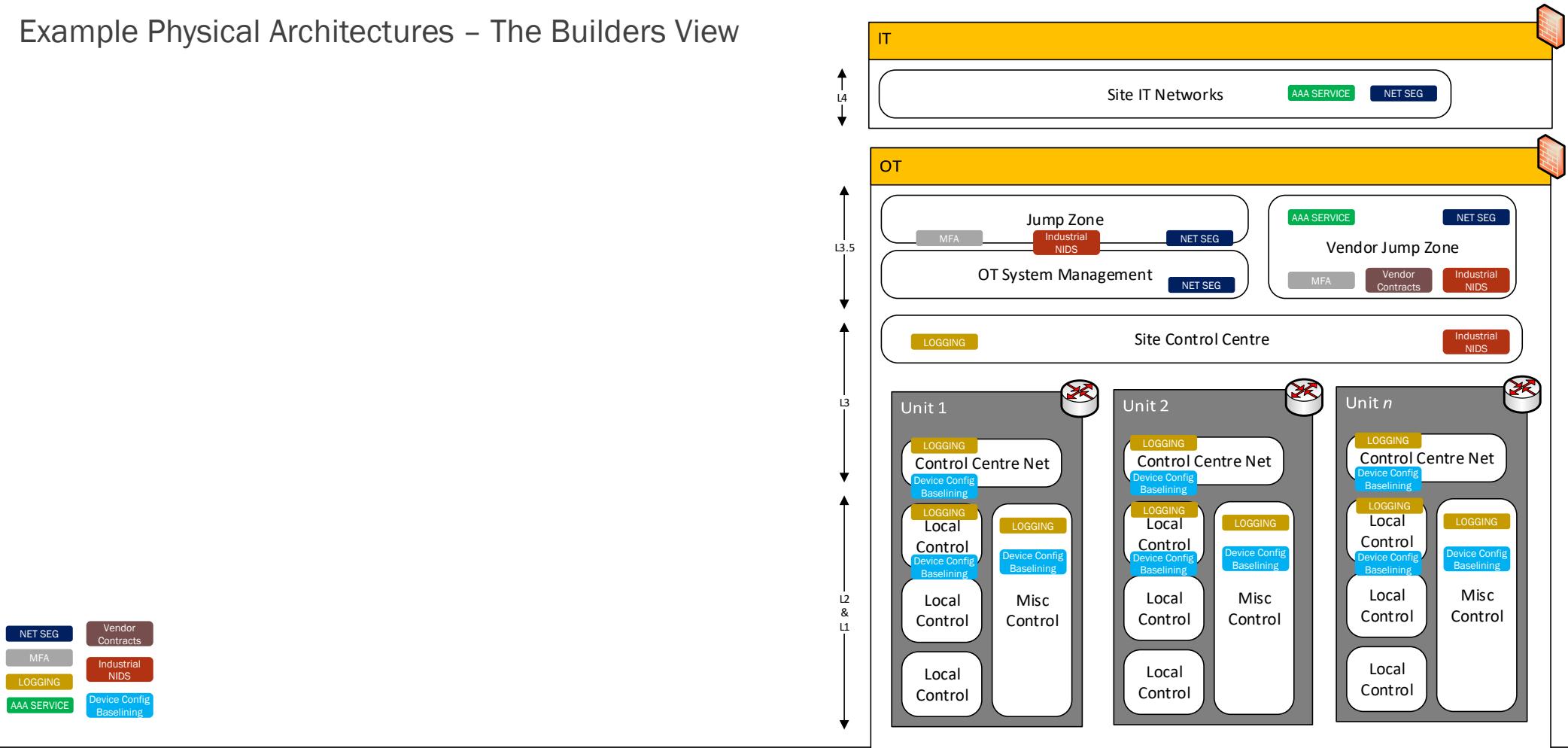
DCS Reference – Electricity Generation (cont.)

Domain Model – The Conceptual View – ESA View



DCS Reference – Electricity Generation (cont.)

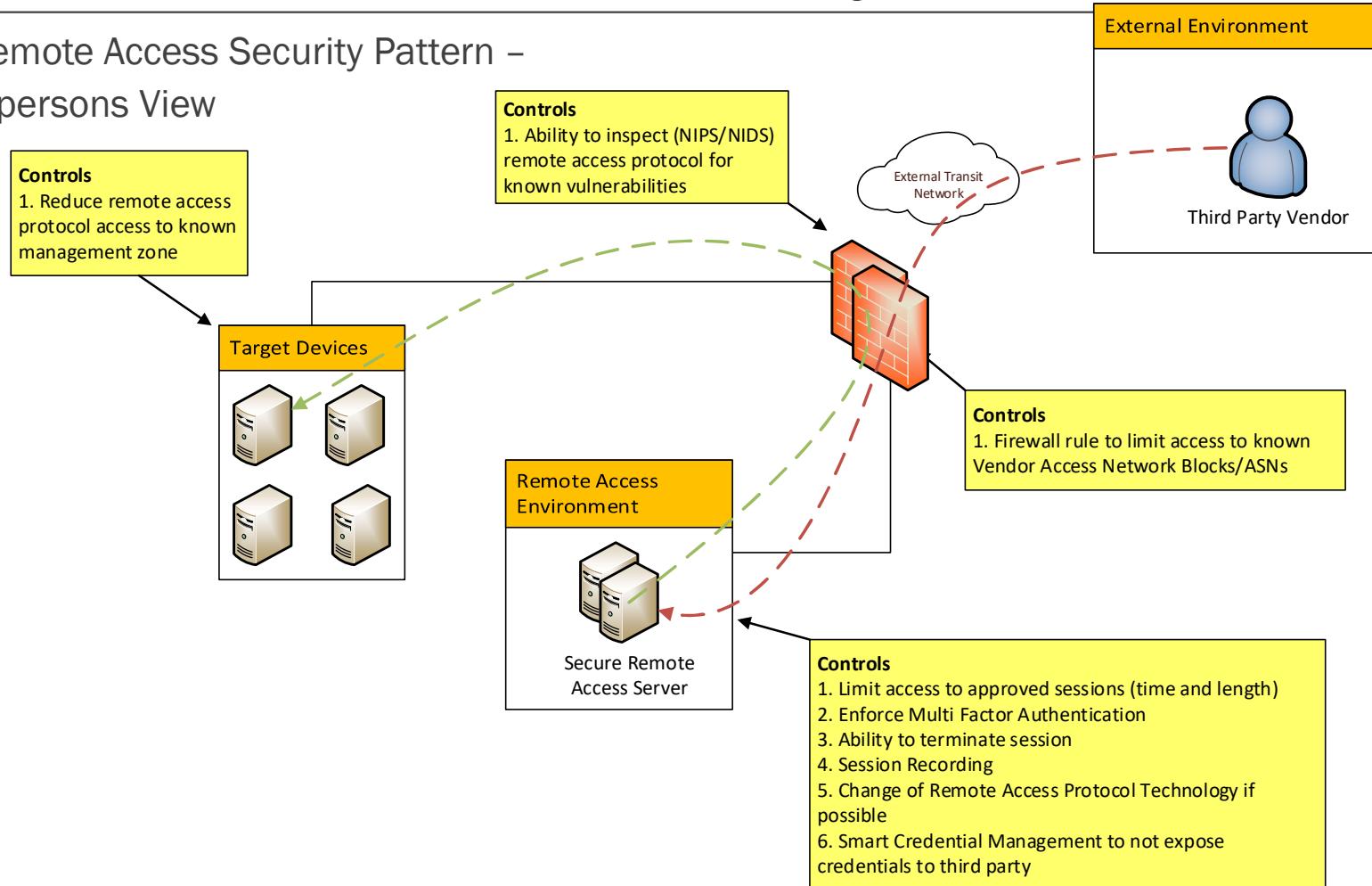
Example Physical Architectures – The Builders View



DCS Reference – Electricity Generation (cont.)

Example Remote Access Security Pattern –

The Tradespersons View



Upkeep of Architecture

HOW TO SUSTAIN CYBER SECURITY MANAGEMENT OF SYSTEMS

Make Architecture a Living Process

- Architecture can not be a fire and forget project
- Seek management support and buy in – articulate that architecture is a whole of life cycle capability
- It has to be embedded within the Business, Technology and Projects Processes

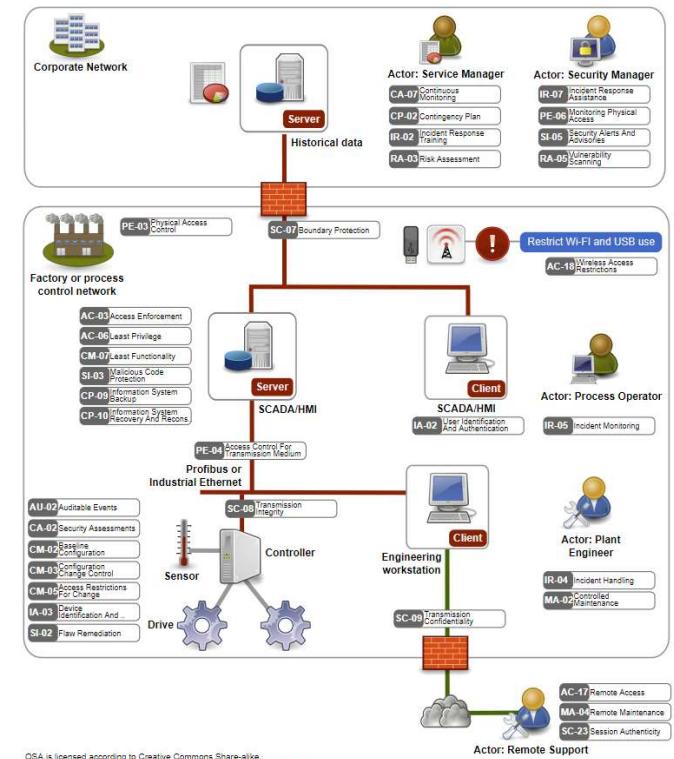
OpenSecurityArchitecture.org – Patterns

Security Patterns are an excellent tool to help:

- share knowledge;
- sustain standards;
- simplify operational cyber security risk; and
- to make the Architecture Review Board (ARB) process as efficient as possible.

OpenSecurityArchitecture.org SP-023 is an excellent example

This can be a reference design that can be reused in the organisation and makes the Design and Review Process Simpler - it is easier to do version control with a pattern.



Next Steps

SOME HOMEWORK FOR YOU WHEN YOU GET BACK TO WORK

Next steps

Next Week

1. Review the content of this presentation and rate your organisations capability against
 - Architecture Planning Capability
 - Architecture Establishing Capability
 - Architecture Upkeep Capability
2. Reach out to your tech teams to seek their views & support

Next Month

1. Build a central point to keep your architectural material
2. Consider whether the C2M2 v2 materials are a good starting point for your organisation
3. Identify your capability gaps and what the plan is to fill them
4. Seek Management Support

Next 6 Months

1. Embed managing Cyber Security across the life cycle of new projects
2. Build an uplift program to audit your *as-is* state for security capabilities and build a plan to get them to the *to-be* state

Questions?

 @beLarge

 <https://github.com/belarge>