THE SPECTRUM GROUP

Systems Integration: Effective DOD Test & Evaluation

11 CANAL CENTER PLAZA, SUITE 103, ALEXANDRIA, VA 22314
703.683.4222 | INFO@SPECTRUMGRP.COM | WWW.SPECTRUMGRP.COM

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Discussion/Agenda

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- Systems Integration: Statements, Motivations, Objectives
- Integration, Test & Evaluation history: STATING THE PROBLEM
- INTRO to PLM (Product Life-cycle Management), CMMI, Systems integration, Automated testing
- System Integration planning and execution
- Systems Integration Test configurations
- Automated Testing Strategies, Benefits
- System Integration Results and Benefits
- Summary

Systems Integration Statements

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- **Definition: The bringing together of the component subsystems into one system and ensuring that the subsystems function together as a system.**
- **In the DOD, ATC, and other sectors, significant cost, quality, and schedule impacts, *perceived* as attributable to the Test and Evaluation programs of many projects and their embedded systems, have often been observed.**
- **Systems Integration in the past has been in some cases restricted, viewed as a contributor to these impacts, and therefore not cost effective in some medium to large scale test programs.**
- **This presentation demonstrates otherwise**

DOD to Industry Engineering Directives: Motivations & Objectives

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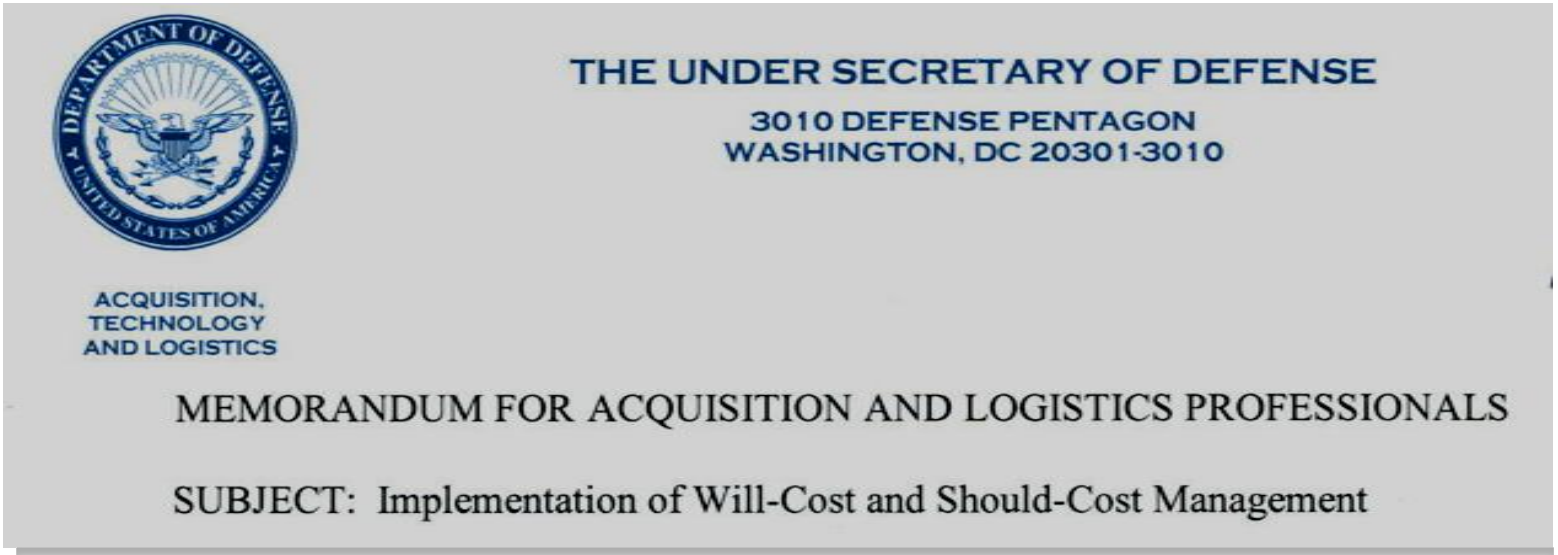

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

MEMORANDUM FOR ACQUISITION AND LOGISTICS PROFESSIONALS

SUBJECT: Implementation of Will-Cost and Should-Cost Management

9. In the area of test:

   a. Take full advantage of integrated Developmental and Operational Testing to reduce overall cost of testing;
   b. Integrate modeling and simulation into the test construct to reduce overall costs and ensure optimal use of National test facilities and ranges.

10. Identify an alternative technology/material that can potentially reduce development or life cycle costs for a program. Ensure the prime product contract includes the development of this technology/material at the right time.

PLM
CMMI
Systems Integration

Automated Testing
TESTPLANT/EGGPLANT

Integration, Test & Evaluation
Historically, THE PROBLEM

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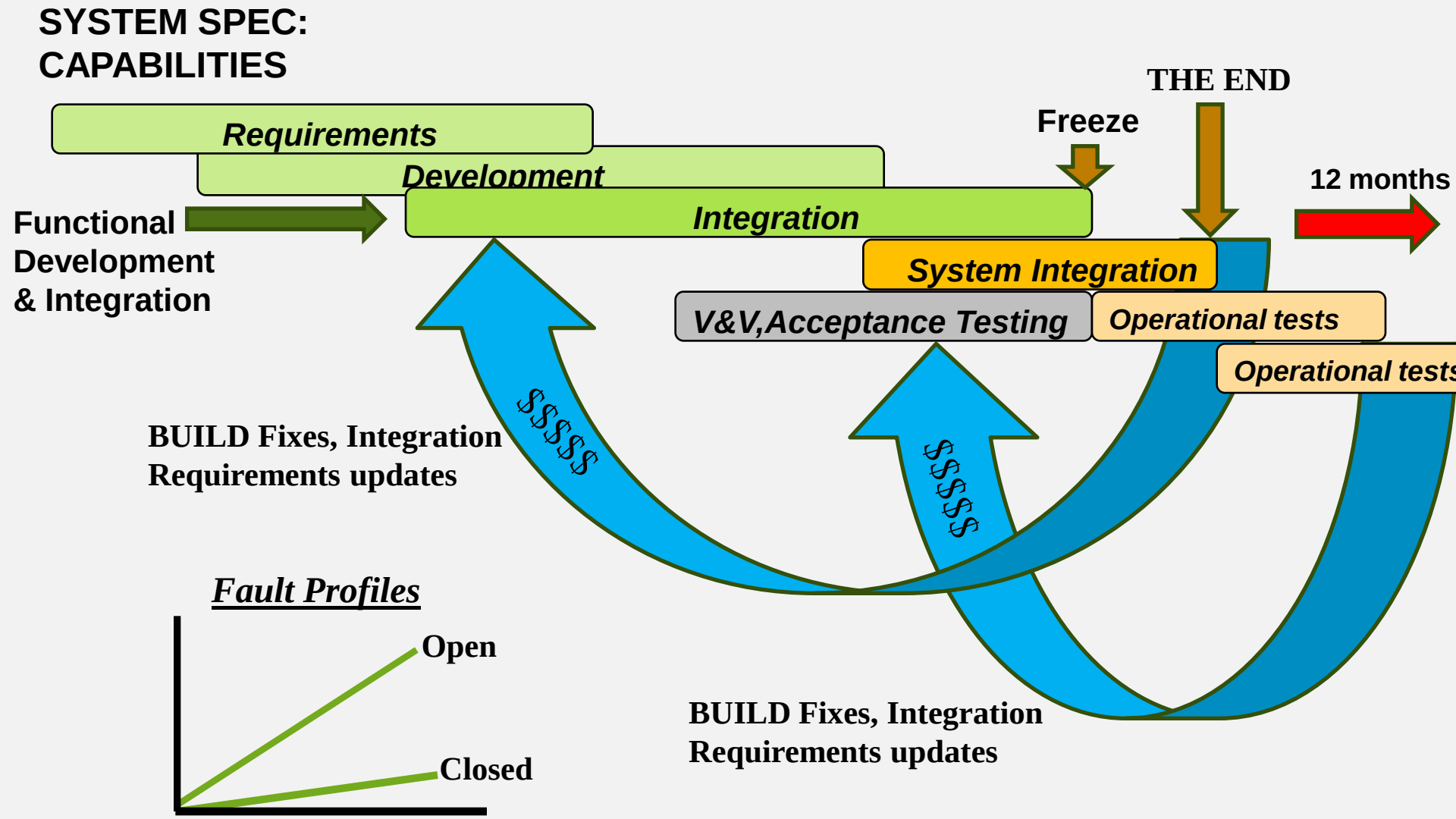

Cost, Schedule, Quality Issues: THE PROBLEM Contributors

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- Inadequate PLM, enforcement of life-cycle & Build entrance and exit criteria
- Not involving the operational USER throughout the PLM
- PLM Functional focus, rather than operational capability
- Cross IPT Independent teams in Integration, Systems, V & V, TEST
- Shall/Test case (Breadth & Depth) proliferation in life-cycles across teams
- Duplicate, overlapping, Repetitive SPRs
- Inefficient or absent use of automated testing, non-cost effective strategies
- Life-cycle/Team Testing and analysis tool proliferation
- Lack of Test & Analysis tool certification

PLM, CMMI, Systems Integration Automated Testing (PCSIA)

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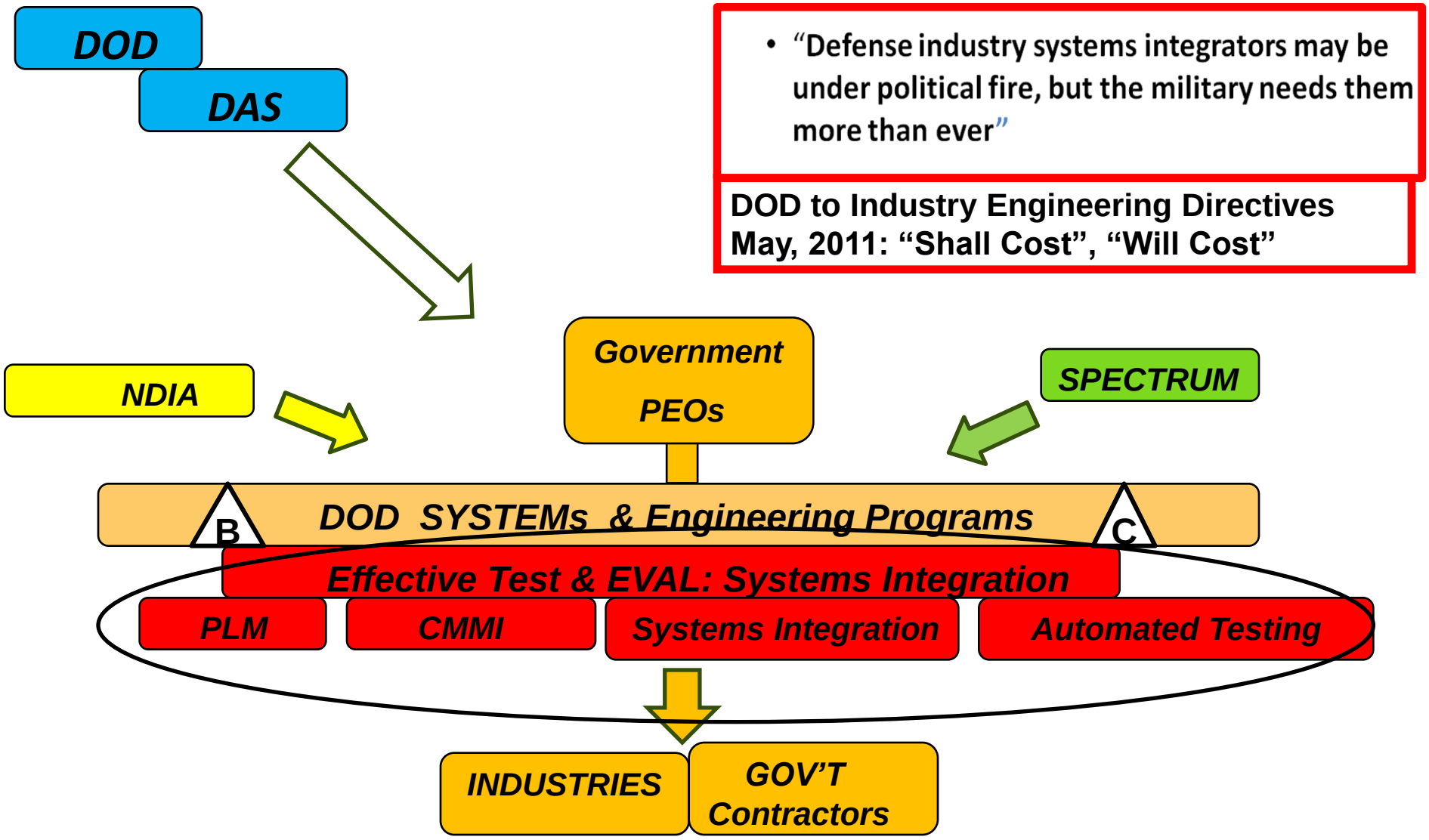

Product Life Cycle Management (PLM) Considerations

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- **Product Lifecycle Management (PLM) is a strategic and integrated business approach that applies a set of engineering process and management solutions in support of the collaborative creation, development, execution, test, production, and use of products across the extended enterprise spanning from product concept to maintenance and support.**

❖ "Systems Integration by definition is closely tied to and must be embedded in the critical path of HW/SW development/integration, builds definition & releases, V & V testing, subcontractor management, and system & operational testing"

❖ " Systems Integration is not just an independent evaluation and assessment of a collection of subsystems into a system, but embedded in the principles and guidelines of PLM (Product Life-cycle Management) and CMMI. It can be further optimized and enhanced by the use of automated testing strategies employed by new technology tools such as TESTPLANT/eggplant."

PLM

- Product Life-Cycle Management
- Engineering Process
- Managed Builds/Products
- Development/Test Gates

CMMI

- Project Collaborations
- Teaming
- Stakeholders
- Roles, Responsibilities
- Team Integration, Test Planning

Systems Integration

- System Integration PLM Plan
- Labs, facilities, analysis, tools
- System Capability Management
- Entrance/Exit build release criteria
- Cross IPT Teaming

Automated Testing

- PLM Strategic Planning
- Embedded, Institutionalized
- Build Evaluation/Assessment
- Data, analysis, logistics
- Government Testing support

TESTPLANT EGGPLANT

- Complete Test Process capabilities
- Cost effective Strategies
- New imaging technologies
- non-invasive, local & remote testing

The Roles of Systems Integration

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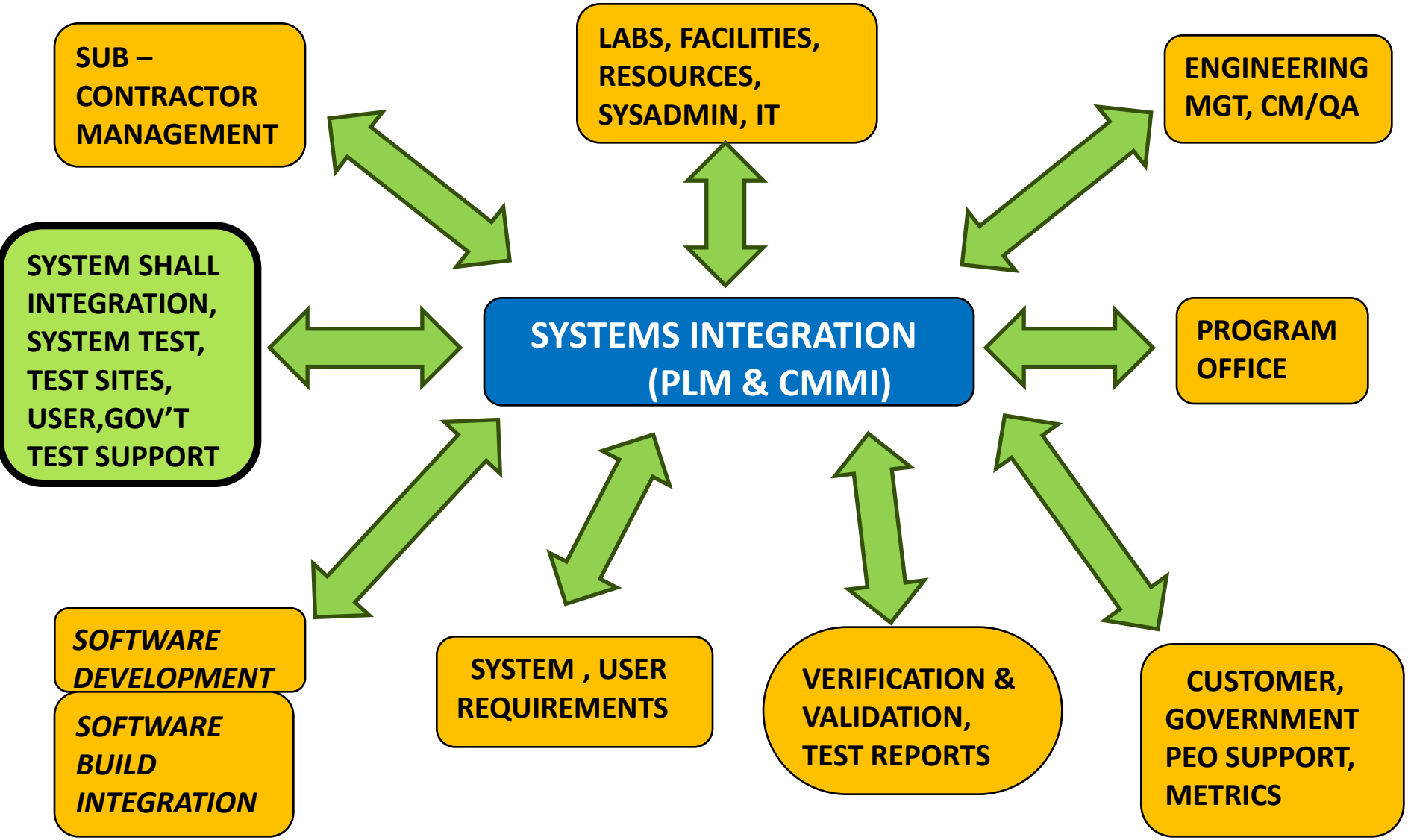

Systems Integration Planning

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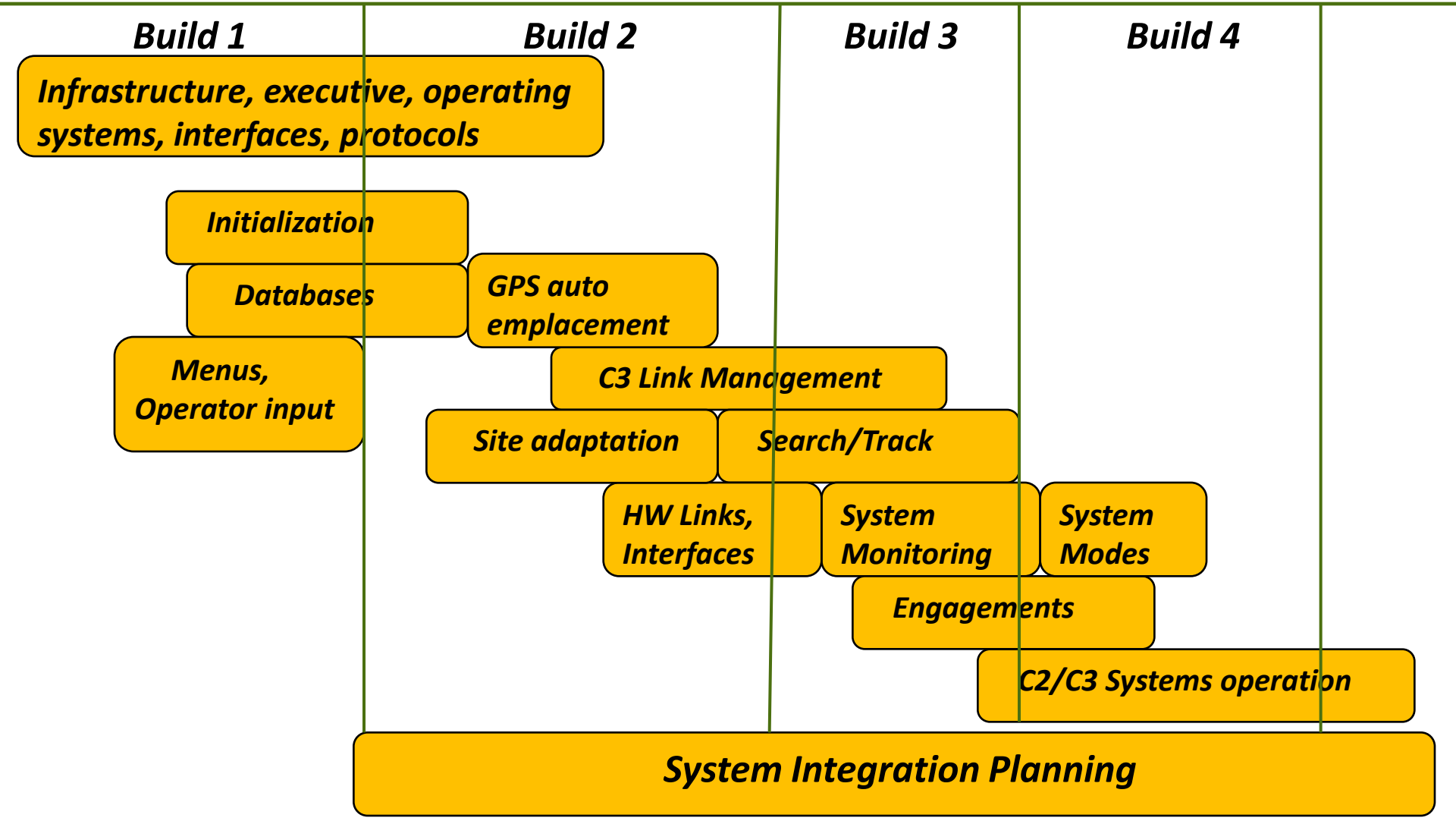

Systems Integration Planning

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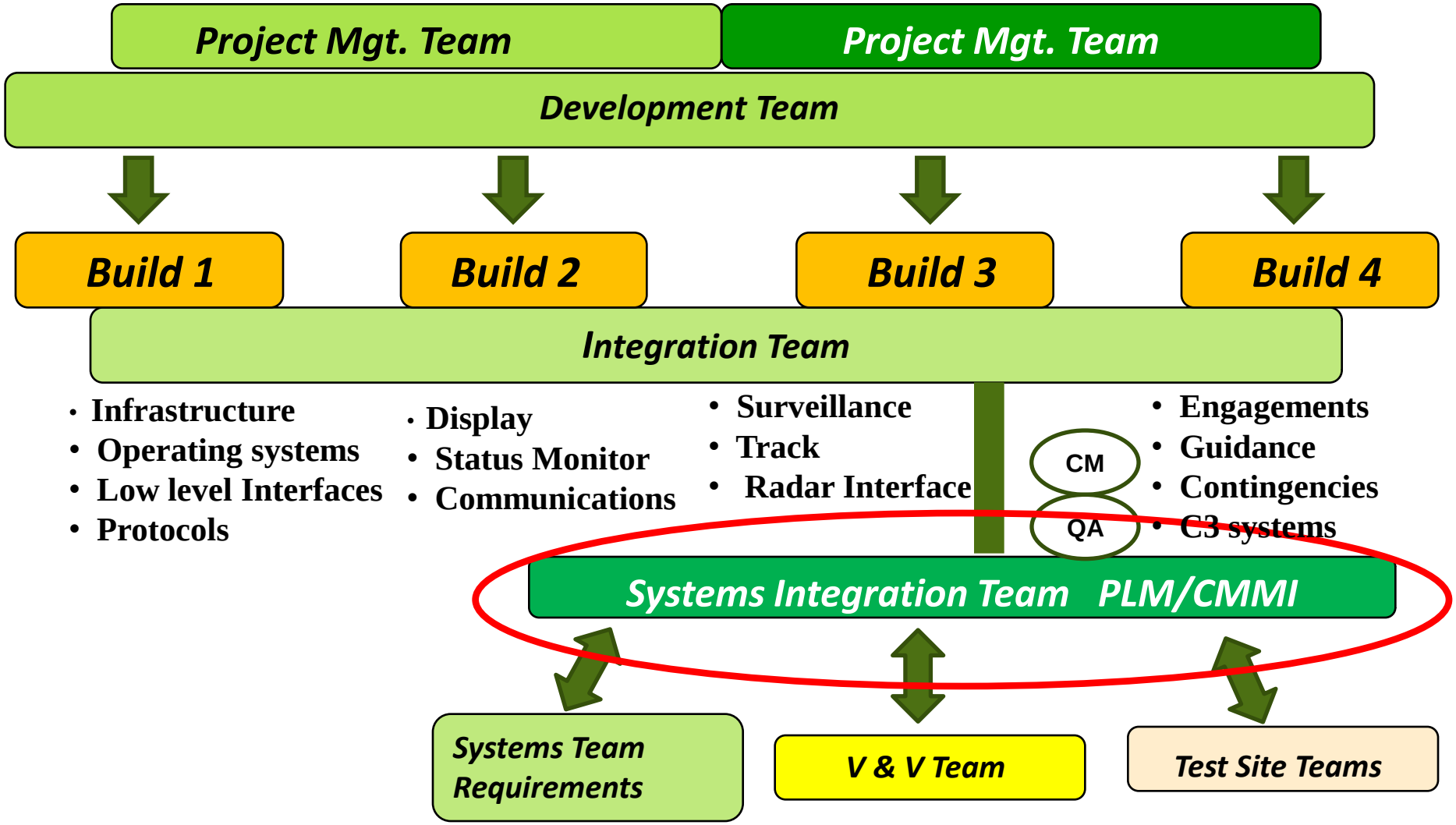

Systems Integration Team, CMMI

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The CMMI Product Integration process area describes system integration strategies supporting effective Test and Evaluation execution, such as:

- Setup a team, identify stakeholders, team roles & responsibilities
- Establish a System integration plan via “system spec shall” testing, tracking, and capability/limitation measurement techniques through base-lining, regression Testing
- Coordination of integration, V & V, system Test, and operational Test “system shall” test coverage, breadth & depth
- Establish and utilize entrance and exit criteria disciplines via PLM methods to form the basis of readiness review meetings and critical release decisions
- Ensure systems engineering/operational user active participation in test designs, system evaluation and analysis
- Establishment of integrated lab facility and test site resources, Build/Test tools, and an instrumentation/analysis logistics plan
- Execute an incremental plan for achieving “full” system level integration by testing with “live” hardware, with a planned mix of simulators in the total system
- Examination/coordination of Test problem reports from various teams and sites
- Management and coordination of build releases to major test teams & events, CM/QA

Systems Integration Execution

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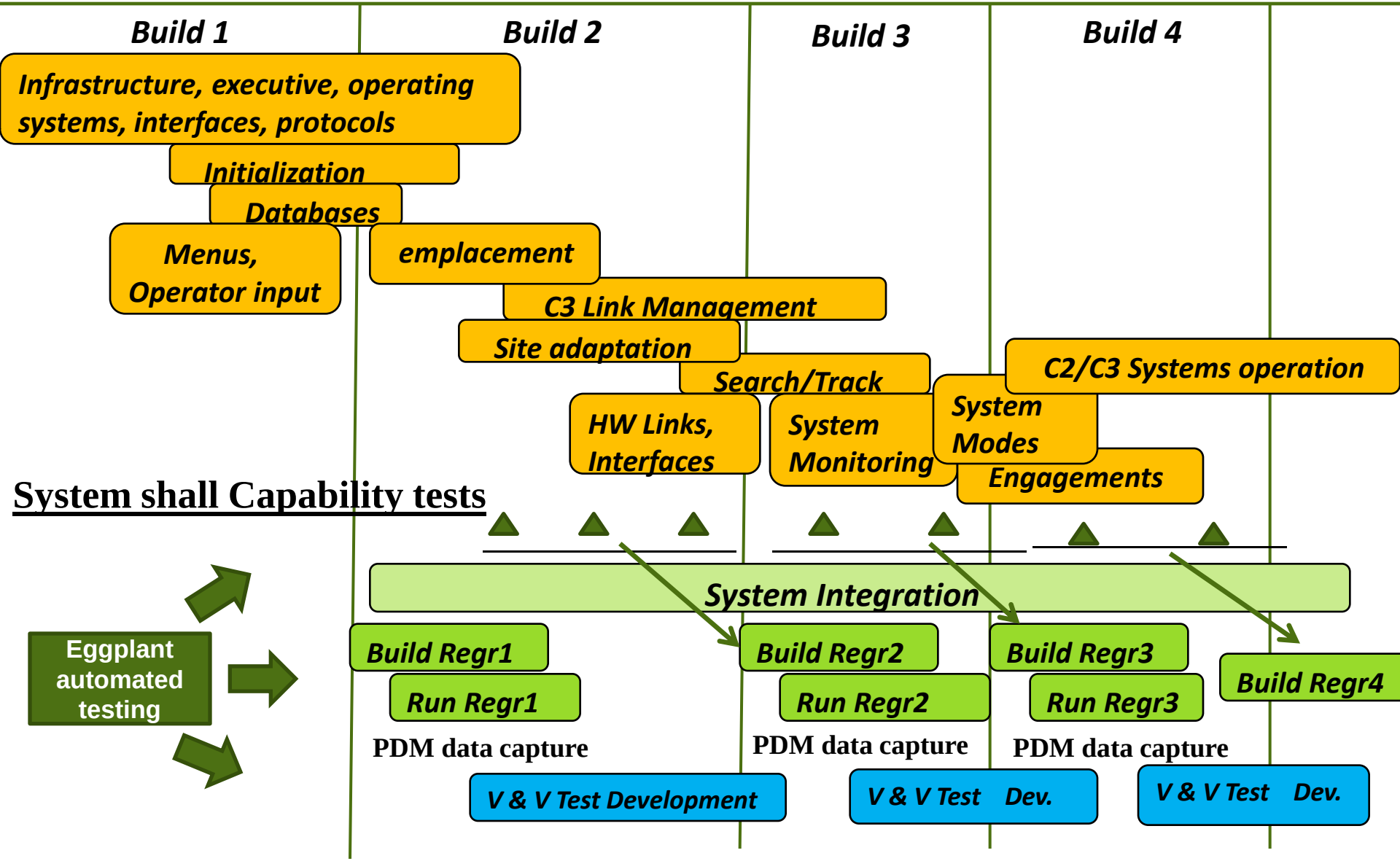

Systems Integration Execution

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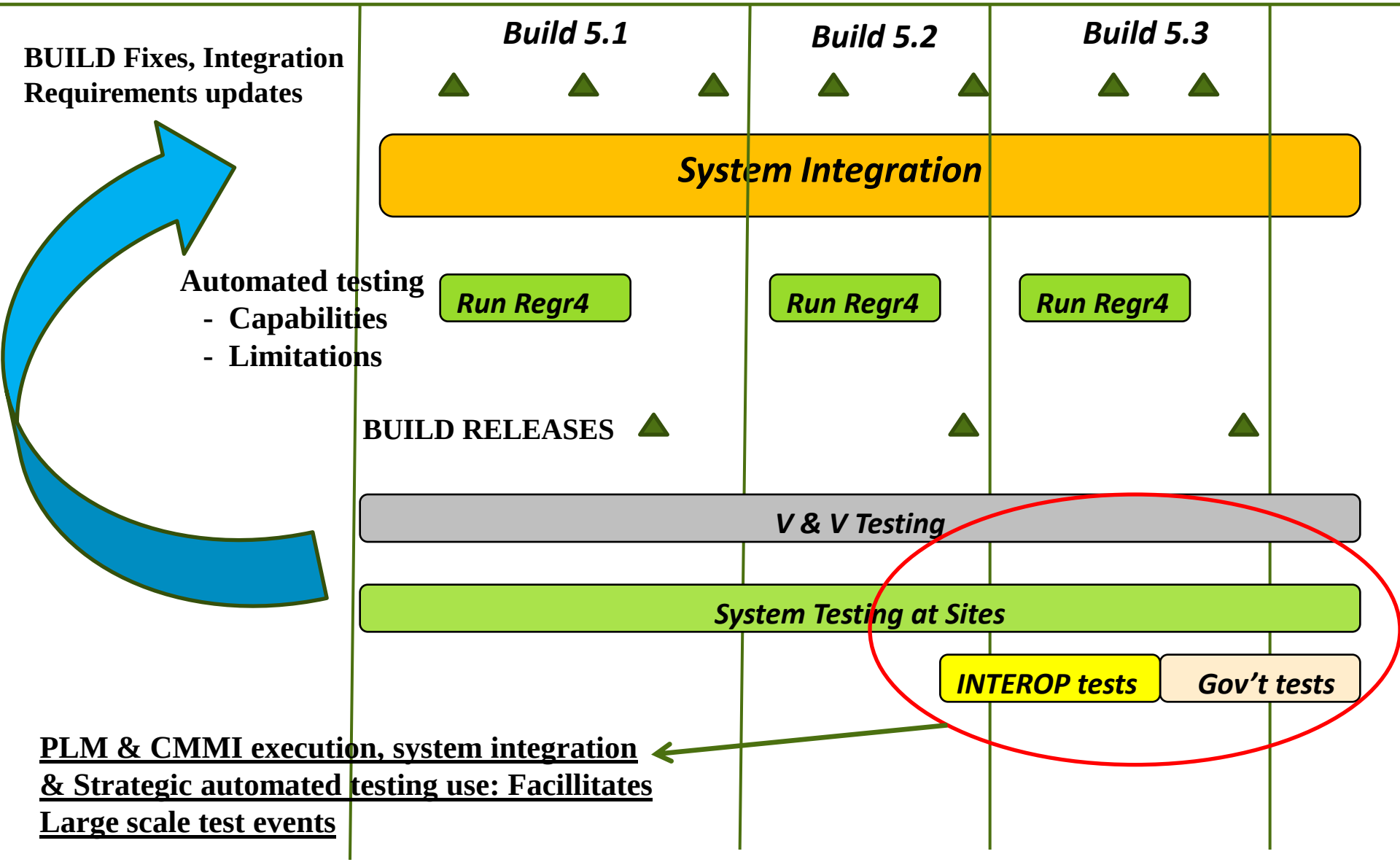

Systems Integration Test Configurations

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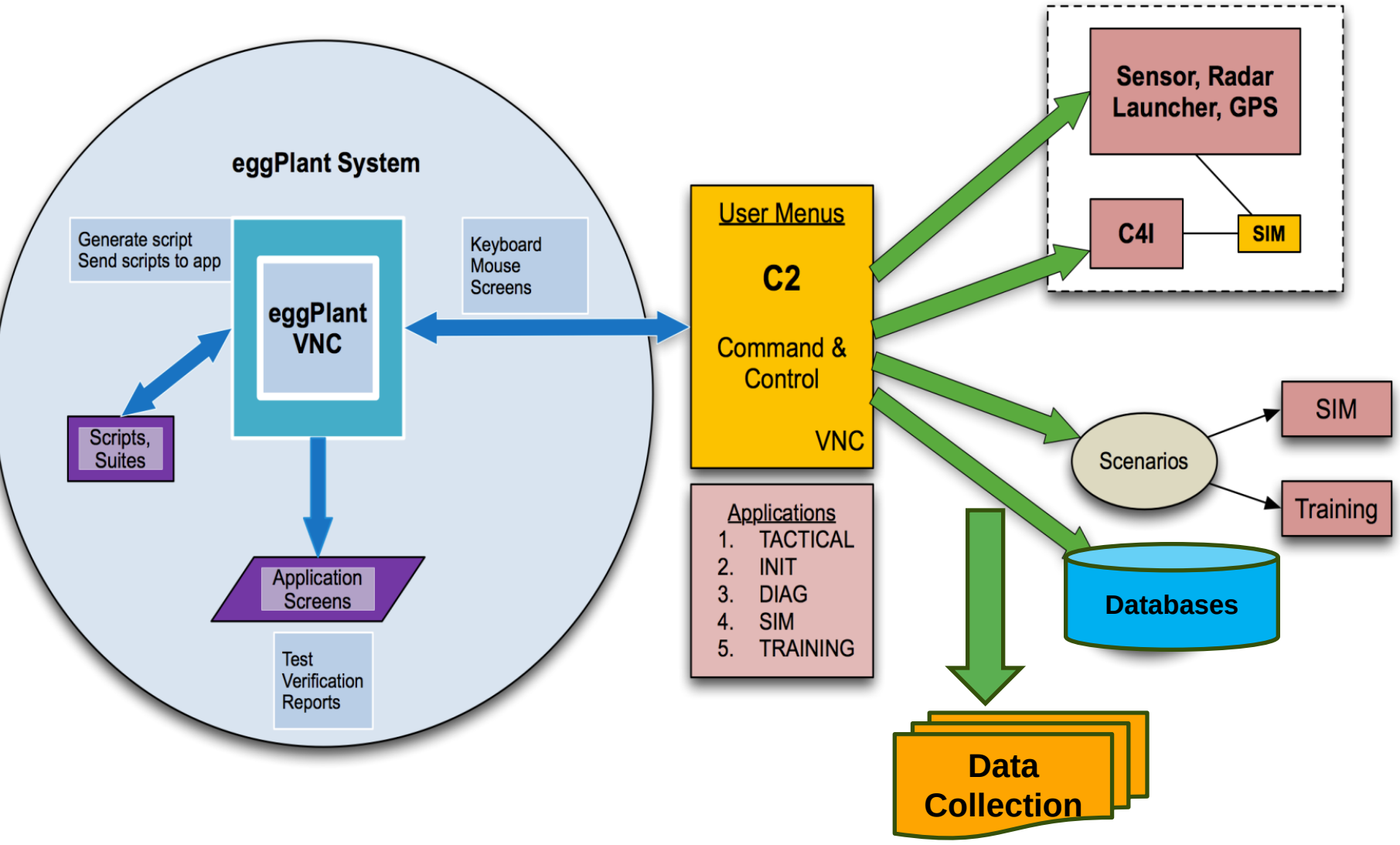

What is automated testing? What are its components?

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- **Automated testing is to effect the automated execution of a system by driving its displays, or command & control systems, with keyboard, mouse, and/or button & switch inputs based on a pre-defined, pre-built, and planned test design stored in scripts, suites, or libraries for system auto-execution, auto-verification via display screens, and test reporting as strategically planned, scheduled, and embedded in integration & test phases.**

<u>Components:</u>

1. **Test designs, scripting of suites, libraries**
2. **Test execution, test verification, test data**
3. **Test analysis, Test reporting, Test results**

System Integration/Automated Testing

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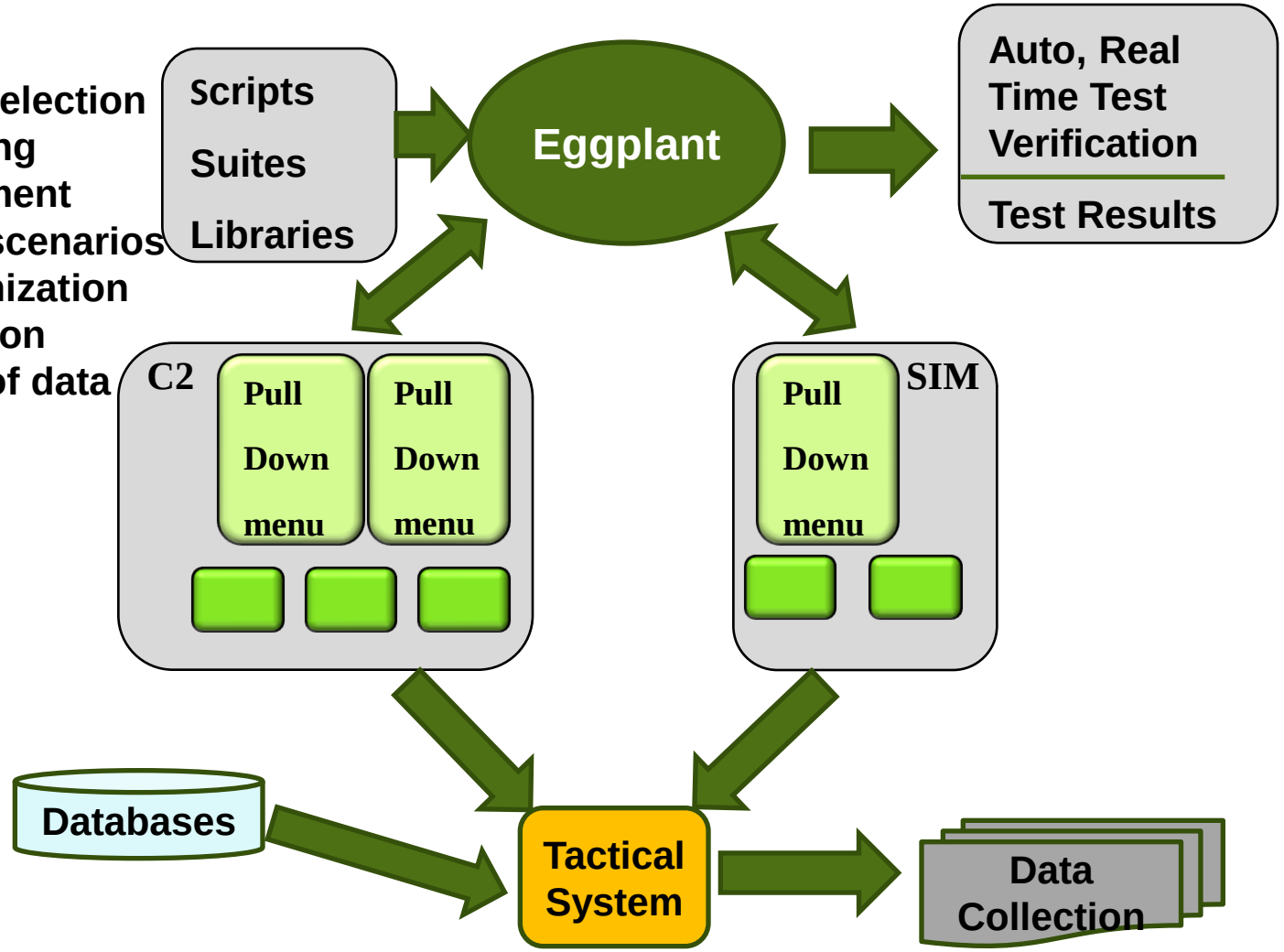
Test execution: Operational system & SIM automated Testing:

- Script, suite selection
- Test scheduling
- Test management
- Coordinated scenarios
- Test synchronization
- CM organization
- Test storage of data



Automated Testing Components

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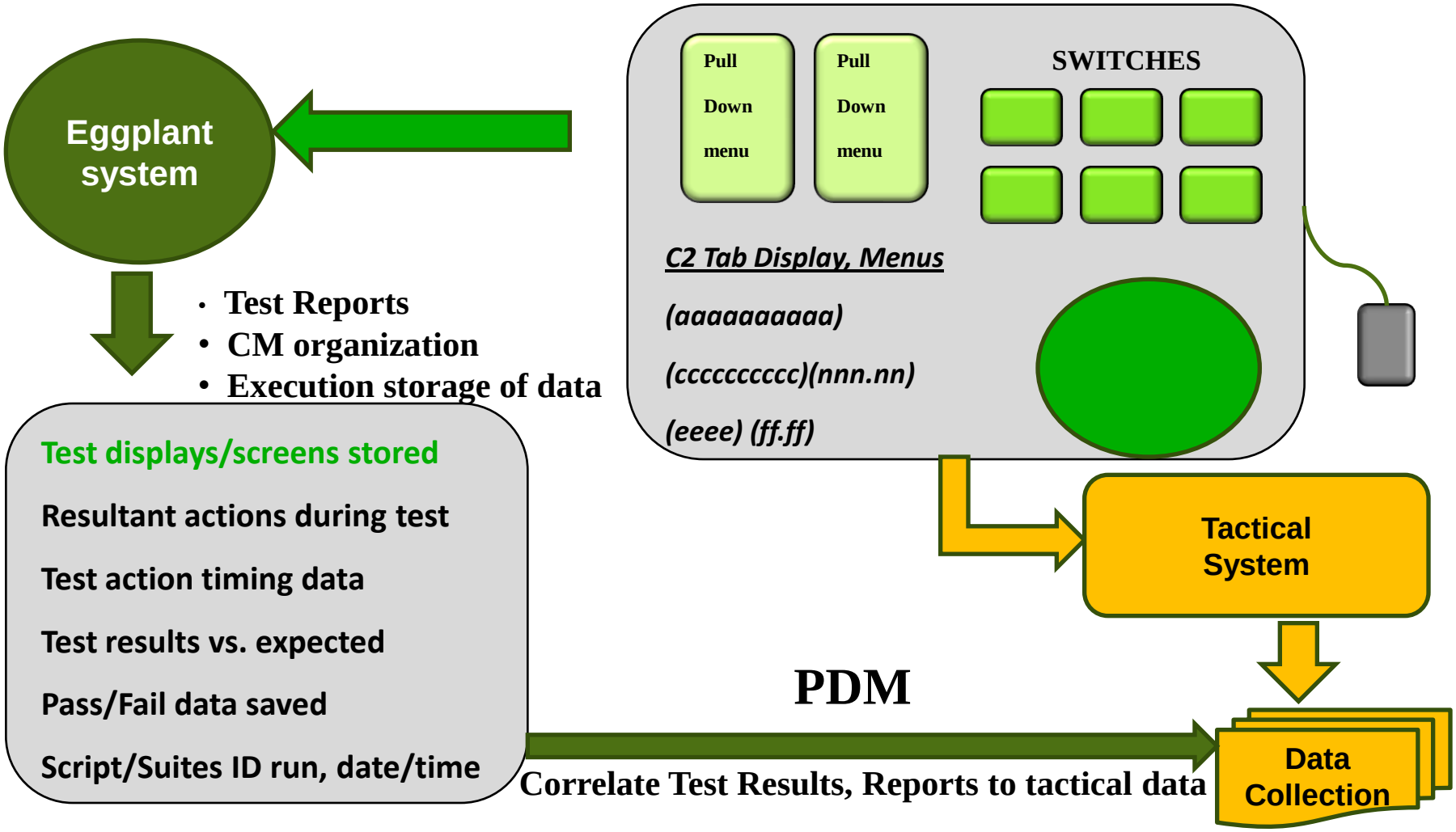
3. Test analysis, Test reporting, Test results:



Strategies for Automated Testing

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Cost effective, Properly Planned & Targeted Strategies required to improve efficiency, quality, cost, productivity

- Functional GUI and C2 Display Testing
- Build Functional and Capability Integration
- Integration Test Orchestration & Coordination
- Build Base-lining
- Regression testing
- Verification & Validation formal test
- System Engineering Test
- System Integration
- Initialization, Scenarios, Databases
- System Capability, Limitation Assessments (Decision Criteria)
- Performance Test, Endurance tests
- Government testing
- Systems Interoperability

Why automated testing? Benefits

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- Pre-planned, project embedded, repeatable
- Efficient, cost effective with strategic planning
- Productivity improvements
- “shall cost”, “will cost”
- Quality enhancing
- PLM, PDM contributor
- Breadth & depth of tests
- Test coverage, contingencies
- Multi – Configuration support
- Capability & limitation evaluator during the life-cycle
- Effective Test & Evaluation

System Integration: Results & Benefits

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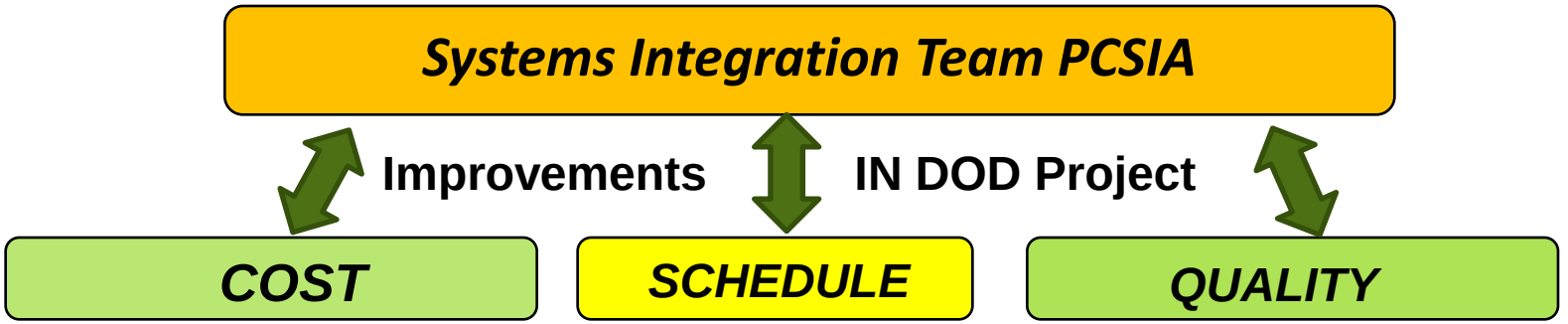

System Integration Plan: System capability focus &Test Coverage in PLM
Planned /coordinated Test data Collection, Data reduction, data analysis tools

Shall Test Coverage Breadth and depth; analysis/consolidation of Test cases

- System Capability Management
- Identify Limitations in system
- Project/Team Collaboration

- Labs, facilities, analysis, tools
- Integrated, Managed Products Throughout phases & Life-Cycles

- Reduction/Examination/coordination of Test problem reports from various teams and sites
- Management and coordination of build releases to major test teams & events, interface to CM and QA teams for effective use of resources
- Establish and utilize entrance and exit criteria disciplines via PLM methods to form the basis of readiness reviews meetings and critical release decisions
- Facilitate operational/user Testing and verification of System spec capabilities in endgame

Systems Integration: Results & Benefits

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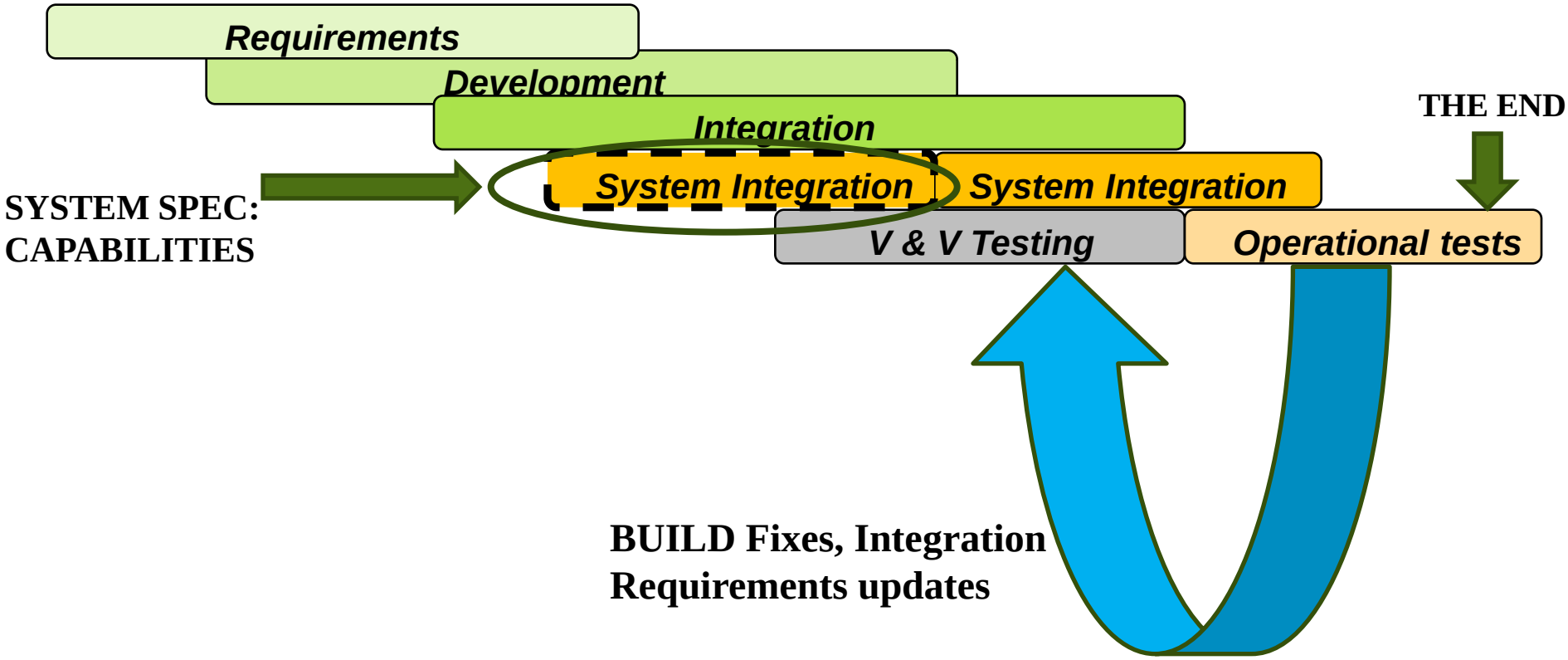
PLM/CMMI: "Systems Integration must be embedded in the critical path of HW/SW development/integration, builds definition & releases, V & V testing, Subcontractor management, system & operational testing"



Summary

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- Through the strategies and methods of PLM and CMMI, the system integration team provides for an effective, efficient, and coordinated mechanism required from the first build through initial deployment.

- The continuous flow of requirements, incremental development, problem solving, simultaneous integration at multiple labs and test sites, formal validation Test, and system engineering/operational user test activities necessitate the critical functions that this team performs.

- A constant “TEST” situational awareness and continuous build planning and system assessments will help to provide for more effective, “will-cost”, and “should-cost” test and evaluation programs in DOD and ATC projects.

- The System integration team also provides for potential opportunities, strategies, and targeted use of new tools and technologies, such as new cost effective automated testing products (TESTPLANT) for system base-lining, regression testing, and system integration & Test uses.

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11 CANAL CENTER PLAZA, SUITE 103, ALEXANDRIA, VA 22314
703.683.4222 | 703.683.0645 FAX | INFO@SPECTRUMGRP.COM
WWW.SPECTRUMGRP.COM

Bob Koczat

THE SPECTRUM GROUP

- **Senior Engineering Fellow: Raytheon (retired 2007) 35 years Systems, Software, Test, Project engineering, Program Management**
- **DOD PATRIOT/HAWK/UEWR Air Defense Systems: Engineering, Systems Integration**
  - ***Lead Roles and responsibilities in systems/software development, integration, V & V testing, events, missile firings, interoperability, government & operational testing at various labs, test sites and missile ranges (i.e. WSMR, etc)***
- **FAA STARS Air Traffic Control Systems: Systems Integration Lead**

- **The SPECTRUM Group, Wash DC: Engineering Member**
- **TESTPLANT Consulting: Introduction of Automated Testing with eggplant into DOD, Aviation, and Aerospace Sectors**
- **RMK Systems Integration, LLC**

Contact Information

THE SPECTRUM GROUP

Name: **Robert Koczat**

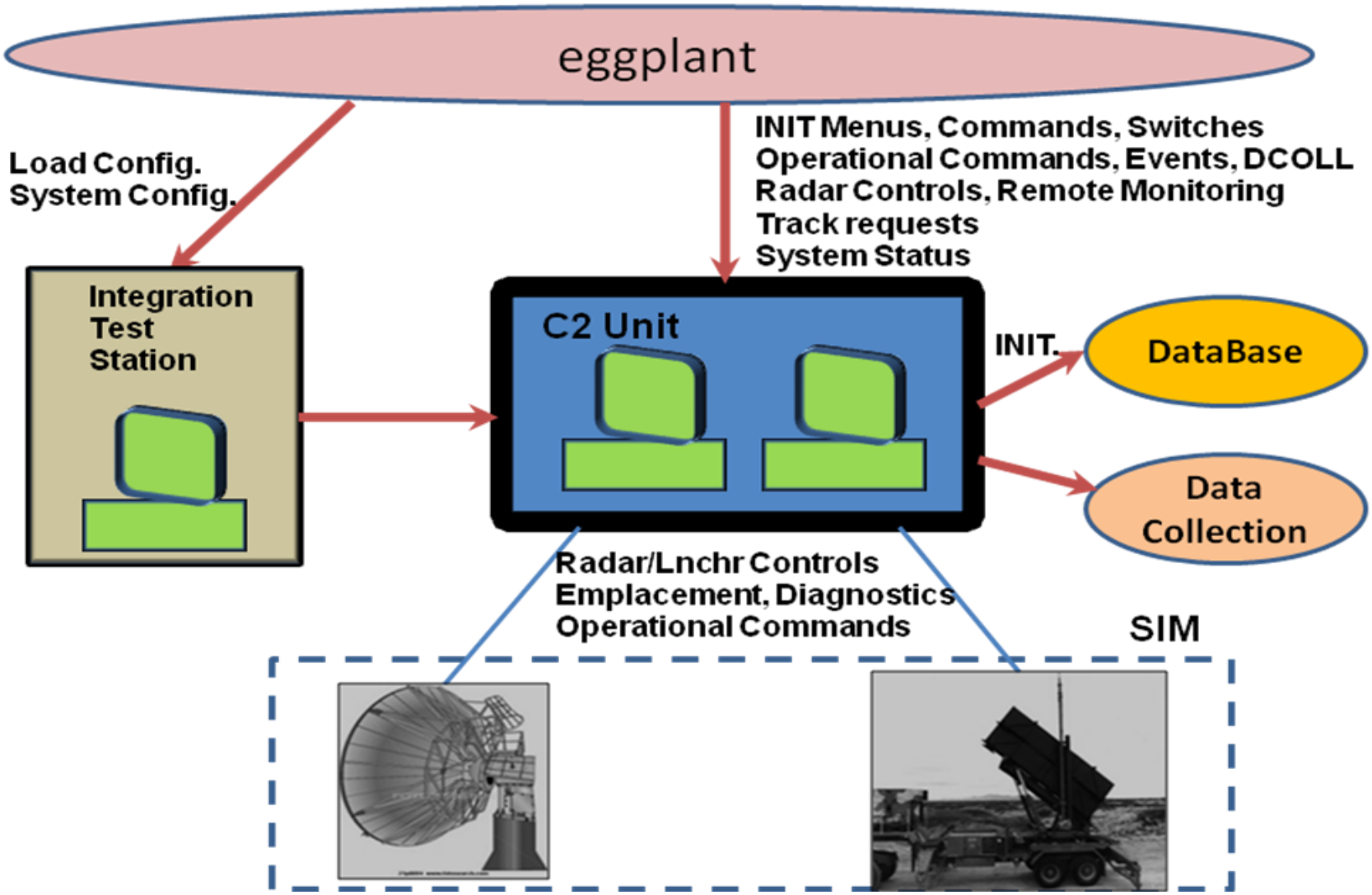
Phone: **603 - 560 - 1687**

Company: **The SPECTRUM Group**

Email: **Robert.Koczat@comcast.net**
Bkoczat@spectrumgrp.com

BACKUPS

C2 Air Defense System



UAV – GIS Operational System Testing

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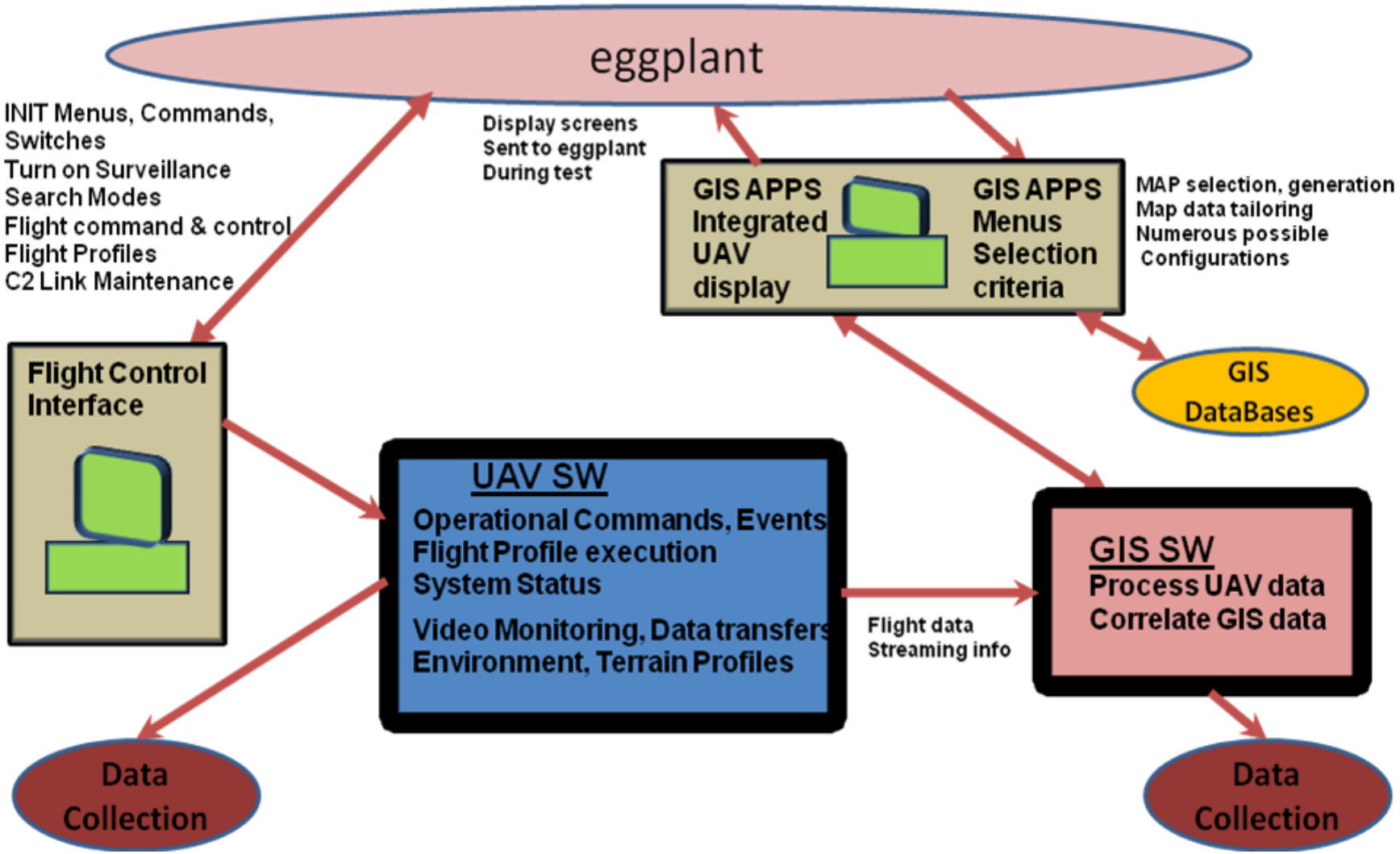

System Initialization, Emplacements

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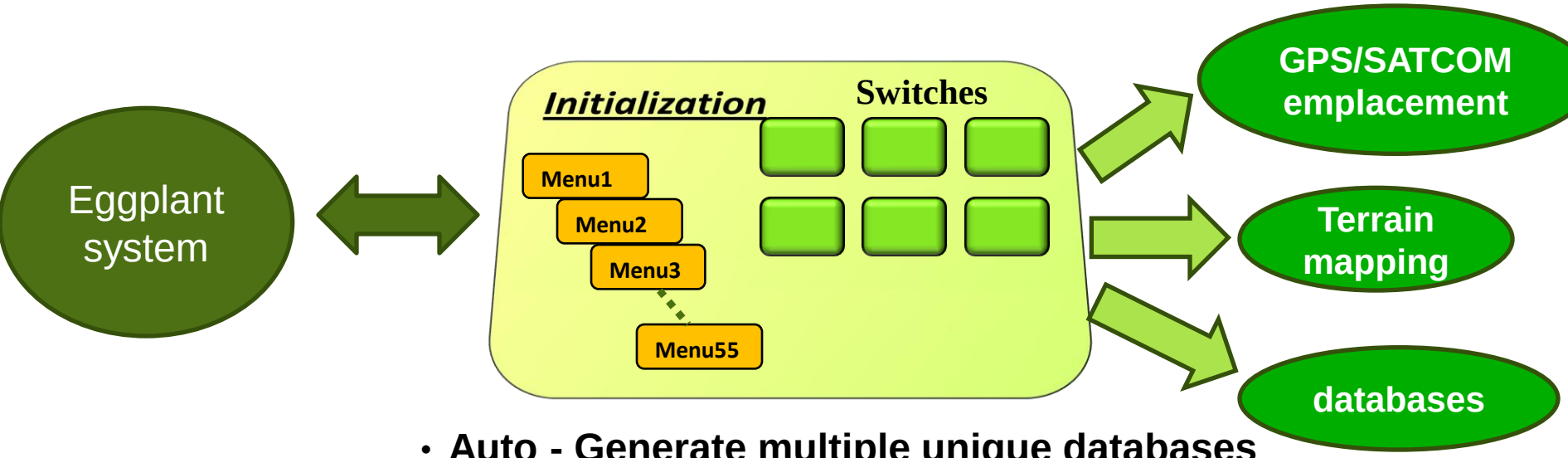

- Auto - Generate multiple unique databases
- Site Adaptation
- Multiple location, orientation tests
- Terrain Maps for site locations
- Operational parameter configurations

Automated Testing Components

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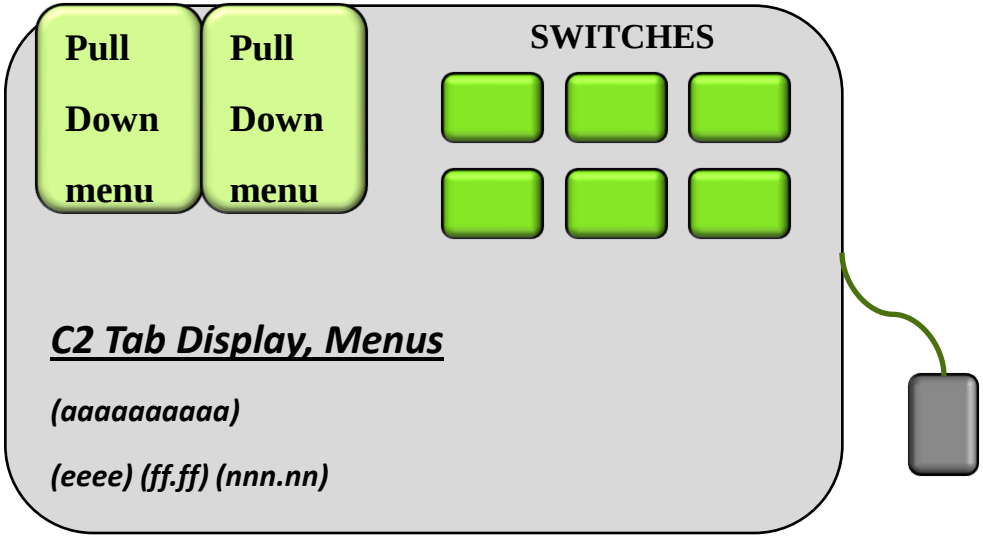
1. Test designs, scripting of suites, libraries:

Eggplant system

- Create, Select & Capture
- Image captures
- Mouse actions
- Keyboard actions
- Switch actions



Test Design

Scripts

Suites

Libraries

- Automatic script creation
- Script commands, Test events
- Create events on images
- Script elaboration, editing, tailoring
- Loops, delays, pause, continue
- Expected Results
- Build in Auto-Verification tests, Pass/Fail
- Organize into suites, functional libraries

Automated Testing Components

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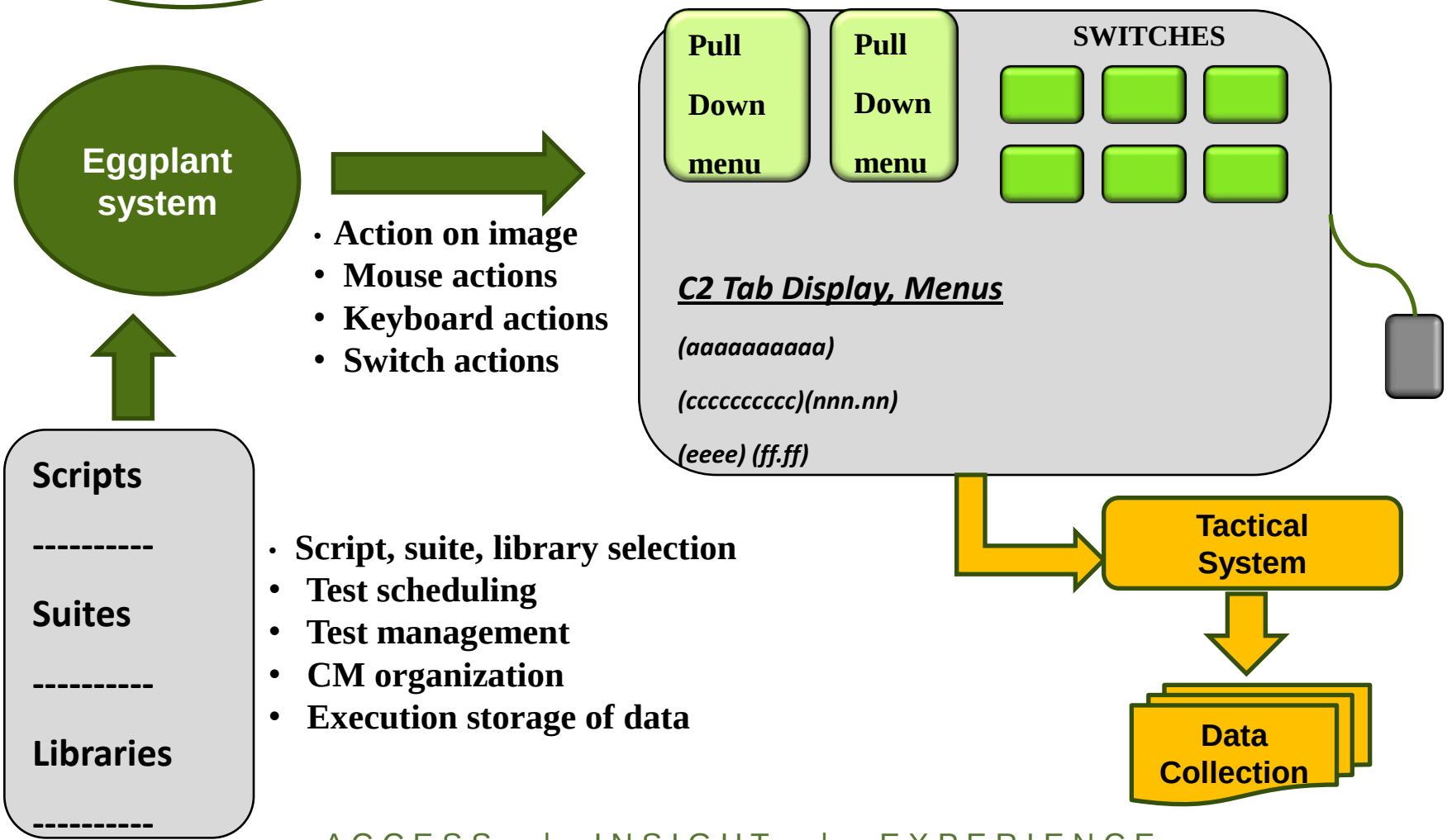
2. Test execution, test verification, test data:



- Action on image
- Mouse actions
- Keyboard actions
- Switch actions

- Script, suite, library selection
- Test scheduling
- Test management
- CM organization
- Execution storage of data

Automated Testing Components

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2. Test execution, test verification, test data: