Software Integration Options
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Vision and Purpose

- Easy integration of third party software is critical for Cray systems
  - Cray provides a complete software stack, but makes decisions on its content based on aggregate customer requirements
  - Some customers may prefer alternative stacks or components
- By deploying modular software with well-defined APIs, customers will have choice
- This talk (and paper) surveys the various parts of the Cray software ecosystem and describes the plethora of integration options possible
Feedback and Benefits

● To best support and exploit the benefits of this flexibility, Cray must understand the types of software integrations customers are interested in doing.

● In addition to this presentation (and short Q&A), a BOF is scheduled to help collect your feedback in this area.
  ● BOF 10A 5:10pm today
Three categories of software

1. Component Management
   Individual hardware components and their associated controllers, usually presenting a RedFish API

2. System Management
   Responsible for the configuration, operation, and monitoring of the entire system, focused on RESTful APIs

3. Managed Ecosystem
   Operating system and services used on compute and service nodes (e.g. CLE)
Major Integration Points

- Allows replacement of most or all Cray software in a category or layer
  - Completely replace the managed ecosystem with something other than CLE
  - Completely replace Cray System Management or the upper layers
    - Different customer types may integrate to different layers
  - Components are what they are, including their controllers
    - Details depend on specific system
    - Software API is based on Redfish® to allow easy use of other System Management stacks
System Management Software Components

Customer-facing Servers
- Hardware Consumer
- Dynamic Infrastructure Consumer
- Production Class Consumer

System Management Servers
- Image Creation
- Adv Power
- Monitoring
- High Availability
- Image Mapping
- Log Mgmt

Hardware Support Services
- Bootstrap Orchest'n
- RBAC Security
- Basic Telemetry
- Boot Services
- Network Services

Platform Support Services
- Config Mgmt
- SW Lifecycle

Infrastructure Support Services
- Customer Platform

Embedded Controllers
- Blade Control
- Cabinet Control
- Fabric Management
- Storage Infrastructure
- Compute Hardware
- Service Hardware
- Network Infrastructure

Hardware Support Services

Services
- Level 1
- Level 2
- Level 3
System Management Functionality Tiers

- Systems Management implements three levels of services – each building upon the one below:
  - **Level 1** – Hardware management capabilities
    - Command and control for cabinets and blades
    - Basic fabric management
    - All centered around the Redfish management standard from the Distributed Management Task Force (DMTF)
  - **Level 2** – Basic software infrastructure support service
    - For deploying arbitrary managed software stacks onto the system
    - Core capability to bootstrap a generic image onto a specified resource and initialize it to the point at which it is running and connected to the network
  - **Level 3** – Full support of system management services
    - For deployment of Cray’s custom capability software stack at scale
    - Support for the complete software lifecycle of the Cray Linux Environment (CLE)
    - Functionally equivalent to Rhine System Management environment on the XC today
    - Can be leveraged by other managed ecosystems if they fulfill the dependencies
CLE Software Components (Managed Ecosystem)

- Compilers
- Debugging Tools
- Job Launch
- Performance Tools
- Login Node Commands and Tools
- OpenMP
- MPI
- PGAS
- I/O libs
- libsci
- Process Launch
- Node Health Check
- Core Specialization
- Compute Node Programming Models and Libraries
- MOM
- WLM
- Service Node Services
- DataWarp
- Gateway
- Compute Node Services
- User-mode Containers
- RAS/RCA
- libfabric
- Common User-Level Services
- Nteroot/DVS
- Lustre
- Common Kernel-Level Services
- Kernel
- Network Driver
- Virtualization
- Node Hardware
- Compute Node Services
- Programming Models and Libraries
- Core Specialization
- Compute Node Services
- Common User-Level Services
- Common Kernel-Level Services
- Node Hardware

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Minor Integration Points

- Cray provided categories and layers mostly remain
- Individual components are replaced as desired
- Other components are added to augment system

- System Management examples:
  - Image creation, monitoring analysis tools, orchestration

- Managed Ecosystem examples:
  - Workload manager, programming tools, runtime libraries
Execution Objects, Isolation, Orchestration

● Containers and virtualization ease the integration of third party software
  ● Provide complete environments with many of the dependencies
  ● Isolate components from each other except where required
  ● Useful for both major and minor integrations
  ● Current focus on user-mode containers

● Depending on component and complexity, orchestration may also be needed
  ● For issues such as scaling, resiliency, and availability
Conclusion

● Cray is embarking on a new era of software flexibility and integrability
● Modularity and the use of well-documented APIs is essential
● RESTful interfaces provide a good model for such APIs, including Redfish

● What software would you like to integrate?
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Q&A

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