Developing Portable HPC Applications using Intel® QuickAssist Technology Accelerator Abstraction Layer Software (AAL)

An Introduction to AAL

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Objective

- Introduce Intel® QuickAssist Technology Accelerator Abstraction Layer (AAL) Software
  - High level overview
  - What is it solving and how?
- Take away:
  - Is AAL something you would like to learn more about?

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Problem Statement

Need for acceleration may be met by specialized acceleration technology, but...

- High cost of entry
  - $$ for hardware, development time...
- Non-standard software development environment
  - Technology/vendor specific interfaces
- High total cost of ownership
  - Typically low-level interfaces; device driver, ISA...
- Technology changing rapidly
 - Difficult to adopt new technology

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Solution

Provide enabling technology that:

- Reduces cost of entry
  - Increase choice of accelerator technologies
  - Enable best of breed
  - Simplify development
- Reduces total cost of ownership
  - Enable efficient use of platform resources
  - Build in reliability and extensibility
- Improves platform agility
  - Enable developers to keep pace with changing technology

Intel's FPGA accelerator platform with AAL enables this solution

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FPGA Accelerator Platform Components
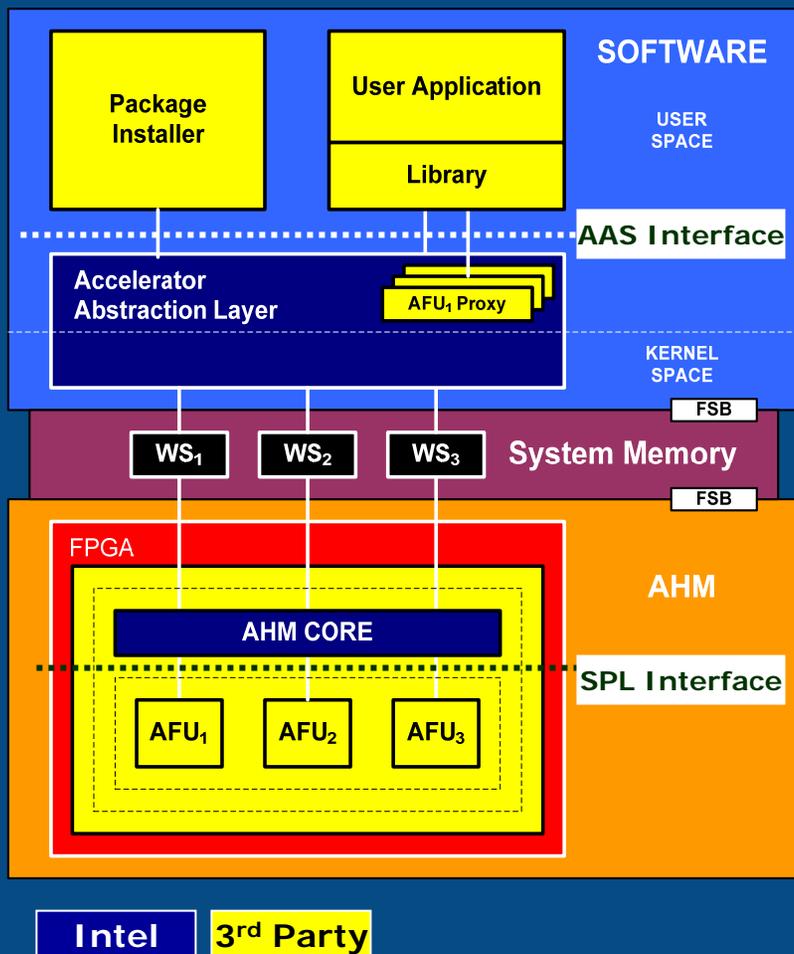
- **Accelerator Hardware Modules** (AHM) contain FPGA and local memory
- **Accelerated Function Units** (AFU) represent an FPGA accelerated algorithm
- Intel-supplied **AHM Core** logic implements FSB protocol, low-level AHM device and internal system interfaces (System Protocol Layer - SPL)
- **Workspace** is system memory that is managed by AAL
  - Pinned and mapped into application's virtual address space
  - Data exchanged using messaging and shared workspace
- **Accelerator Abstraction Layer** (AAL) provides platform level services (AAS) for integrating accelerators into Intel platforms

AAS and SPL interfaces ensure portability of application and AFU

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Intel® QuickAssist Technology Accelerator Abstraction Layer (AAL) SW

- Low level software layer
  - Uniform set of platform services

- Independent of accelerator technology
  - Tightly coupled accelerators: FSB and Intel® QuickPath Interconnect
  - Loosely coupled accelerators: PCI Express* Technology

- Independent of accelerated workloads
  - Data and Task parallel
  - Very Large to small data sets, streaming data

- Designed to be compatible with existing frameworks

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AAL Architecture Overview

- Service Oriented
  - Publish/Request Service Model
  - Client Decoupled from Implementation
    - Location, Quantity, Taxonomy
  - Increased Reuse
    - Resource aggregation and sharing
    - Dynamic reconfiguration/reprovisioning
  - Dynamic Interface Binding
    - Accelerator resources "Virtualized"
    - Reduced compile/link level dependencies

Service Oriented Architecture provides Platform Agility

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AAL Architecture Overview

- Object Oriented
  - Interface oriented design
    - Abstraction from implementation
  - Extensiblility
  - Higher degree of reuse
  - Simplified development

Object Oriented Architecture provides Portability and Simplicity

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AAL Architecture Overview

- Infrastructure Enables Common Services
  - Configuration Management:
    - Resource, Policy, Workspace
  - Communications:
    - Registration, Request, Binding, Transport
- Extensible
  - New services can easily be added
  - No impact on existing services
  - Many services can be replaced or enhanced

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AAL Architecture Overview

- Workspace Memory Management
  - Allocation, Pinning, Security
- Resource and Policy Management
  - Enables sharing between Apps/Users
- Resource Management
  - Enables dynamic "runtime" reprovisioning and reallocation
- Policy Management
  - Enables sophisticated policies for resource sharing
  - Open inetrfaces allow 3rd party to define policies, properties
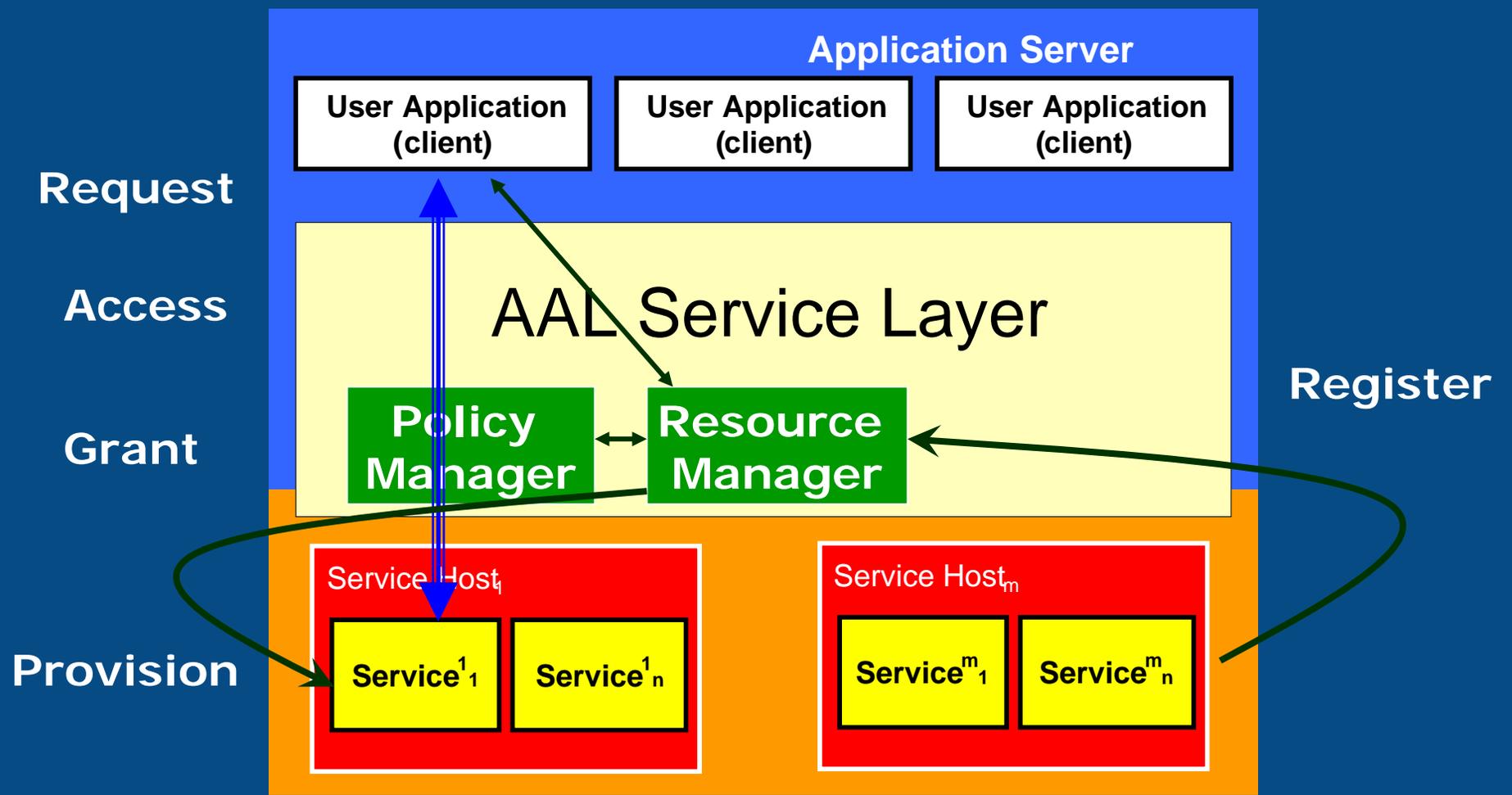
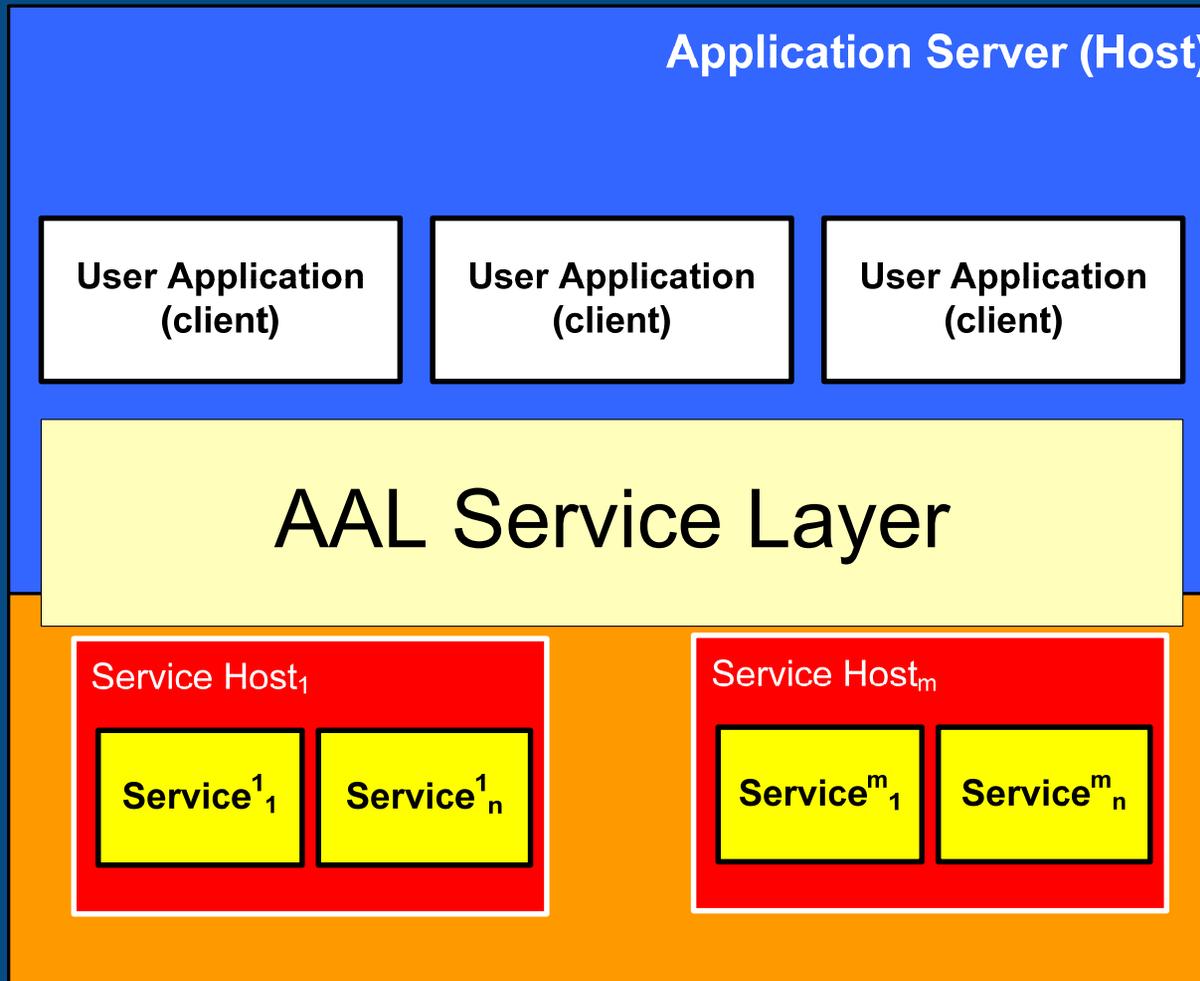(intel)

AAL Architecture Overview

- Asynchronous Programming
  - Well suited for embarrassingly parallel workloads
  - Well suited for location abstraction
    - High latency call stacks do not block application
  - General model
    - Does not preclude more restrictive models
- AAL provides constructs to simplify use
  - Synchronization, Message delivery
  - Several message delivery modes
- Exception Handling
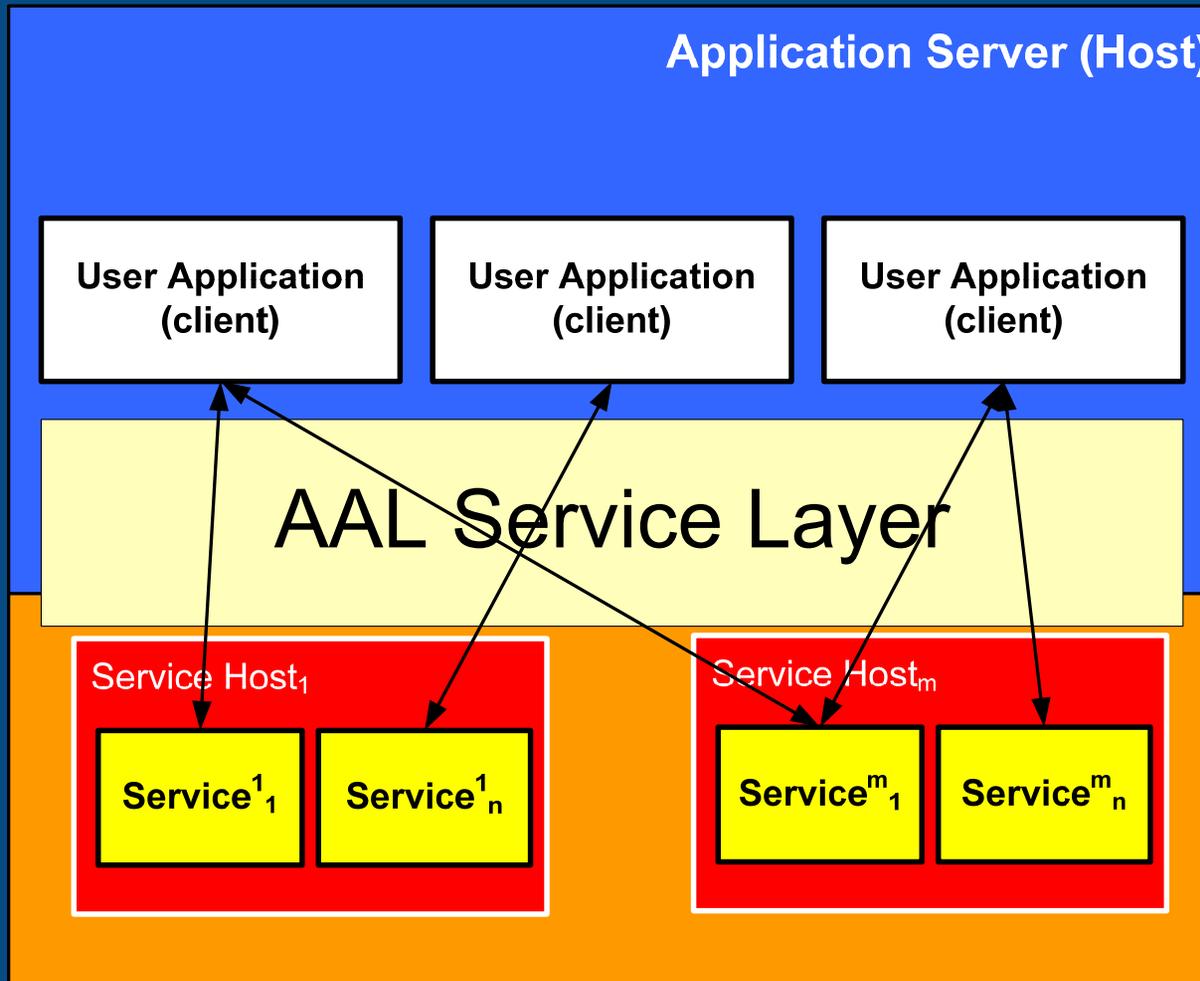
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SOA Model

Application Server

| User Application (client) | User Application (client) | User Application (client) |

Request

Access

AAL Service Layer

Grant

Register

Policy Manager

Resource Manager

Service Host$_1$

| Service$^1_1$ | Service^1_n |

Service Host$_m$

| Service$^m_1$ | Service^m_n |

Provision

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Client/Service Model

Application Server (Host)

User Application (client)

User Application (client)

User Application (client)

AAL Service Layer

Service Host$_1$

Service$^1_1$

Service^1_n

Service Host$_m$

Service$^m_1$

Service^m_n

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Client/Service Model

Application Server (Host)

User Application (client)	User Application (client)	User Application (client)

AAL Service Layer

Service Host$_1$

Service$^1_1$	Service^1_n

Service Host$_m$

Service$^m_1$	Service^m_n

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More Information:

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