An Overview of Microsoft Robotics Developer Studio

Benjamin Fonooni

Outline

- Introduction to MRDS
- RobuBOX
- Practical Experiences
  - Starting MRDS
  - Working with the web GUI
  - HTTP Communications via Lokarria

What is MRDS

A development platform for the robotics community, supporting a wide variety of users, hardware, and application scenarios.

Broad Third Party Support

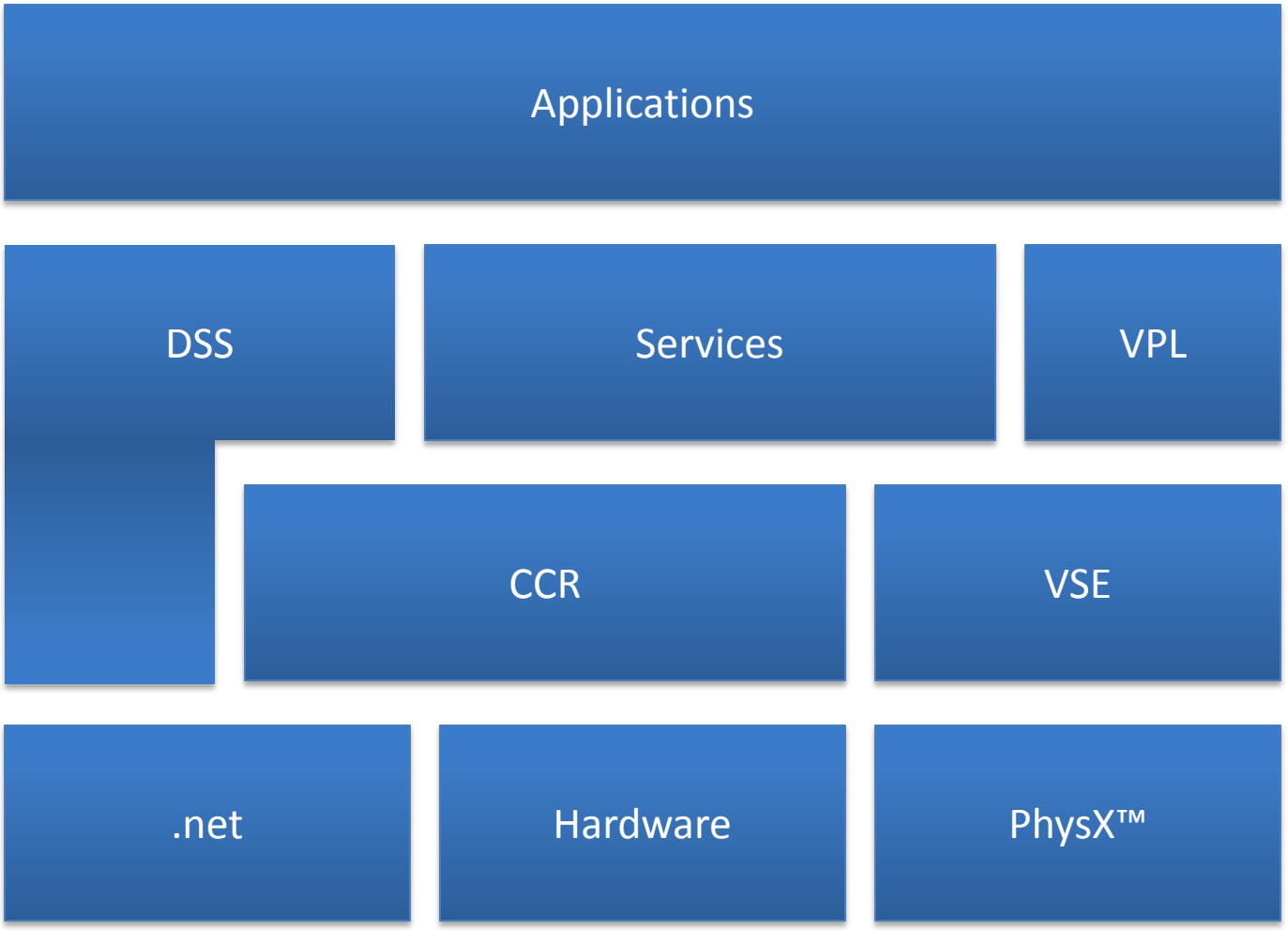
A Robotic Application

- An application is a composition of loosely-coupled components concurrently executing
  - Orchestration of sensors/actuators
  - User interface
  - Behavior

MRDS Features

- Design of software modules
- Communication protocols
- Methods for easy process monitoring
- Simulation of systems
- Distribution of systems across multiple hosts
- Rapid prototyping
- Significant number of standard components for IO, control, basic processing, and interfaces

Main Components of MRDS



Concurrency and Coordination Runtime (CCR)

- CCR addresses problems like
  - Asynchrony
  - Concurrency
  - Coordination and Failure Handling
- Responsible for
  - Making writing and managing asynchronous processes easy
  - Avoiding need to understand manual threading, semaphores, etc.
  - Coordinating between components

Decentralized Software Services (DSS)

- DSS addresses problems like
  - Robustness
  - Composability
  - Observability
- Responsible for
  - Making state observable, easily accessible
  - Providing for reusability and failure tolerance
  - Supporting remote/distributed execution
  - Making the programming model scalable

Decentralized Software Services (DSS)

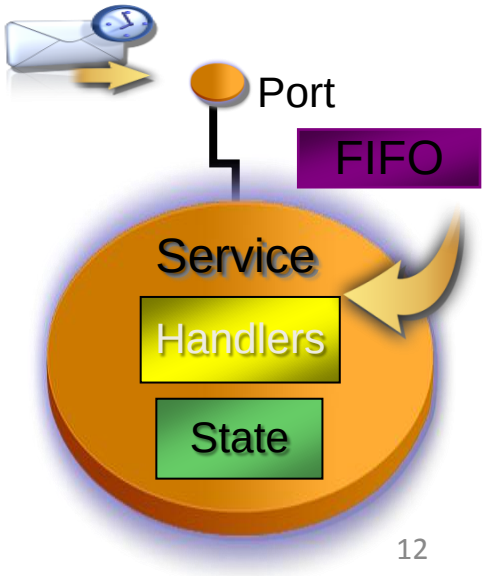
- Services communicate using DSS protocol – referred to as DSSP
- The communication model is similar to SOAP (Simple Object Access Protocol)
- Services are orchestrated (combined) into applications
- The communication is based on the Representational State Transfer (REST) model

Representational State Transfer (REST)

- Originally developed with HTTP/1.1 protocol
- World is composed of clients and servers
- Clients generates requests
- Servers receive requests and generate responses
- Responses enable transfer of data / resources
- Clients are at rest or in transition between states
- REST architectures are based on a set of constraints that define principles for design

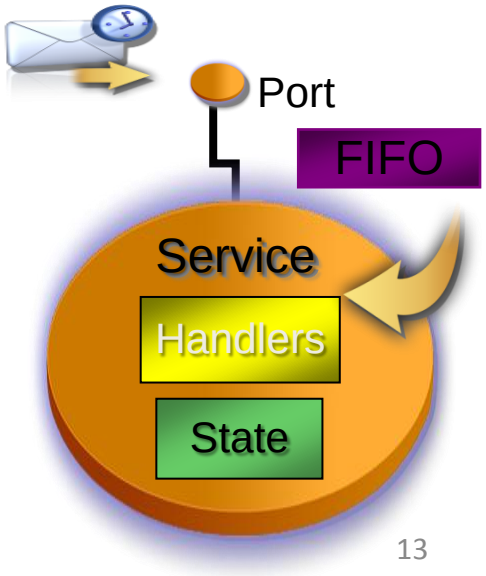
Building Blocks of a Service

- A Service
  - Has structured state
  - Interacts using messages over ports
  - Supports handlers (encapsulate behaviors)
- Basic Operations
  - State retrieval and manipulation
  - Create and terminate
  - Notifications



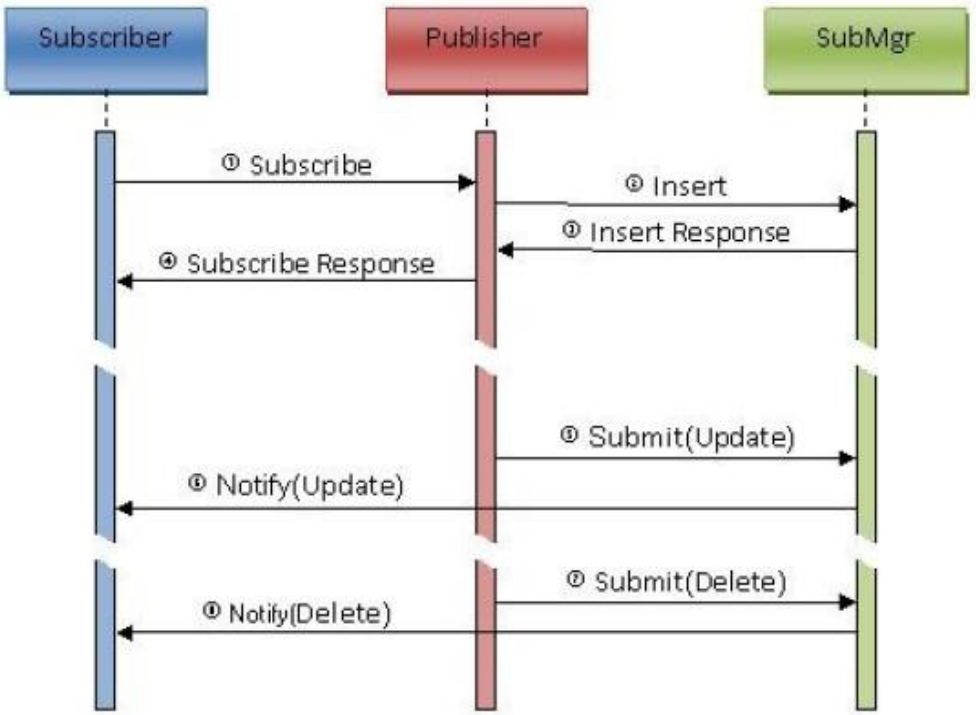
Building Blocks of a Service

- Supports dynamic discovery
- Restartable
- Provides simple abstraction for hardware and software
- Provides aggregated, compositional functionality
  - Sensor fusion
  - Motor drive
- Inherently distributed and is asynchronous
- Can have “partners”



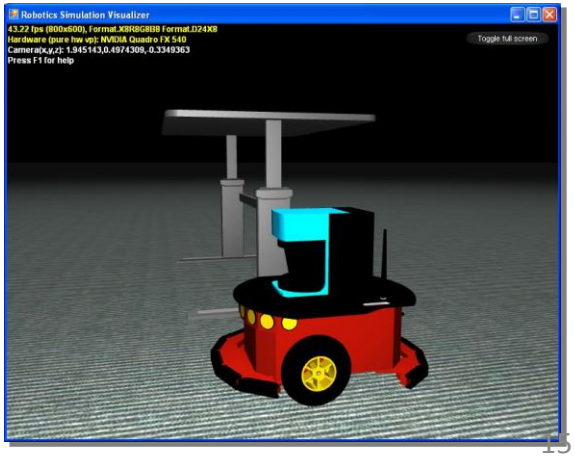
MRDS Publisher-Subscriber

- Communication Model
- Data Exchange Synchronization



Authoring Tools

- Simulation and visualization tools
  - High resolution 3D rendering
    - Visual and physics views
  - High performance physics engine
    - PhysX™ supplied by Ageia Technology
    - Optional hardware acceleration
  - Makes technology accessible
  - Enables fast prototyping and debugging
  - Extensible by code or data

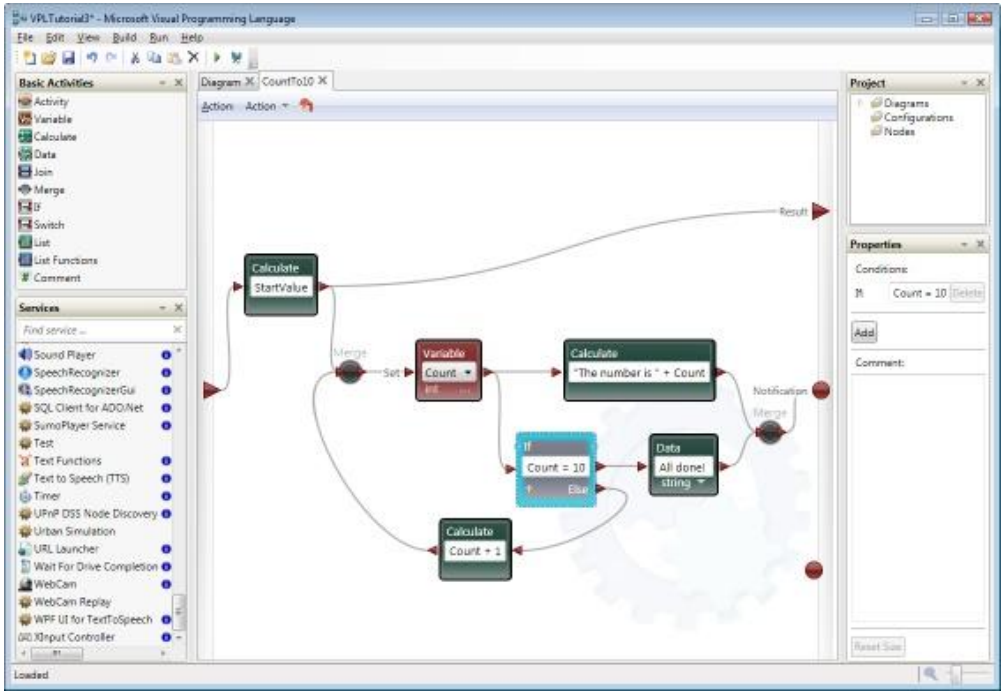


Authoring Tools

- Web browser based programming/control
  - Scripting (e.g. JScript)
  - Windows Gadgets
- Supported by multiple programming languages
  - Microsoft Visual Studio and VS Express (e.g. C# and VB .net)
  - Iron Python
  - Third party languages (e.g. Java and C++)

Authoring Tools

- Visual Programming Tool
  - Dataflow editing
    - Simple connections
    - Building blocks
    - Model checking
    - Code generation
  - Dashboards
    - Robot models
    - Novice to Expert



RobuBOX

- Set of abstract services
- Definition of all actuators and sensors
  - DifferentialDrive
  - Laser
  - Telemeter
  - Localization
  - …
- A service to store recorded paths
- Navigation and Mapping
- Lokarria

Lokarria

- Access to abstract contract data using HTTP requests
- Half-REST architecture
- Supports HTTP GET
- Supports HTTP POST
- JSON format data exchange
- Works on simulated and real robots

Questions?