JavaScript/DDS Integration: Using Node.js and OpenDDS

OMG Data Distribution Service
Information Days, March 2013

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Extending the DDS Global Data Space to the Web

- Problem Statement
  - Large Asian bank operating in several countries
  - Expanding its country-specific Financial Trading Services to >10K users, using desktop and mobile devices
  - Requirements:
    - Low cost of operation/distribution
    - Rapid response to changing competitive marketplace
    - End-to-end control
  - Phases:
    I. Market data distribution
    II. Secure mobile trading

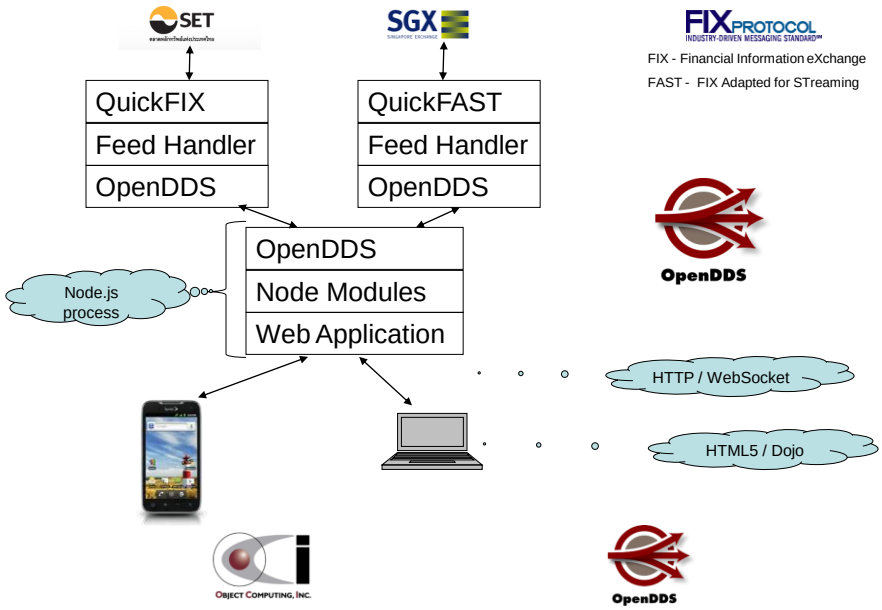
Node.js http://nodejs.org

- Server-side software system designed for writing scalable Internet applications, notably web servers.
- Uses Google's V8 JavaScript engine, the libuv portable event loop library, and a core library written in JavaScript.
- Uses event-driven, asynchronous I/O to minimize overhead and maximize scalability.
- Portable to multiple operating systems.
- Applications are written JavaScript, some also include compiled (C/C++) modules.
- OCI offers a training class in Node.js

OpenDDS http://opendds.org

- Implementation of the OMG DDS* 1.2 and DDS-RTPS 2.1 specifications
  - *DCPS layer with all optional profiles
- Open source, permissive license, public source repo
- Core libraries written in C++, includes Java API
- Configurable transports:
  - TCP, RTPS, UDP-unicast, UDP-multicast, shared memory
- Configurable discovery: centralized, peer-to-peer (RTPS)
- Modeling tool based on Eclipse with code generation
- OCI offers training classes in both OpenDDS programming with C++ and the OpenDDS Modeling SDK

Solution Architecture



Demo Application

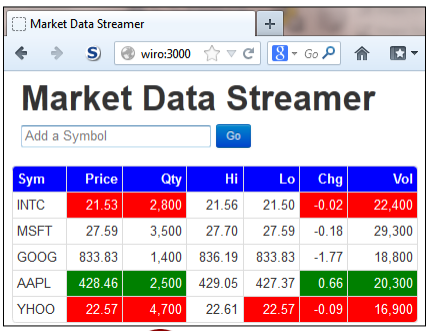
- OpenDDS process (C++) publishes sample market data
- Web server (Node.js) subscribes to the market data
- Web client receives dynamic updates using WebSockets (Socket.IO module for Node)

```
module MarketData {

#pragma DCPS_DATA_TYPE "MarketData::SymbolDefinition"
#pragma DCPS_DATA_KEY  "MarketData::SymbolDefinition symbol"
  struct SymbolDefinition {
    string symbol;
    string description;
    float closing_price;
  };

#pragma DCPS_DATA_TYPE "MarketData::Trade"
#pragma DCPS_DATA_KEY  "MarketData::Trade symbol"
  struct Trade {
    string symbol;
    float price;
    unsigned long quantity;
  };

};
```



Sym	Price	Qty	Hi	Lo	Chg	Vol
INTC	21.53	2,800	21.56	21.50	-0.02	22,400
MSFT	27.59	3,500	27.70	27.59	-0.18	29,300
GOOG	833.83	1,400	836.19	833.83	-1.77	18,800
AAPL	428.46	2,500	429.05	427.37	0.66	20,300
YHOO	22.57	4,700	22.61	22.57	-0.09	16,900

OBJECT COMPUTING, INC.

OpenDDS

OpenDDS Module for Node.js

- NPM Module http://npmjs.org
  - Our module ("npm install opendds") is open source and uses open source libraries and tools, wrapping the C++ OpenDDS code.
- API Design
  - Minimal API: only what's required to subscribe to DDS data, including optional QoS and Content-Filtering
  - Each data sample is delivered via a callback function which runs on Node's event loop.
- IDL / JavaScript mini-mapping (see next slide)

Mapping IDL to JavaScript

- The current implementation only needs to translate IDL structs to JavaScript objects, not the other way around
  - Including all data types that structs used with DDS can contain
- IDL Boolean is JavaScript Boolean
- Mapped to JavaScript Number:
  - IDL octet, integral and floating point types
- Mapped to JavaScript String:
  - IDL char, wchar, string, wstring, enum
- Mapped to JavaScript Object: IDL struct, union*
- Mapped to JavaScript Array: IDL sequence, array*

* => not yet implemented

Quality of Service and Content-Filtered Topic

- DURABILITY QoS Policy
  - Used by the “Symbols” topic (TRANSIENT_LOCAL kind)
  - Publishing side writes each instance just once, most likely before subscribing side (Node.js) has even started
- Other QoS Policies are left at default values in this demo
- Content-Filtered Topic
  - Used by the “Trades” topic
  - Only trades involving symbols which the user has requested (using the Web interface) pass the filter
  - Other trades are not sent on the network
    - Due to publisher-side evaluation of the Content-Filtered Topic

Scalability

- Additional Feed Handlers
  - New market data sources
  - Each feed handler could be responsible for a subset of symbols (per-channel, or segmented)
  - Redundancy using DDS OWNERSHIP and LIVELINESS QoS
- Additional Web Servers
  - Use Node’s “cluster” module to start multiple instances on the same host (in order to make use of multi-core systems)
  - Use web server load balancing to scale to multiple hosts

Future Directions

- OpenDDS Module for Node.js could eventually gain support for:
  - IDL unions and arrays
  - Current features (subscribe) with the full DDS DCPS API:
    - Topic, MultiTopic, ContentFilteredTopic (dynamic parameter changes)
    - Subscriber, DataReader
    - Listeners/Conditions
    - Built-In Topics
  - Ability to publish data samples using a simplified API
    - Example use case: web server load balancing and stats
  - Publication with the full DDS DCPS API:
    - Publisher, DataWriter

For More Information

- OpenDDS: http://opendds.org
- Object Computing, Inc.: http://ociweb.com
- Node.js: http://nodejs.org
- Financial Domain
  - FIX: http://fixprotocol.org
  - QuickFIX: http://quickfixengine.org
  - FAST: http://fixprotocol.org/fast
  - QuickFAST: https://code.google.com/p/quickfast (an OCI project)
  - Liquibook: https://github.com/objectcomputing/liquibook
- Adam Mitz: mitza@ociweb.com