Rai Technology

Technology Overview
October 2009

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About Rai

- Founded 2003 in San Francisco, California.
- Offices in USA, UK and Japan.
- 20+ customers including many top tier financial institutions around the globe.
- Profitable & stable.
- Support our customers in all time zones 365 x 24 x7.

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Our Technologies

- Middleware Monitoring:
  - Rai Insight
- Market Data Distribution Service:
  - Rai Cache
  - Rai ICE
  - Rai API

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Middleware Monitoring

- Rai Insight:
  - Network pcap capture.
  - Decodes TIBCO Rendezvous, ciServer and 29West LBM packets.
  - Continuous real-time monitoring.
  - Rich UI with real time graphs and statistics.
  - Round trip latency analysis.
  - Incident analysis.
  - Usage statistics.
  - Alerting capability.
  - Reporting.

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Market Data Distribution

- Rai Cache
- Rai ICE
- Rai API

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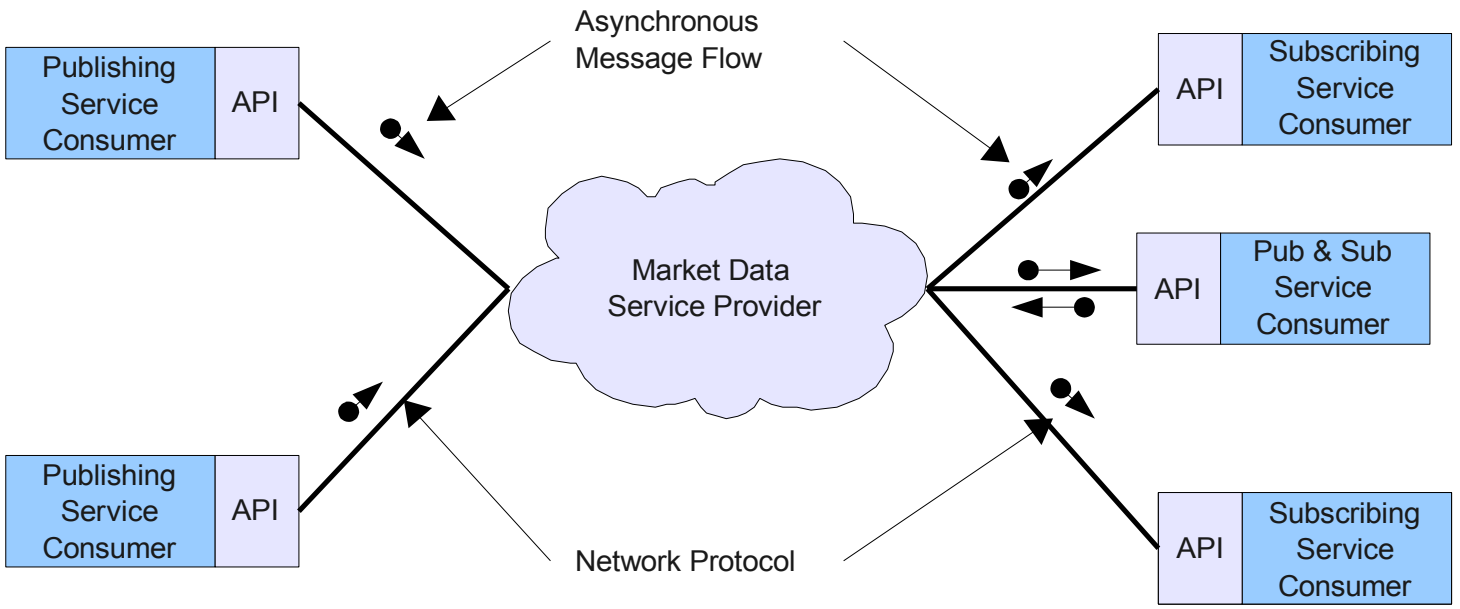
Generic Market Data System



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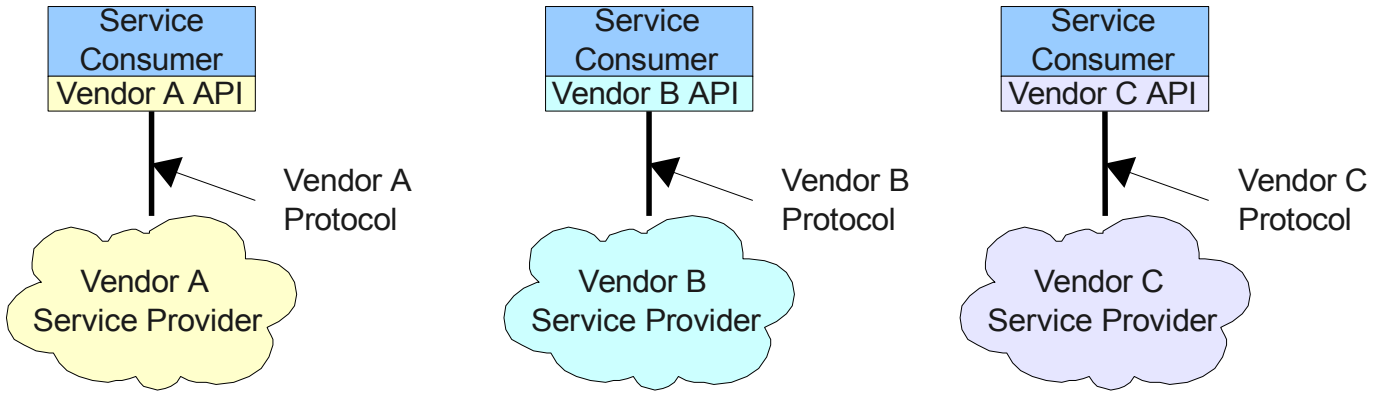
Vendor Lock-in



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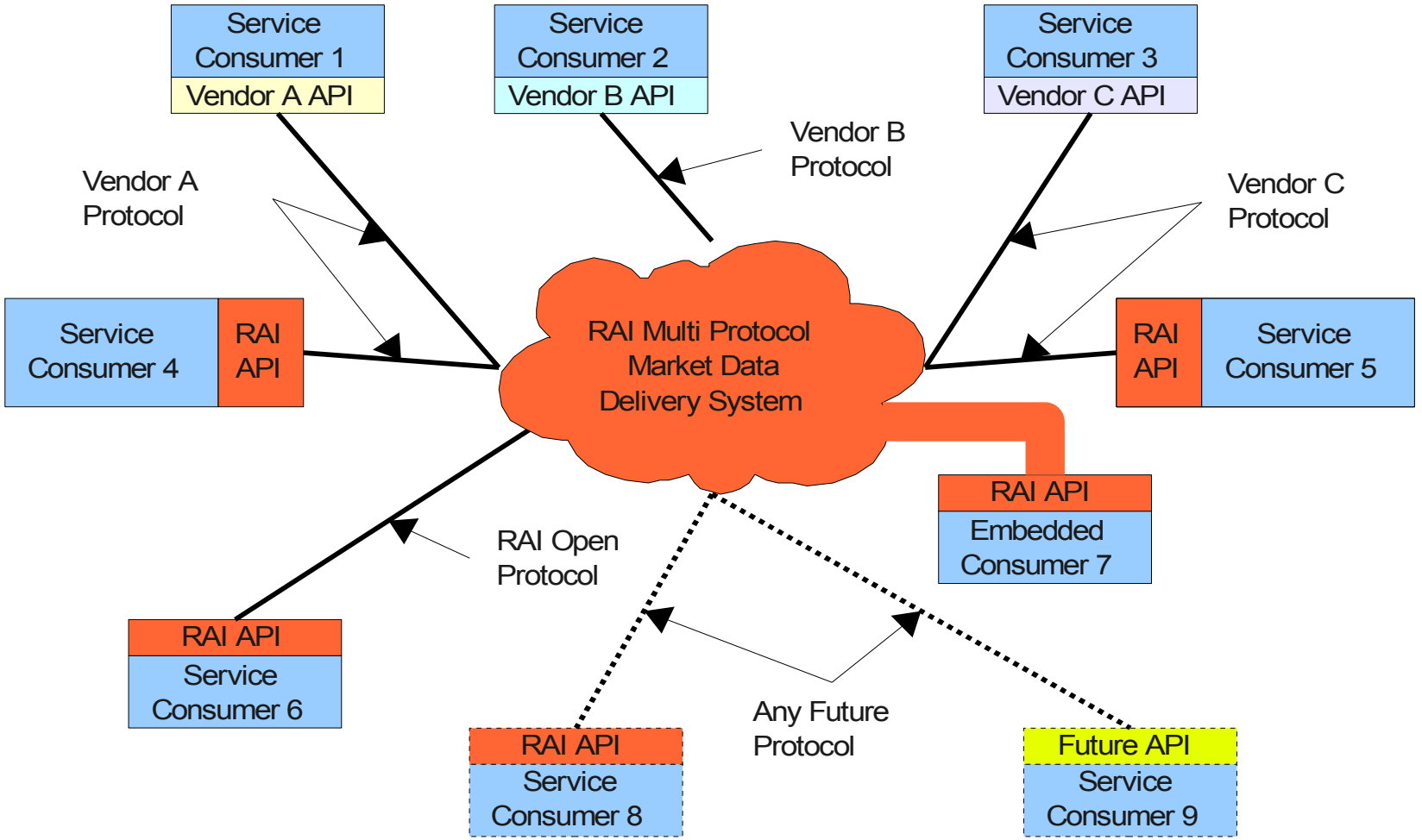
Rai Market Data Distribution System



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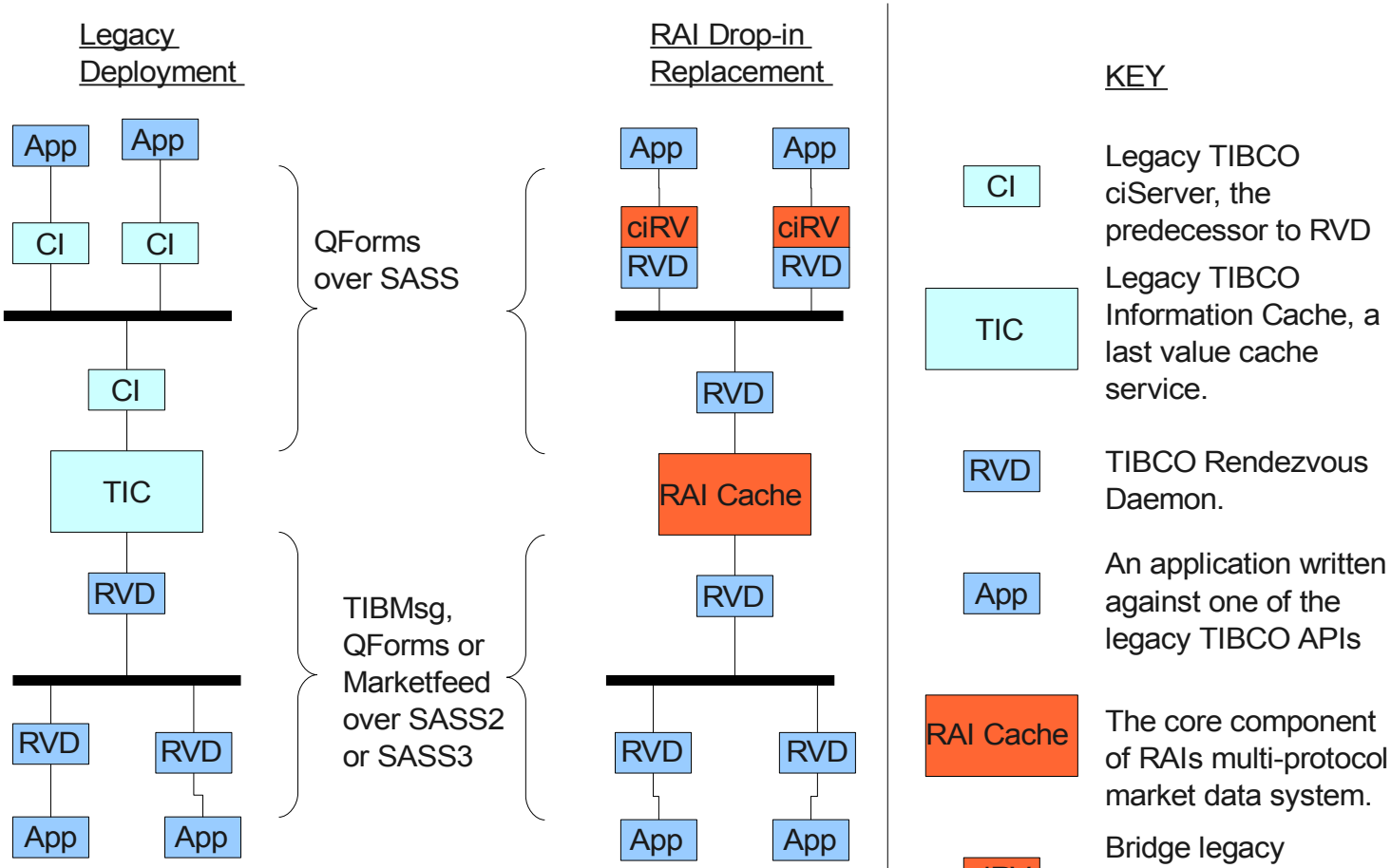
Use Case: TIB Replacement



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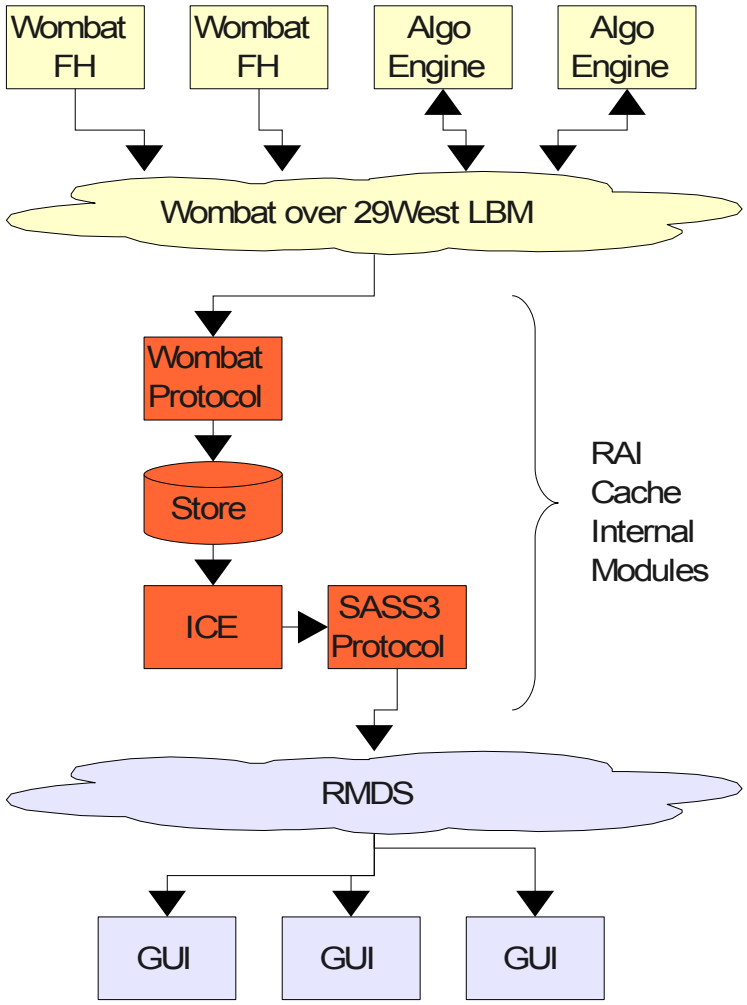
Use Case: High Low Speed Bridge



High bandwidth, low latency

RAI Cache Internal Modules

Lower bandwidth, not highly latency sensitive.

KEY

Wombat FH	Wombat Feed Handler.
Algo Engine	Algorithm trading engine consuming Wombat market service and contributed calculated data.
Wombat Protocol	RAI Cache protocol for handling Wombat market data system.
Store	RAI Cache internal message store.
ICE	RAI Cache Intelligent Conflation Engine.
SASS3 Protocol	RAI Cache protocol for SASS3 over RV.
GUI	Non latency sensitive GUI consumers of SASS3 market data system.

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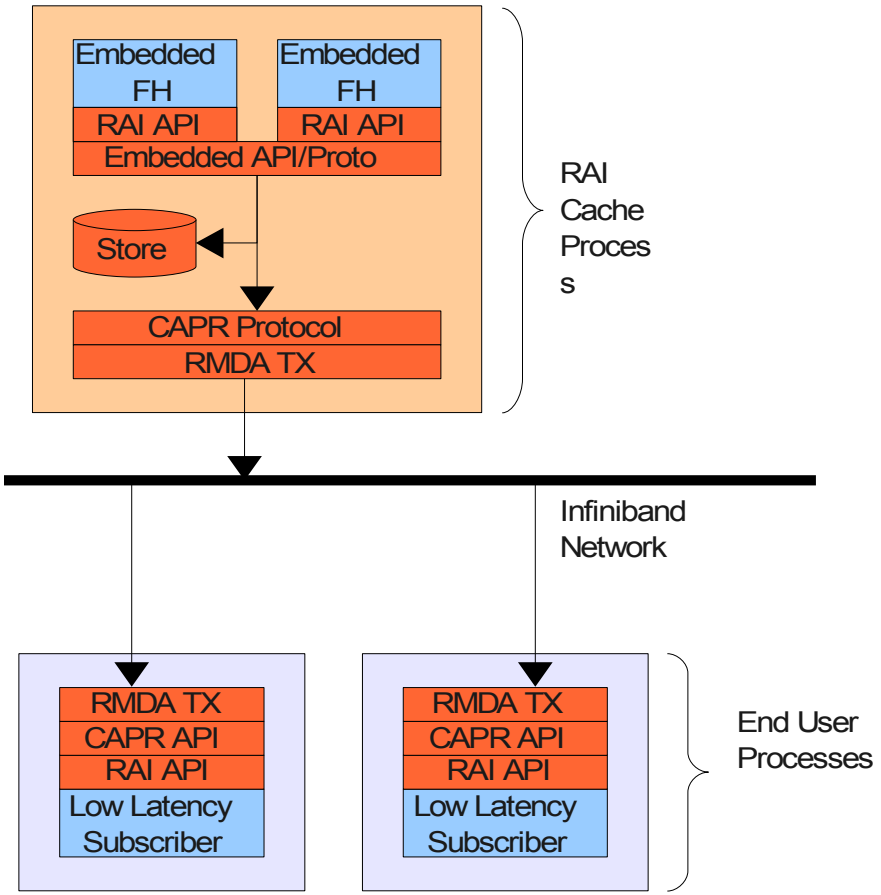
Use Case: Low Latency Solution



KEY

Embedded FH	Feed handler developed on RAI API, built and deployed as a embedded service within the RAI Cache.
RAI API	RAI API interface
Embedded API/Proto	Implementation of RAI API for communicating with in-process instance of RAI Cache.
CAPR Protocol	Cache Protocol, service provider side.
RMDA TX	RMDA over Infiniband transport implementation
CAPR API	API implementation. Cache Protocol, service consumer side .
Low Latency Subscriber	Market data subscriber developed on RAI API, built and deployed as standalone application.

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Rai MDDS Components

- Rai Cache:
  - Protocol neutral/extensible.
  - Subscription Management.
  - Last Value Cache.
  - Full image and delta updates.
  - Dictionary download services.
  - Conflation.
  - Delayed Data.
  - Optimized file based backing store.
  - Fault tolerance.
  - Arbitrary horizontal scaling.
  - HTTP administration.
- Rai API:
  - Protocol neutral/extensible.
  - Access all Rai Cache services.
  - C++, Java & C#
- Rai ICE
  - Intelligent Conflation Engine.
  - Each outgoing channel in the Cache can set its conflation parameters independently.
  - Alternatively, can be deployed a separate process to the Cache.
  - Can configure limit as messages and/or bytes per second.

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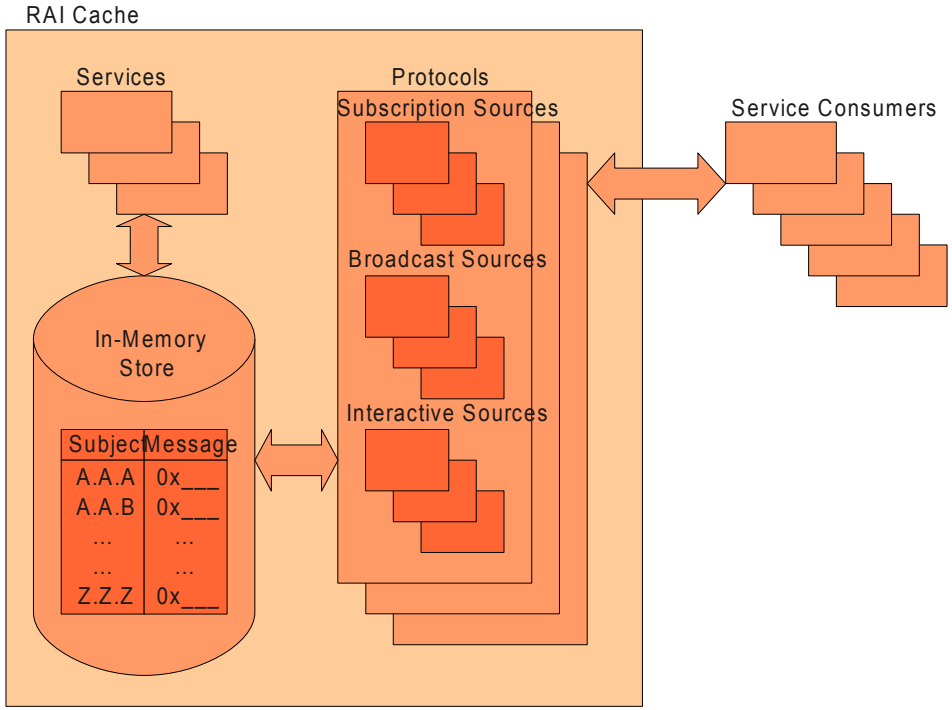
Rai Cache Architecture



- Subject: String name logical data channel. Standard dotted notation.
- Message: A buffer of data packed according to some scheme.
- Service: Internal client of in-memory store. Generally used to build ancilliary services, such as the backing store.
- Protocol: Internal client of in-memory and implementation of server side of a specific market data service protocol.
- Source: In or out channels covering some configurable root subject.
  - Broadcast: Incoming broadcast data.
  - Subscription: Handles client subscriptions.
  - Interactive: Like a broadcast source but receives notifications of subscription start/stops.

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Services and Protocols

- Protocols:
  - SASS over CI
  - SASS2/3 over RV
  - Wombat MAMA
  - Reuters RFA 5.x & SSL
  - Cache Protocol (CAPR)
- Services:
  - Store
  - Delay
  - Admin

Rai Protocols

- Cache Protocol (CAPR)
  - Rai designed transport and payload agnostic protocol.
  - Rai Cache supports dynamic loading of transports and message formats.
  - Full specification openly published.
- Embedded “Protocol”:
  - Cache client and cache in same process space.
  - Cache client uses RaiAPI
  - RaiAPI implementation communicates directly with in-process Cache.

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Rai API

- Mostly pure interface, some abstract classes.
- Runtime implementation required for each specific market data service protocol. Currently implementations for:
  - All classic TIB protocols.
  - The Cache Protocol.
  - Embedded Protocol.

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