The Architecture, Design and Support of Thomson Reuters RMDS incorporating

3rd party Data feeds

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Principal Consultant KSS

1 - Introductions

- Housekeeping
- Course Tutor
- Delegates
- Rules Of Engagement
- Disclaimer
- Agenda for the Day

John Best

- 2 Years Research Assistant and Junior Lecturer, Computing Dept, Kings College London.
- 20+ Years Finance Industry Experience
  - Networks
  - Dealing Floor Management
  - Trading Systems Design
  - Consultancy
- Investment Banks, Brokers and Vendors
- Lives in the Lake District to escape London
- 15 Minutes of Fame – Rhino Incident

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Caption Competition

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- ➢ **All views in this presentation are the views of the author and not necessarily the views of his employer or his employers' clients. The author is solely responsible for any potential misrepresentations of reality.**

- ➢ **Complaints and other feedback are most welcome, please contact:**

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RMDS, Data Feeds and System Management

- This unit aims to provide a detailed breakdown of RMDS, its core components are individually assessed and their function and features investigated.

- Illustrations of functionality will be provided from a Test RMDS system

- To get the most out of this part of the course delegates should have a <u>basic</u> understanding of <u>networks</u> and <u>linux / unix,</u>

Principles Of Market Data Platform Design

- Business Drivers
  - Data Sources
  - Users of Data
- Technical Solutions
  - Stage 1 Data Collection & Normalisation
  - Stage 2 Data Transformation
  - Stage 3 Data Distribution
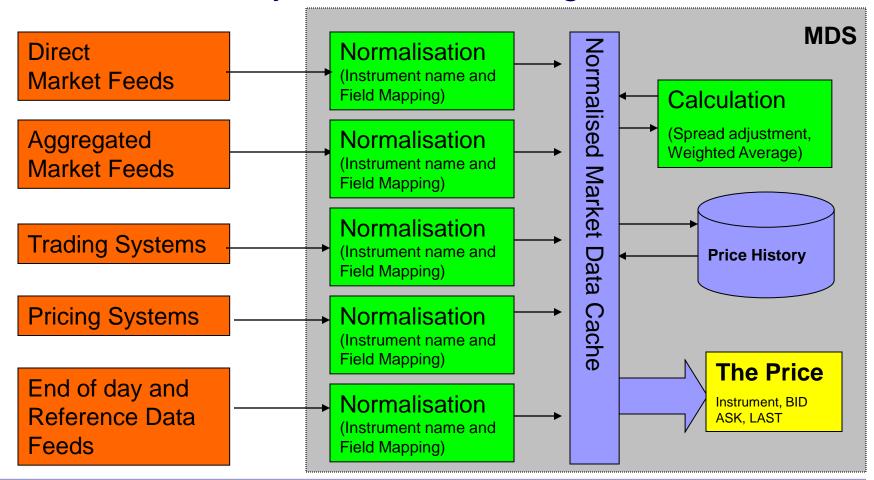 - Stage 4 Data Access Control
  - Stage 5 Extending the Infrastructure

Market Data Platforms – Business Drivers

- ☐ Data Collection Prices, News and Reference Data from as many sources as possible
  - ■ Data Feeds
  - ■ Direct from Trading Desks
  - ■ Trading Systems
  - ■ Whiteboards
  - ■ Central Data Manipulation/Transformation
- ☐ Data Storage for Analytics, Risk management and Testing Trading Sytategies and Models
  - ■ History Database
- ☐ Data Distribution
  - ■ Internal Systems
  - ■ Desks via Market data display terminal and Excel
  - ■ Other Offices
  - ■ Clients
    - ☐ Web Site
    - ☐ White Labelled Display
  - ■ Vendors
    - ☐ For fee or Attracting Order flow

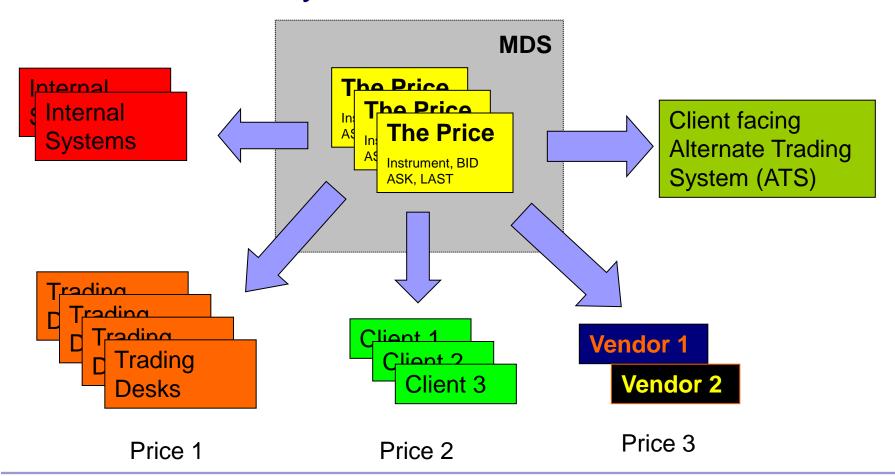# Incoming Data – More than one version of the truth

➢ Market Data System– Price Integration

MDS

Direct Market Feeds	→	Normalisation (Instrument name and Field Mapping)
Aggregated Market Feeds	→	Normalisation (Instrument name and Field Mapping)
Trading Systems	→	Normalisation (Instrument name and Field Mapping)
Pricing Systems	→	Normalisation (Instrument name and Field Mapping)
End of day and Reference Data Feeds	→	Normalisation (Instrument name and Field Mapping)

Normalised Market Data Cache

Calculation (Spread adjustment, Weighted Average)

Price History

The Price Instrument, BID ASK, LAST

Distribution Interfaces – More than one version of the truth

➢ ## Market Data System– Price Distribution

MDS

Internal Systems

The Price
Instrument, BID ASK, LAST

Client facing Alternate Trading System (ATS)

Trading Desks

Client 1
Client 2
Client 3

Vendor 1
Vendor 2

Price 1

Price 2

Price 3

Technical Solutions - Data Collection & Normalisation

- **Incoming Data Feeds and Formats**
  - ☐ Connection Types
    - X.25
    - Async modems etc
    - TCP/IP
    - File Transfer (Push or Pull)
  - ☐ Message parsing
    - Broadcast (with/without sequence numbers)
    - Point to Point (with/without recovery)
    - API
  - ☐ Message Payload – Initial Image or Update
    - Byte stream
    - Field value pair
    - Structured object
- **Feedhandler has to**
    - Normalise Data
    - Maintain data integrity
    - Alert Errors

Technical Solutions - Data Transformation

- Data may not be in the form you want it !
  - Pages to Records
  - Records to Pages
- Simple derived calculations
  - Add Mid Field ie bid+ask/2
- More complex calculations
  - Average or Fair price from multiple brokers
  - VWAP from previous trades
- Delay data
  - Avoid costs
- Sample Data
  - Reduce load on down stream devices

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Technical Solutions - Data Distribution

- **Generate Feed**
  - ☐ Send data to Vendor or Client
- **Point to Point**
  - ☐ Routable TCP/IP based connection
  - ☐ Access managed from Distribution Hub
- **Broadcast/multicast**
  - ☐ Send common data set to multiple clients
  - ☐ Client has to "play catch"
  - ☐ Client device responsible for recording data usage

Technical Solutions - Data Access Control

- Exchanges and other Data Suppliers Licence clients to use data.
    - Back billing for under reported usage may extend to 5 years !
    - Data suppliers undertake/commission Audits on client sites
- Any Market Data Platform must have a mechanism for recording and reporting potential and actual data usage.

Technical Solutions - Extending the Infrastructure

- **Platform Technology is a key part of the bank's investment to realise commercial advantage.**
  - ☐ Adding to the Data (API)
    - The Platform can become a key resource, housing data on the markets and securities, from an external as well as internal perspective
      - ☐ Using API's internally developed and 3rd party applications can leverage the Platform Knowledge base.
  - ☐ Adding to the Reach (WAN Gateways)
    - A Platform represents a large investment in data processing, the content can be extended to smaller offices using wide area gateways.
  - ☐ Cohesion (API)
    - The Platform can assist with providing the bank's systems with common pricing and reference data from a common core.

Introducing The Reuters Data Model and API

- **RMDS under the Covers**
  - Market Feed and SSL
  - Open Message Model and RFA
- **Reuters Data Feeds**
  - RDF
  - Direct Feeds
  - Aggregated Direct Feeds

Thomson Reuters Enterprise Platform Evolution

1990s ➔ Triarch/TIB – src_dist / sink_dist / TIC
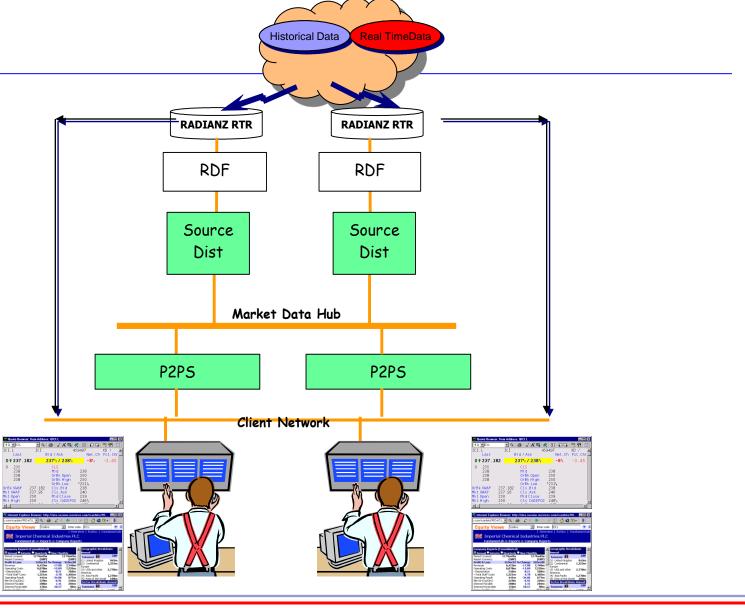
2000s ➔ RMDS – MDH / P2PS / RTIC

Today ➔ Enterprise Platform – ADH / ADS

ADH – Advanced Data Hub
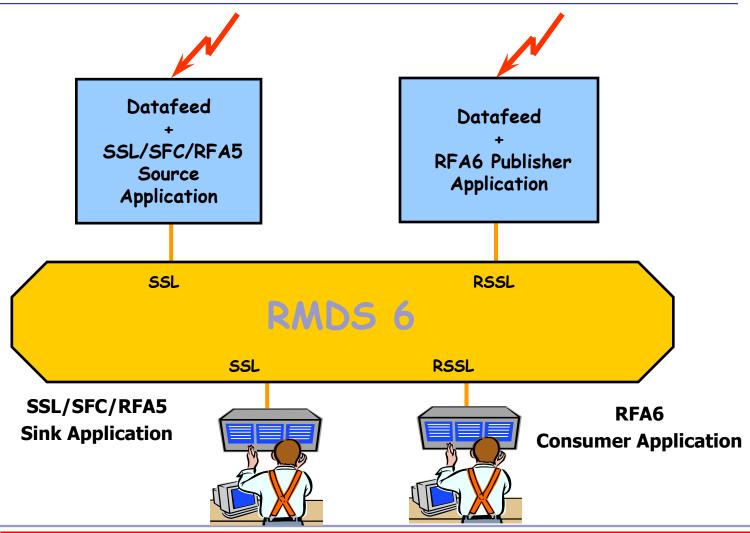ADS – Advanced Distribution Server
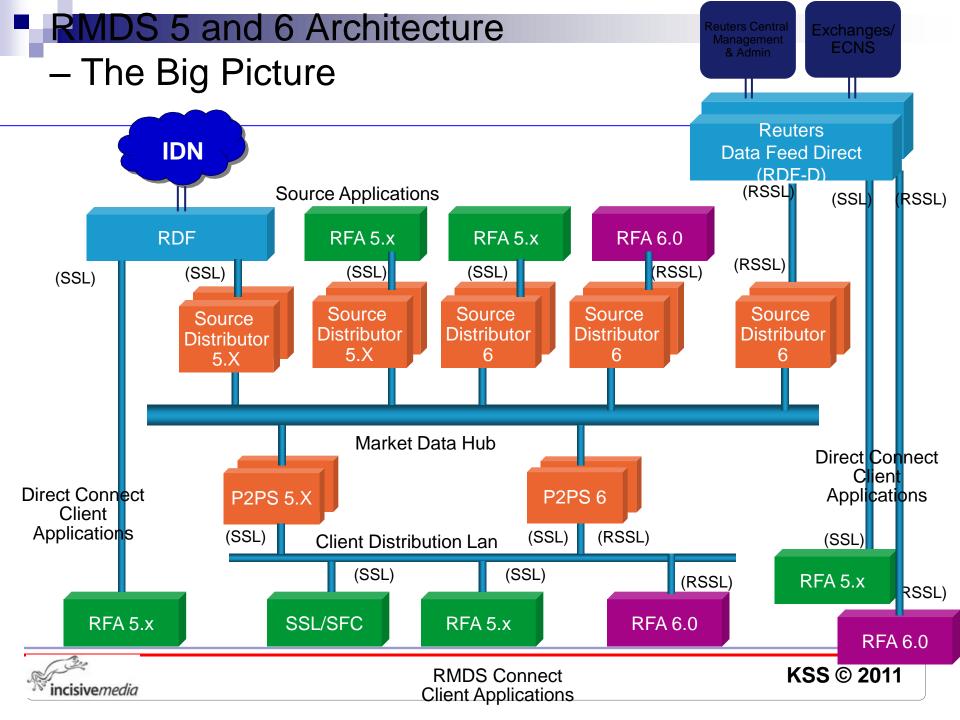
Real Time Data and Historical Data

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RMDS 6 Components

RMDS 5 and 6 Architecture
– The Big Picture

Market Feed and SSL

- **Market Feed (MF)**
  - □ Underpins IDN Network, Marketlink, Triarch and RMDS upto V5
  - □ Components
    - Security Id, **RIC=** Reuters Instrument code
    - Field / Value Pair
      - □ **FID** = Field ID, Can be tokenised
      - □ Value in a Textual Representation
      - □ Appendix A
- **SSL**
  - **SSL** = Source Sink Library
  - API for developing MF based Applications

Appendix A

■ The Market Feed Definition

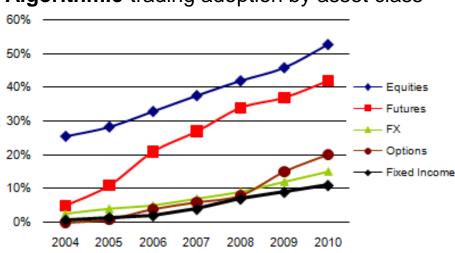| ACRONYM	DDE ACRONYM	FID	RIPPLES TO	FIELD TYPE	LENGTH	Notes
PROD_PERM	"PERMISSION"	1	NULL	INTEGER	5	Product permissions information,
RDNDISPLAY	"DISPLAYTEMPLATE"	2	NULL	INTEGER	3	Display information for the IDN terminal device.
DSPLY_NAME	"DISPLAY NAME"	3	NULL	ALPHANUMERIC	16	Expanded name for the instrument.
RDN_EXCHID	"IDN EXCHANGE ID"	4	NULL	ENUMERATED	3 (3)	Identifier for the exchange on which the instrument trades.
TIMACT	"TIME OF UPDATE"	5	NULL	TIME	5	Time when the head end updated a certain field or fields in the record.Which field depends on the instrument.
TRDPRC_1	"LAST"	6	TRDPRC_2	PRICE	17	Previous last trade prices or values stack.
TRDPRC_2	"LAST 1"	7	TRDPRC_3	PRICE	17	"
TRDPRC_3	"LAST 2"	8	TRDPRC_4	PRICE	17	"
TRDPRC_4	"LAST 3"	9	TRDPRC_5	PRICE	17	"
TRDPRC_5	"LAST 4"	10	NULL	PRICE	17	"
NETCHNG_1	"NET CHANGE"	11	NULL	PRICE	17	between latest trading price or value and the historic closing value or settlement price.
HIGH_1	"TODAY'S HIGH"	12	NULL	PRICE	17	Today's highest & lowest transaction value
LOW_1	"TODAY'S LOW"	13	NULL	PRICE	17	Today's highest & lowest transaction value
PRCTCK_1	"TICK:UP/DOWN"	14	NULL	ENUMERATED	1 (1)	The direction of trading from the previous trade
CURRENCY	"CURRENCY"	15	NULL	ENUMERATED	4 (3)	The currency in which the instrument is quoted.

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General Market Trends

The market is very different today than it was even 5 years ago…

Source: NYSE, Nasdaq, World Federation of Exchanges

Legend: Total Shares (m) — Total Trades (k) — Shares / Trade

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Trend towards trade Automation

Algorithmic trading adoption by asset class

Legend:
- Equities
- Futures
- FX
- Options
- Fixed Income

(Source: Aite Group)

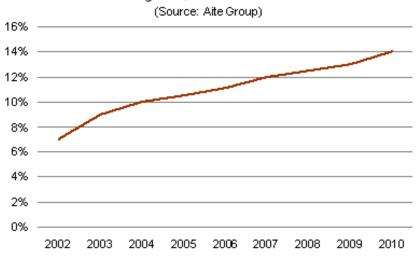**HF trading in equities now approaching 70% of volumes by 10% of financial institutions**

(Source: Aite Group)

Fragmentation in Europe:
- **118 Multi Lateral Trading Facilities (MTF)**
- **58 Regulated Markets (RM)**
- **23 Systematic Internalisers (SI)**
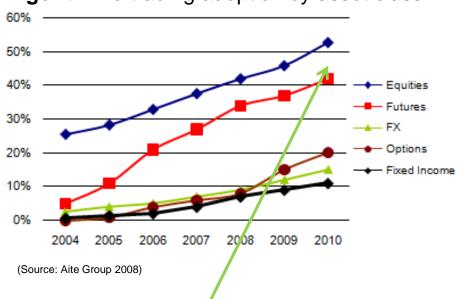
Percentage of Quant-Driven Global AUM
(Source: Aite Group)

Trend towards trade Automation

Algorithmic trading adoption by asset class

(Source: Aite Group 2008)

HF trading in equities now approaching 70% of volumes by 10% of financial institutions

(Source: Aite Group)
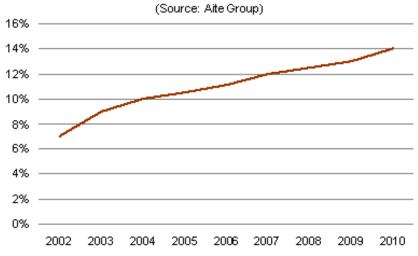
Recent analysis indicates FX trading to be at 45% automated in 2010

Percentage of Quant-Driven Global AUM
(Source: Aite Group)
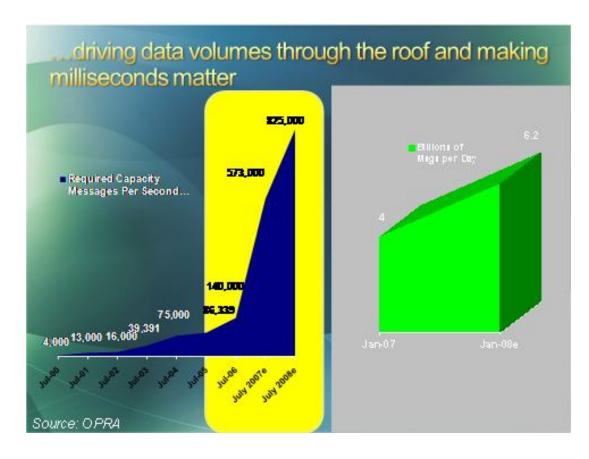
External Drivers for RMDS 6

OPRA Feed Volumes
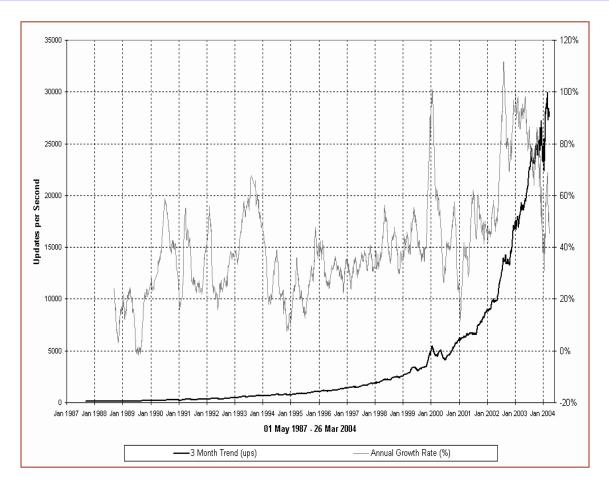
- Direct Exchange Feeds
- Custom Exchange Feeds
  - Activ Financial
  - FixNetix
- New Low Latency Platform Players
  - 29 West
  - Skyler
  - Aleri

Reuters Internal Drivers for RMDS 6 and RFA 6

Reuters Core Network Throughput

- Core IDN Network Capacity Upgrade
  - New Feeds
- Develop More Platform Capacity
- Driven by
  - Trends in Algorithmic Trading
  - The Quest for Speed
  - Programmatic access of new data types
- Extend applicability of Platform from Front to Back Office

- Break

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Enterprise Platform
New APIs

Open Message Model

Domain Message Model	Content Definition Model	• Instrument Types • Required Fields • Field Meanings & Relationships		Product Directories
	Item Type Model	• Real World Types (Market Price, Market By Order, News, Historical, etc).		Reuters Domain Models
Open Message Model	Data	• Date Containers • Primitive Data Structures	**RFA/UPA** RSSL Protocol	**Data Package**
	Transport	• Interaction Paradigms • Event Model • Symbology • Quality of Service • Entitlements		**Message Package** **Session Package**
Wire Format		• Wire Encoding		Reuters Wire Format

App ↕ RFA UPA

- **Reuters Wire Format (RWF)** is the physical way of expressing OMM data on the wire. RWF is not exposed to the application.

- **Open Message Model (OMM)** is a powerful capability that allows the representation of data using complex data structures and rich request paradigms.
  OMM is composed of Reuters SSL (RSSL), a new transport protocol, and RFA interfaces that allow the application to publish, subscribe and manipulate data

- **Reuters Domain Model (RDM)** is the definition of specific types of data. RDM specifies how request, response, and content messages are represented for concrete data types (e.g. Order Book).

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Open Message Model Primitive Data Structures
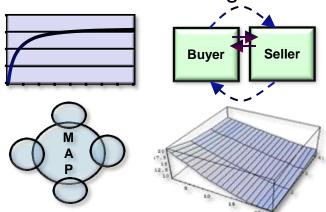
OMM uses the following building blocks:

Field List - A list of field/value pairs representing a logical record

Vector - A simple integer indexed (zero based) vector of information

Map - A simple key indexed vector of information

Series - A list of coherently structured tabular information (e.g. historical data)

Element List - A list of self describing field value pairs, no dictionary is needed

Open Message Model - Data Structures cont.

- OMM containers can be nested within each other to model hierarchical data
  - Users can use OMM to create custom data models e.g.
    - Yield Curve
    - Swaps
    - Multi Asset Portfolio
    - Implied Volatility Surface
    - Others as required

Buyer   Seller

M
A
P

- Thomson Reuters have used OMM to define a set of models called the Reuters Domain Models (RDM)

OMM Advantages

- **Reduced bandwidth**
  - 50% reduction in typical image and update size from RMDS5/MF
  - 84% reduction in typical image and update size from RMDS5/TibMsg

- **Increased throughput**
  - 45%-100% increase in throughput, same hardware
  - Using the new ADH and ADS component of our market data system, tests scaled to 40 million updates per second

- **Lowest latency**
  - Fewer bytes to read, write, and send
  - Latency measured in microseconds

- **Unlimited flexibility**
  - Innovate new data models
  - Custom models fully supported by our market data system

OMM Advantages cont.

- **Faster application processing of data**
    - Faster to parse OMM messages
    - Can utilize binary data quicker in applications

- **Functionality never before possible**
    - Publish the QoS for the data
    - Provide responses (models) with multi-part responses
    - HTTP/HTTPS connectivity to RMDS
    - Pause and resume a stream
    - Generic Message, bi-directional generic messages
    - Private streams - exclusive data exchange between a provider and consumer
    - Batch OMM item requests rather requesting items one at a time
    - OMM Dynamic views to receive just a subset of the entries
    - OMM Posting
    - OMM warm standby by using a primary and backup stream
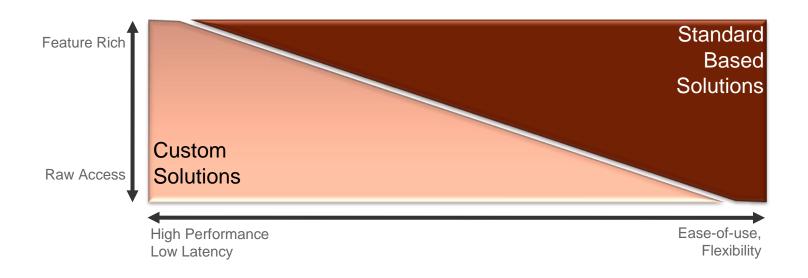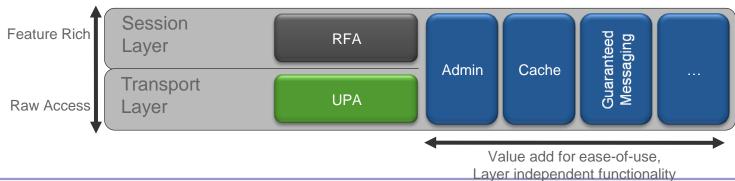
OMM and RFA

- **The Open Message Mode (OMM)**
  - New Data model for Financial Instruments
    - Multiple Asset Classess
    - Real time and Reference Data
- **Reuters Foundation Architecture (RFA)**
  - Implements OMM
  - Backward compatibility to Market Feed (MF)
- **Reuters Wire Format (RWF)**
  - A binary implementation of RFA providing the lowest latency implementation of OMM and RFA
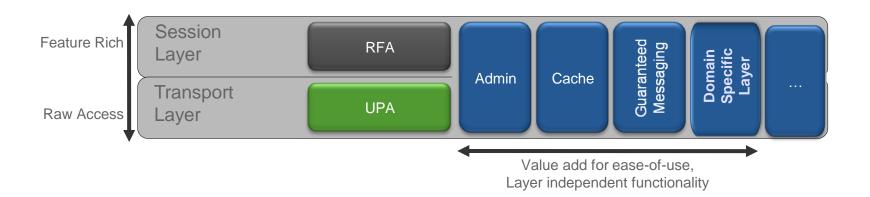
APIs fit for purpose – API Strategy

APIs fit for purpose – Value Add

| | Session Layer | RFA | Admin | Cache | Guaranteed Messaging | Domain Specific Layer | ... |
| Feature Rich / Raw Access | Transport Layer | UPA | | | | | |

Value add for ease-of-use,
Layer independent functionality
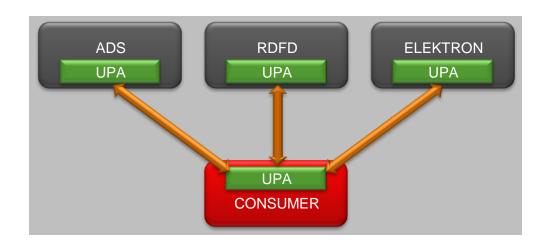
Value Add Layers
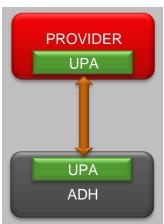
• Ease of Use / Expanded Functionality

• Based on Features/Domains, can work with UPA or RFA

• Provide as supported libraries in each API release

• Source Code provided for Value-Add layers.

• Allows clients to build their own custom layers quickly if they don't want to use the supported ones provided.

UPA (Ultra Performance API)

The Ultra Performance API (UPA) is the first client release of the low-level internal API which is currently utilized by the Thomson Reuters Enterprise Platform for Real Time and its dependent APIs for the optimized distribution of OMM/RWF.
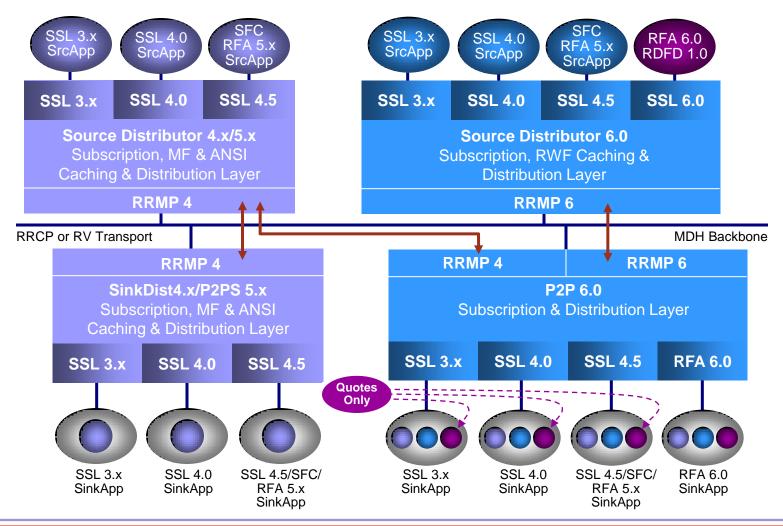
API General Capabilities Comparison

Capabilities		RFA	UPA	Capabilities		RFA	UPA
Transport	Compression via OMM	✓	✓	Domain Models	Custom Data Model Sup.	✓	✓
Transport	HTTP via WinlNet – RWF	✓	✓	Domain Models	RDM – Dictionary	✓	✓
Transport	RV Multicast	✓		Domain Models	RDM – Login	✓	✓
Transport	TCP/IP – RWF	✓	✓	Domain Models	RDM – Market Price	✓	✓
Transport	TCP/IP – SSL	✓		Domain Models	RDM – MarkebyOrder	✓	✓
Application Types	Consumer	✓	✓	Domain Models	RDM – MarketbyPrice	✓	✓
Application Types	Provider – Interactive	✓	✓	Domain Models	RDM – Market Maker	✓	✓
Application Types	Provider – Non-Interactive	✓	✓	Domain Models	RDM – Source Directory	✓	✓
General Capabilities	Batch Support	✓	✓	Domain Models	RDM – Symbol List	✓	✓
General Capabilities	Generic Messages	✓	✓	Encoders/Decoders	ANSI Page	✓	✓
General Capabilities	Pause/Resume	✓	✓	Encoders/Decoders	DACS Locks	✓	✓
General Capabilities	Posting	✓	✓	Encoders/Decoders	Market Feed/TIB Msg	✓	
General Capabilities	SnapShot Requests	✓	✓	Encoders/Decoders	OMM	✓	✓
General Capabilities	Streaming Requests	✓	✓	Encoders/Decoders	RMTES	✓	✓
General Capabilities	Views	✓	✓	Encoders/Decoders	TS1 Parser	✓	✓

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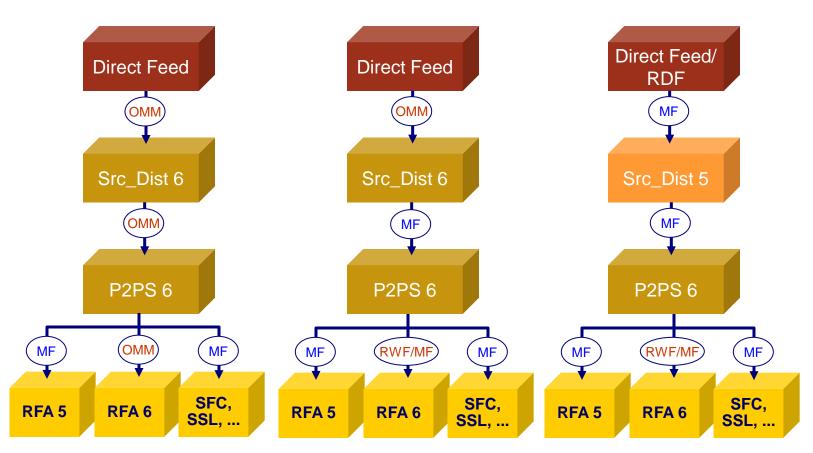
RMDS 6.0
Application Compatibility

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RMDS 6

Conversion Facilities

- Conversion in P2PS and Source Distributor is for **Level 1 data ONLY**
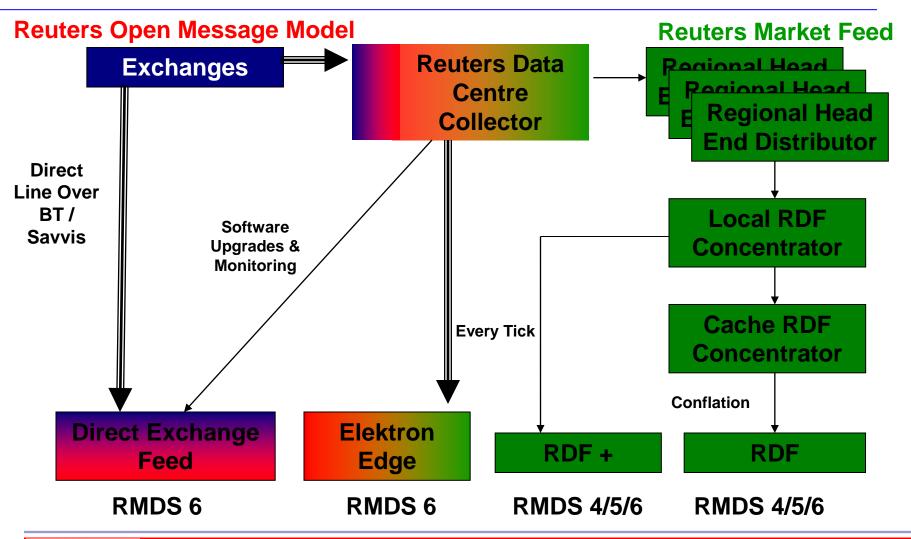
OMM – What does it mean

- **Extensible data structure for the future**
  - First products RMDS 6 and RDF Direct
    - P2PS key component (universal tool !)
  - Retained control of market
  - Reduced bandwidth and latency
- **Areas Of Concern**
  - Core network Investment & Delivery
    - Project Elektron
  - Keeping display products up to date
    - V6 of 3000xtra and Eikon Workstation

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Reuters Data Feed Options

Reuters Open Message Model

Reuters Market Feed

| Exchanges | ⇒ | Reuters Data Centre Collector | → | Regional Head End Distributor |

Direct Line Over BT / Savvis

Software Upgrades & Monitoring

Every Tick

Local RDF Concentrator

Cache RDF Concentrator

Conflation

| **Direct Exchange Feed** | **Elektron Edge** | **RDF +** | **RDF** |
| RMDS 6 | RMDS 6 | RMDS 4/5/6 | RMDS 4/5/6 |

3) What is RMDS and what does it do?

- Reuters Market Data System (RMDS) is a suite of software Components \that distributes Reuters Real-Time Data, and other 3rd party data which consists of many markets around the world.

- RMDS uses various network protocols (TCP, UDP and Multicast) to transfer real time market data using such application protocols Sink Source Library (SSL) and Reuters Reliable Control Protocol (RRCP).

- A well-structured RMDS environment is made up of a network topology intended to maximize availability and ensure data accuracy. The layout is designed specific to the needs of each client.

- RMDS has the ability to service multiple feeds at once, broadening the information accessibility to the clients.

- For the Reuters consolidated feed (known as IDN_RDF or IDN_SELECTFEED), information is accessed through a client application by calling in a Reuters Instrument Code (RIC). These proprietary codes are mapped by Reuters to display the appropriate information, whether it be stock or page data.

Who uses Reuters Real-Time Data?

- Financial institutions such as investment banks, hedge funds, brokers, etc.

Platforms and Operating Systems

Product Category	Product	Windows 95	Windows 98	Windows NT 4 SP4	Windows NT 4 SP5	Windows NT 4 SP6	Windows 2000 SP1	Windows 2000 SP2	Windows 2000 SP3	Windows 2000 SP4	Windows 2003	Windows 2003 SP1	Windows 2003 SP2	Windows XP Home	Windows XP Home SP1	Windows XP Pro.	Windows XP Pro. SP1	Windows XP Pro. SP2	Solaris 2.5.1	Solaris 2.6	Solaris 7	Solaris 8	Solaris 10 SPARC	Solaris 10 X86	RH Advanced Server 2.1	RHEL 3.0	RHEL 4.0	RHEL 5.0	SLES 9	SLES 10	HP-UX 10.0	HP-UX 10.2	HP-UX 11.0	HP-UX 12.0	AIX 4.2.1	AIX 4.3.x
Feed handler	IDB Eurobrokers Server 5.0.1																					X	X			X	X*	X	X	X						
	IDB Garban US Treasury Server 5.0																					X	X			X	X*	X	X	X						
	IDB Hilliard Farber Server 5.0																					X	X			X	X*	X	X	X						
	IDB Liberty Server v. 5.0.2																					X	X			X	X*	X	X	X						
	IDB Patriot Server v. 5.0																					X	X			X	X*	X	X	X						
	IDB Prebon Yamane Server 5.0																					X	X			X	X*	X	X	X						
	IDB Tradition Server 5.0																					X	X			X	X*	X	X	X						
	IDB Tullet & Tokyo US Server v. 5.0																					X	X			X	X*	X	X	X						
Infrastructure	MDH Source Infra 6.0																						X	X		X	X		X							
	MDH Source Infra 6.2																						X	X		X	X		X							
	MDH Source Infra 6.3																						X	X		X	X	X	X	X						
	MDH Source Infra 5.3																					X	X			X	X*		X*							
	DTIC RMDS Ed. V. 11.1																					X	X			X	X*		X*							
	DTIC RMDS Ed. V. 11.2																						X	X		X	X		X							
	DTIC RMDS Ed. V. 11.3																						X	X		X	X		X							
	RTIC v. 11.1																					X	X			X	X*		X*							
	RTIC v. 11.2																						X	X		X	X		X							
	RTIC v. 11.3																						X	X		X	X		X							
	P2PS 6.0									X													X	X		X	X		X							
	P2PS 6.2									X													X	X		X	X		X							
	P2PS 6.3									X													X	X		X	X	X	X	X						
	P2PS 5.1																					X	X		X	X*			X*							
Access Control	DACS 5.2 <DACS-API>				X	X	X	X													X	X			X		X	X								
	DACS 5.2 <station / infra>																									X		X	X							
	DACS 5.3 <DACS-API-daemon>				X	X	X	X	X												X	X		X	X	X	X	X	X*		X					
	DACS 5.3 <infra>																							X	X	X	X	X	X*		X					
	DACS 5.3 <station>																									X	X		X	X*		X					
	DACS 6.0 <DACS-API>				X	X	X	X	X												X	X	X		X	X	X	X	X*	X	X	X				
	DACS 6.0 <infra>																									X	X	X	X	X	X	X				
	DACS 6.0 <station>																									X	X	X	X	X	X	X				
	ELS v. 2.0			X	X	X	X	X	X	X									X		X	X			X		X	X*	X*							
	ELS v 2.0.4						X	X	X	X											X	X			X		X	X*	X*							
	ELS v 2.0.5						X	X	X	X											X	X	X		X		X	X*	X*							
	ELS v 2.0.6						X	X	X	X	X	X									X	X	X		X		X	X*	X*							
Value Added	DBU 4.0			X	X	X	X	X	X	X												X				X										
	DBU 4.2			X	X	X	X	X	X	X												X				X										
	DBU 4.2.2			X	X	X	X	X	X	X												X				X	X*				X					
	DBU 4.2.3								X	X												X				X	X				X					
	DTS 5.1																			X		X				X	X				X					
	DTS 5.2.1																					X				X	X									
	DTS 5.3																					X	X			X	X			X						

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See Referenced Documents Page

RMDS Components

- ### Reuters Data Feed (RDF)
  The RDF is managed by Reuters but hosted on the client site. The RDF is normally dual homed and serviced by a specific Reuters data center (Hauppauge, Nutley, etc) throughout the world. The RDF is responsible for servicing the Reuters consolidated feed (IDN_RDF) to Market Data Hubs at the client site.

- ### Market Data Hub (MDH)
  The MDH (also known as a Source Distributor) is hosted by the client and connects to the RDF via the Sink Source Library (SSL) to retrieve the Reuters feed data. Each MDH can publish multiple services, depending on the client's need. The MDH uses UDP Broadcast for sending data to the *Market Data Backbone*.

- ### Point to Point Server (P2PS)
  The P2PS is responsible for accepting client connections and servicing requests for the Reuters consolidated feed or any other broker service available on the network. The service published by the MDH's onto the Market Data Backbone is accessed by the P2PS via UDP Broadcast messages..

- ### Real-Time In-memory Cache (RTIC)
  The RTIC uses Multicast to deliver market data to the client application. This is used in conjunction with TIBCO Rendesvous (RV) to encapsulate the messages for the client.
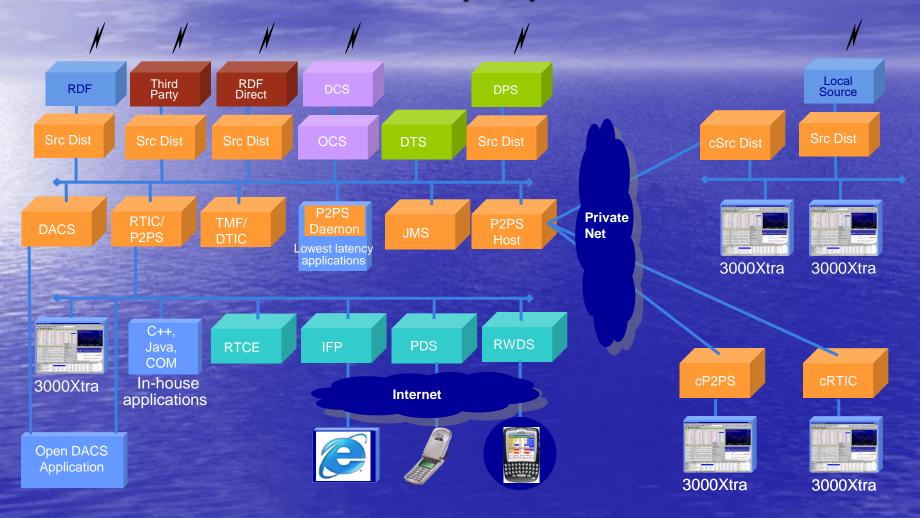
- ### Data Access Control System (DACS)
  DACS is comprised of a Sybase database and several components that interact with RMDS to control what can be accessed by users in the system. This is a necessary piece of the RMDS infrastructure because it is the primary reporting system used by Reuters and most exchanges for billing and fees.

Full-scale RMDS Deployment

RDF

Third Party

RDF Direct

DCS

DPS

Local Source

Src Dist

Src Dist

Src Dist

OCS

DTS

Src Dist

cSrc Dist

Src Dist

DACS

RTIC/ P2PS

TMF/ DTIC

P2PS Daemon

Lowest latency applications

JMS

P2PS Host

Private Net

3000Xtra

3000Xtra

3000Xtra

C++, Java, COM

In-house applications

RTCE

IFP

PDS

RWDS

Internet

Open DACS Application

cP2PS

cRTIC

3000Xtra

3000Xtra

Other Key RMDS Components

- ## Inter Data Broker Feed (IDB)

  IDB feed handlers provide page data from third party brokerages that use vendor specific processes to integrate into the RMDS environment using MDH servers. IDB feed handlers use serial connections directly linking to the vendor

- ## Data Backup Unit (DBU)

  The DBU is an RMDS client that provides time series data to client applications such as 3000xtra. The primary function of the DBU is to cache data from IDN in a centralized place for easy access to historical and real time information

- ## Data Contribution Server (DCS)

  DCS allows clients to make contributions the the Reuters IDN network via the service known as MARKETLINK. The DCS component can function over a serial connection or over IP.

- ## Data Transformation System (DTS)

  DTS, once known as Data Dictionary Server (DDS), is an internal RMDS application that allows users to publish and subscribe to customized data.

4) Legacy Components

- License Server
- Data Dictionary Server
- Data Publishing Server

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The Enterprise License Server (AKA Effix License Server)

☐ Legacy Part of RMDS

- ■ Potential cause of System Unavailability
    - ☐ Used to protect Reuters Revenues
- ■ Selected Products Supported
    - ☐ **Some RMDS applications require an Effix License Server to check the authenticity of the software running on the network. Such applications are 3000xtra version 4.5, DACS 5.3 and DTS.**

Legacy Components (CONT)

- **Data Dictionary Server**
  - Aliasing
  - Page shredding
  - Replaced by DTS
- **Data Publishing Server (old)**
  - Normalises Simple Serial Data feeds
  - Mainly from Brokers

RMDS Protocols and General Configuration

- ■ **RMDS Supports a variety of Protocols**
  - ☐ Client (workstation) and In-house developed data consuming applications
    - ■ These Generally connect to the P2PS server
      - ☐ These connections are known as "Mounts"
      - ☐ Registered by the P2PS for Authorisation and Reporting requirements
      - ☐ Connections may use SSL or RFA API Libraries
  - ☐ Server side protocols (data sources)
    - ■ Extant SSL source and new RFA or RWF sources supported.

A Client Connection

- **IPC / SSL4**
  - ☐ Example Config file

- **RFA**
  - ☐ Example Config file

IPCROUTE and RFA Configuration File

IPCROUTE File Syntax

service_name.client_type:client_host:server_host1 server_host2

Where:-

service_name	triarch_sink (or rmds_ssl_sink) or triarch_dbms
client_type	srclib or **sinklib**.
client_host	hostname on which the client SSL application is running.
server_host	**p2ps01 p2ps02**

RFA Config File Syntax

\Sessions\XtraSession\connectionList = "**Connection_XTRA_SSLED**"

\Connections\Connection_XTRA_SSLED\connectionType = "**SSLED**"

\Connections\Connection_XTRA_SSLED\PortNumber = "triarch_sink"

\Connections\Connection_XTRA_SSLED\ServerList = "p2ps01 p2ps02"

3000 Xtra
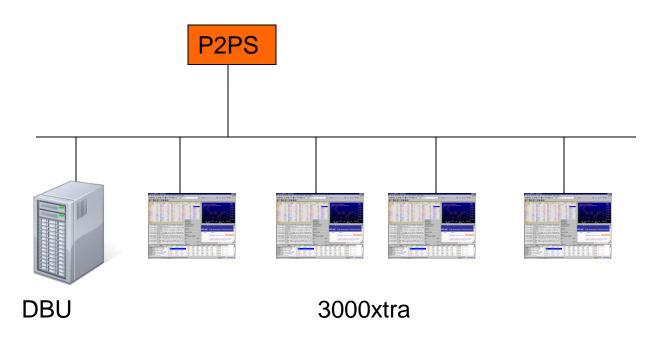
- **Simplest Delivery is**
  - □ 3000xtra Hosted (By Reuters / HP)
    - ■ Massive RMDS Backbone
      - □ In this case London & Geneva
      - □ Fronted By Citrix Servers
      - □ Captive Excel Environment
      - □ Reuters manages DACS system
- **Demo**
  - □ Underlying Reuters Data structures
  - □ Feed Mapping

The DBU

- ## <u>Data Backup Unit (DBU)</u>

  The DBU is an RMDS client that provides time series data to client applications such as 3000xtra. The primary function of the DBU is to cache data from IDN in a centralized place for easy access to historical and real time information.

DBU   3000xtra

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The Market Data Hub (MDH)

- **Feed Handlers deliver data**
- **The MDH is a "Normalised Cache of All Data sources"**
  - ☐ Implemented by multiple Backbone Protocols
    - Common Network standards TCP/IP and UDP
      - ☐ Augmented for Market Data
        - Sequencing – Know if you have missed an update
        - Recovery – get missed updates
        - Failover between multiple feeds
  - ☐ In RMDS these are
    - RRDP, RRMP, RRCP
- In actuality the Cache is a Network Switch

Source Dist

- ## Supply side of the MDH
  - ☐ Source Management
    - Recovery, Data quality, state management, load balancing, source mirroring, supports interactive and broadcast feeds
    - Optionally Maintains cache, auto update
    - Field and update filtering (conflation)
    - OMM, Marketfeed and ANSI Pages
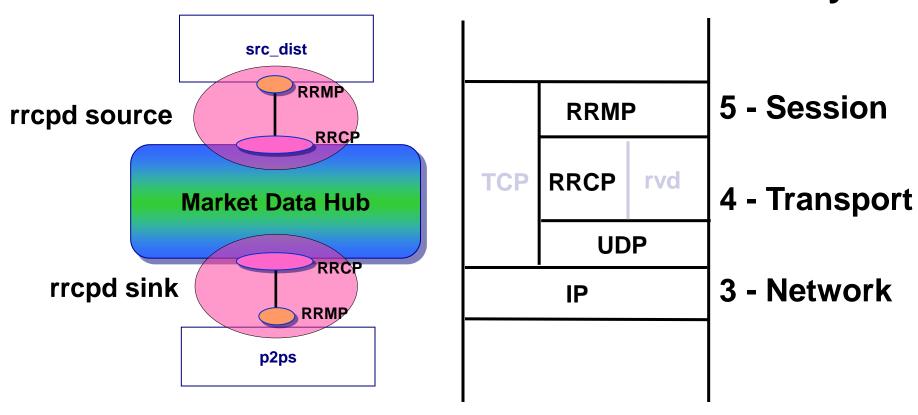
Backbone Protocols

- **RRDP** - Reuters Reliable Datagram Protocol. This protocol is used to communicate between the key Market Data Hub processes. It is made up of two protocol layers—RRCP and RRMP.

- **RRMP** - Reuters Reliable Management Protocol. This is the market data semantics that hub components use to communicate with each other. It uses the RRCP layer for reliable end-to-end communications.

- **RRCP** - Reuters Reliable Control Protocol. This is a transport protocol that builds reliability on top of UDP/IP. It is used to send RRMP packets between components on Market Data Hub. It is similar in function to the RV protocol.

RRDP on the Market Data Hub

OSI Layers

src_dist

rrcpd source

RRMP

RRCP

Market Data Hub

rrcpd sink

RRCP

RRMP

p2ps

	RRMP	5 - Session
TCP	RRCP	rvd	4 - Transport
	UDP	
	IP	3 - Network
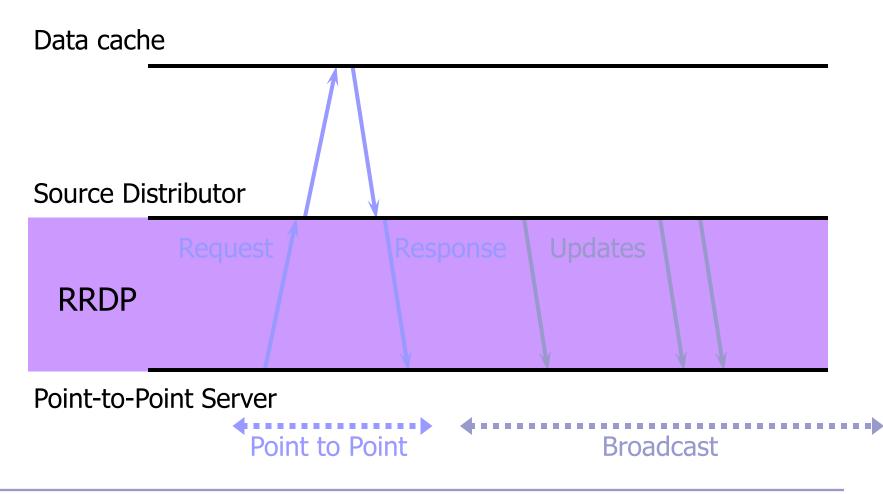
Data Distribution
Reuters Reliable Datagram Protocol

Data cache

Source Distributor

Request   Response   Updates

RRDP

Point-to-Point Server

Point to Point   Broadcast

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rrcpd

<hostname>*RRCP*nodeId

*RRCP*ports

rrcpd source

rrcp_snksrcA
0x8000/udp

0x8011/udp

rrcp_snksrcB
0x8001/udp

0x8010/udp

rrcpd sink
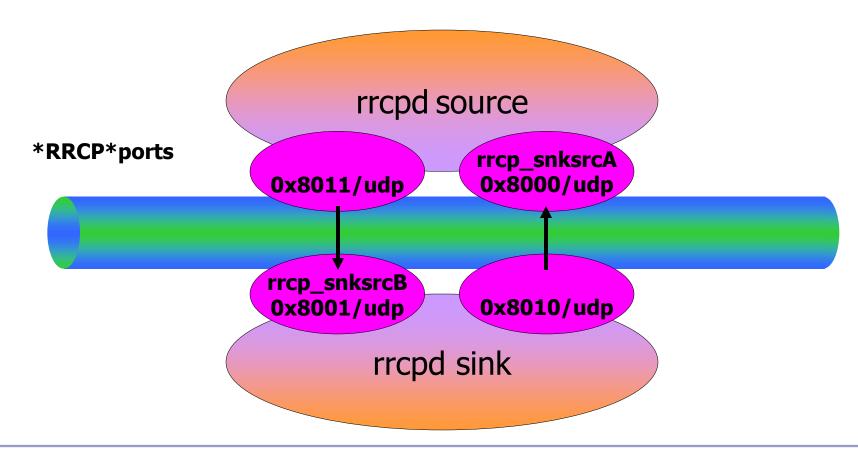
Sample RMDS.cnf file
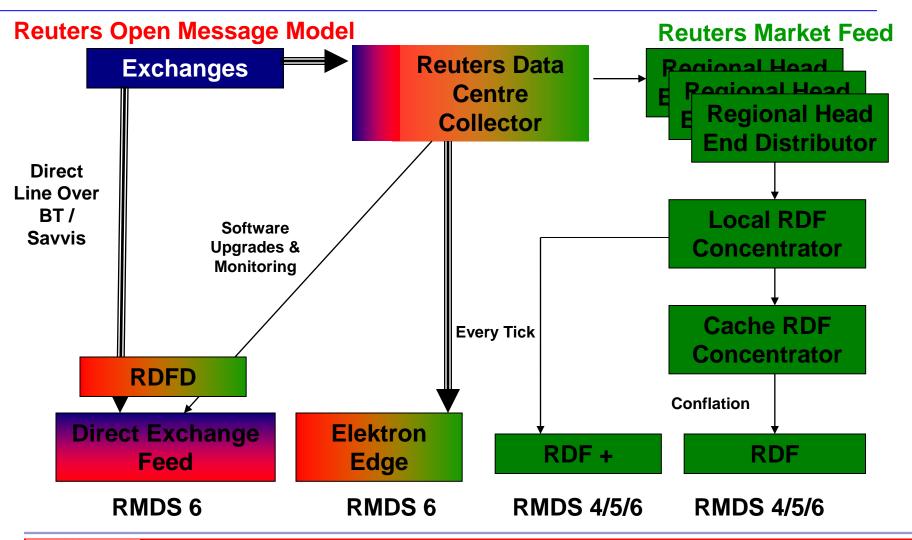
Monitoring a Market Data Hub (MDH)

- Check for running processes (src_dist, rrcpd source & rrcpd sink Hot Standby only)

- Run src_distmon to verify operational status

- Check src_dist.log for errors or warnings. All service outages need investigation.

Reuters Data Feed Options

Reuters Open Message Model

Reuters Market Feed

Exchanges

Reuters Data Centre Collector

Regional Head End Distributor

Direct Line Over BT / Savvis

Software Upgrades & Monitoring

Local RDF Concentrator

Cache RDF Concentrator

Every Tick

RDFD

Conflation

Direct Exchange Feed

Elektron Edge

RDF +

RDF

RMDS 6

RMDS 6

RMDS 4/5/6

RMDS 4/5/6
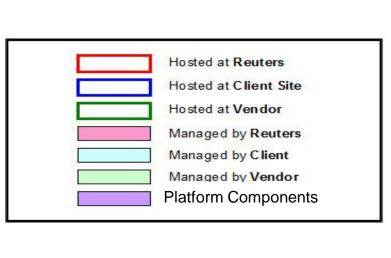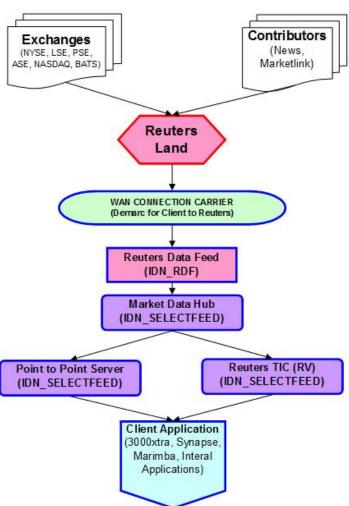
RDF Delivery

- **RDF delivered as a pair of Servers**
- **Transmission from Reuters**
  - ☐ X.25
  - ☐ Satellite
  - ☐ TCP/IP
- **Connection to Platform**
  - ☐ RFA, SSL

Reuters Integrated Data Flow

Source Monitoring

- Check Connection and service availability`

Data Feed (Plus feed, RDF, Bloomberg

Feed Handler

Source Dist
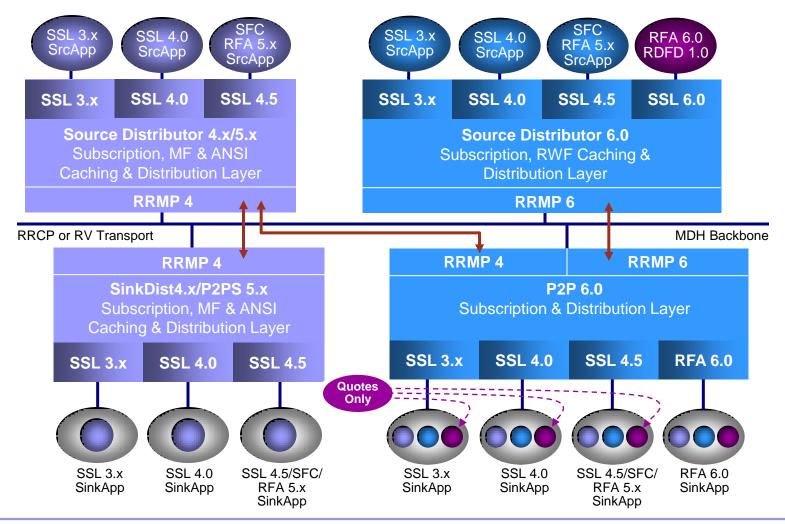
The P2PS – Functionality
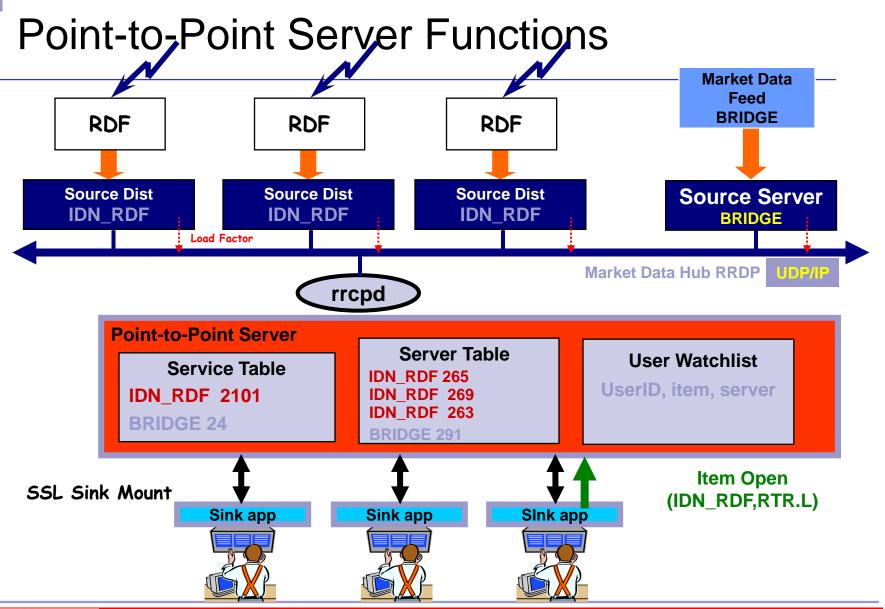
- **One of the most important parts of the RMDS Platform**
  - ☐ **Data distribution via TCP/IP**
  - ☐ **Protocol conversion MDH4 to OMM**
  - ☐ **Support for 100's of users from 1 Server**
  - ☐ **Data Security (close coupled with DACS)**
    - ▪ **Tracks all data usage of connected applications**
  - ☐ **Well Developed Management front end**

Key Components

SSL 3.x SrcApp • SSL 4.0 SrcApp • SFC RFA 5.x SrcApp

SSL 3.x	SSL 4.0	SSL 4.5

Source Distributor 4.x/5.x
Subscription, MF & ANSI
Caching & Distribution Layer

RRMP 4

SSL 3.x SrcApp • SSL 4.0 SrcApp • SFC RFA 5.x SrcApp • RFA 6.0 RDFD 1.0

SSL 3.x	SSL 4.0	SSL 4.5	SSL 6.0

Source Distributor 6.0
Subscription, RWF Caching &
Distribution Layer

RRMP 6

RRCP or RV Transport   MDH Backbone

RRMP 4

SinkDist4.x/P2PS 5.x
Subscription, MF & ANSI
Caching & Distribution Layer

SSL 3.x	SSL 4.0	SSL 4.5

RRMP 4	RRMP 6

P2P 6.0
Subscription & Distribution Layer

SSL 3.x	SSL 4.0	SSL 4.5	RFA 6.0

Quotes Only

SSL 3.x SinkApp • SSL 4.0 SinkApp • SSL 4.5/SFC/RFA 5.x SinkApp

SSL 3.x SinkApp • SSL 4.0 SinkApp • SSL 4.5/SFC/RFA 5.x SinkApp • RFA 6.0 SinkApp

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Point-to-Point Server Functions

Market Data Feed BRIDGE

RDF → RDF → RDF

Source Dist **IDN_RDF** → Source Dist **IDN_RDF** → Source Dist **IDN_RDF**

Source Server BRIDGE

Load Factor

Market Data Hub RRDP **UDP/IP**

rrcpd

Point-to-Point Server

Service Table
IDN_RDF 2101
BRIDGE 24

Server Table
IDN_RDF 265
IDN_RDF 269
IDN_RDF 263
BRIDGE 291

User Watchlist
UserID, item, server

SSL Sink Mount

Sink app   Sink app   SInk app

Item Open (IDN_RDF,RTR.L)

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Request Routing

P2PS Architecture

P2PS 5 (HOST)
8101

P2PS 6 (HOST)
14002

src_dist 5 RRMP 4
rrcpd

src_dist 6 RRMP 6
rrcpd

14002

8101

rrcpd

| SSL | RSSL | RRMP4 | RRMP6 |

Optional Cache (POP Mode)

P2PS Container

8101   P2PS 6   14002

SSL/RFA 5
Client Application

RFA 6
Client Application

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Monitoring a Point to Point Server (P2PS)
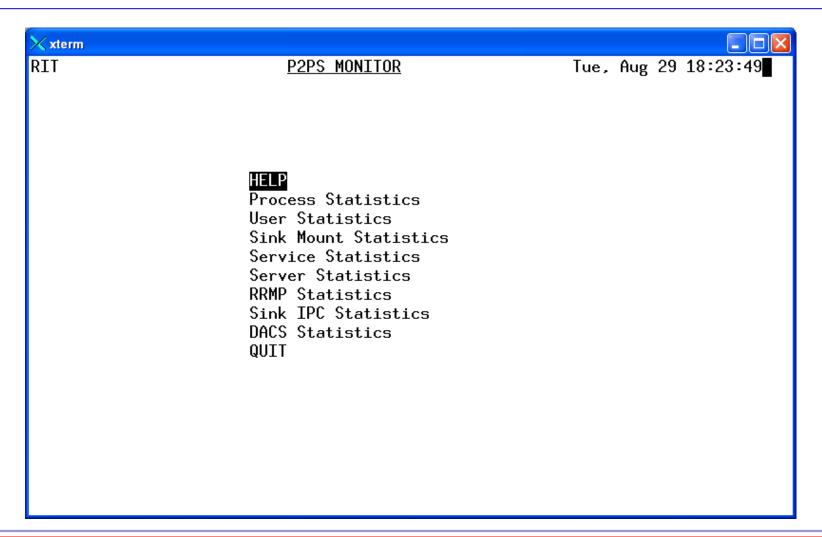
- Check for running processes (p2ps, rrcpd sink, dacs.snkd & dacs.snkd slave)

- Run p2psmon to verify operational status

- Check p2ps.log for errors or warnings

```
ny-p2ps1 - PuTTY
[root@ny-p2ps1:/ ] $
```

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The P2PS Server Monitor - p2psmon

User Statistics
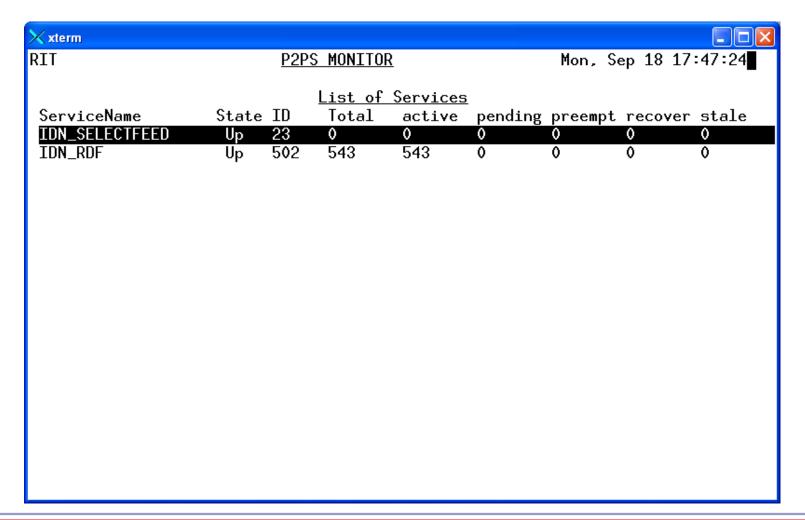
```
X xterm                                                              _ □ X
Reuters                        P2PS MONITOR              Tue, Aug 29 18:24:55█

                            User Database
activeUsers        : 2                percentRsslMountsU: 1
activeSslMounts    : 3                maxRsslMounts     : 100
connectionsAvailab: 97               dumpDB            : False
percentSslMountsUs: 3                 printOutput       : user.out
maxSslMounts       : 100             dumpOutput        : user.dmp
activeRsslMounts   : 1               disconnectStaleSer: 37 38 39 40 256
availableRsslMount: 99               mapSolicitedInfoAp: 37 38 39 40 256
    --More--(Page 1 of 2)
                            List of Users
User Name               Mounts   OpenItems    MaxItems        MaxClass
ivan.buckle             3          118         2400           10
rssl.test               1          3           2400           10
```

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Service Statistics


```
RIT                      P2PS MONITOR              Mon, Sep 18 17:47:24█

                              List of Services
ServiceName       State  ID    Total    active   pending preempt recover stale
IDN_SELECTFEED      Up    23      0        0        0       0       0       0
IDN_RDF             Up   502    543      543        0       0       0       0
```
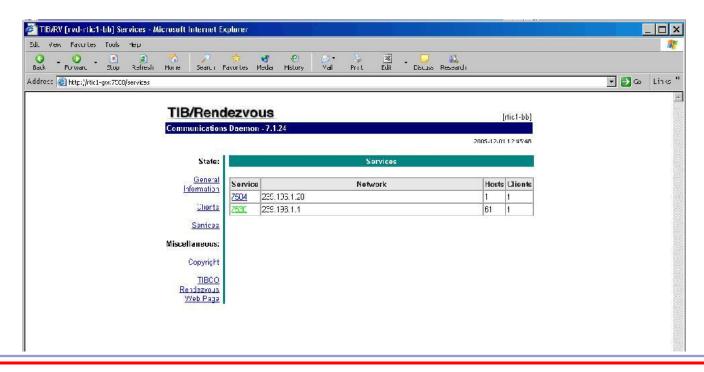
Server Statistics

```
RIT                        P2PS MONITOR              Tue, Sep 19 17:16:30

                          List of Servers
ServerName        ServerId   nodeId        Load    active    pending   pendout
DCS_MARKETLINK    283        33012           0       0         0         0
GARBAN            459        33010           1       0         0         0
DDS               275        33011           0       0         0         0
TDQFS             291        33011           0       0         0         0
IDN_SELECTFEED    271        33008           1       0         0         0
IDN_SELECTFEED    273        33009           1     277         0         0
IDN_RDF           45000      50005         296     753         0         0
```

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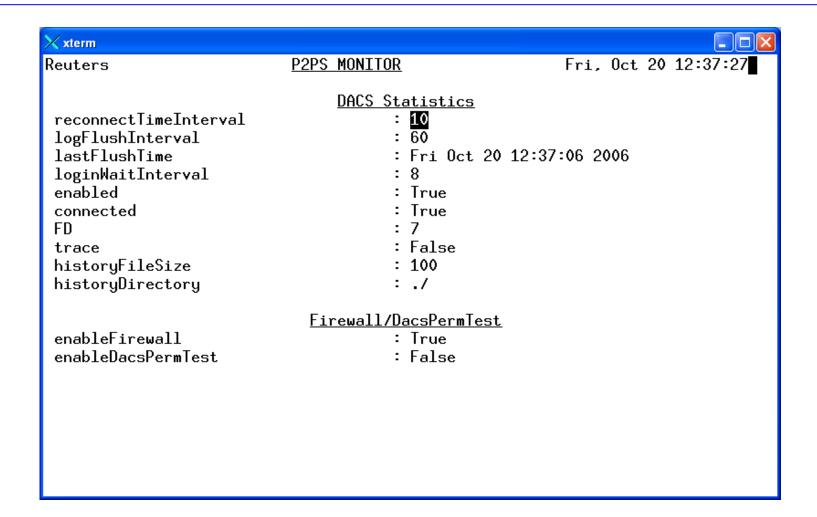
Monitoring a Reuters TIC (RTIC)

- Check for running processes (rtic & rvd)

- Run rticmon to verify operational status

- Check rtic.log for errors or warnings.

- Visit the RVD website (default port 7850) for additional statistics and subscriptions.

P2PS and DACS


```
Reuters              P2PS MONITOR           Fri, Oct 20 12:37:27

                     DACS Statistics
reconnectTimeInterval              : 10
logFlushInterval                   : 60
lastFlushTime                      : Fri Oct 20 12:37:06 2006
loginWaitInterval                  : 8
enabled                            : True
connected                          : True
FD                                 : 7
trace                              : False
historyFileSize                    : 100
historyDirectory                   : ./

                     Firewall/DacsPermTest
enableFirewall                     : True
enableDacsPermTest                 : False
```

Data In

- **MDH and RDF**
  - ☐ RDF connectivity
  - ☐ Source Distributor Monitoring, Troubleshooting and Maintenance

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The DACS

☐ Functionality

☐ Components

☐ Operation

P2PS and DACS


```
 X  xterm                                                                    _  □  X
Reuters                        P2PS MONITOR                    Fri, Oct 20 12:37:27█

                               DACS Statistics
reconnectTimeInterval             : 10
logFlushInterval                  : 60
lastFlushTime                     : Fri Oct 20 12:37:06 2006
loginWaitInterval                 : 8
enabled                           : True
connected                         : True
FD                                : 7
trace                             : False
historyFileSize                   : 100
historyDirectory                  : ./

                            Firewall/DacsPermTest
enableFirewall                    : True
enableDacsPermTest                : False
```
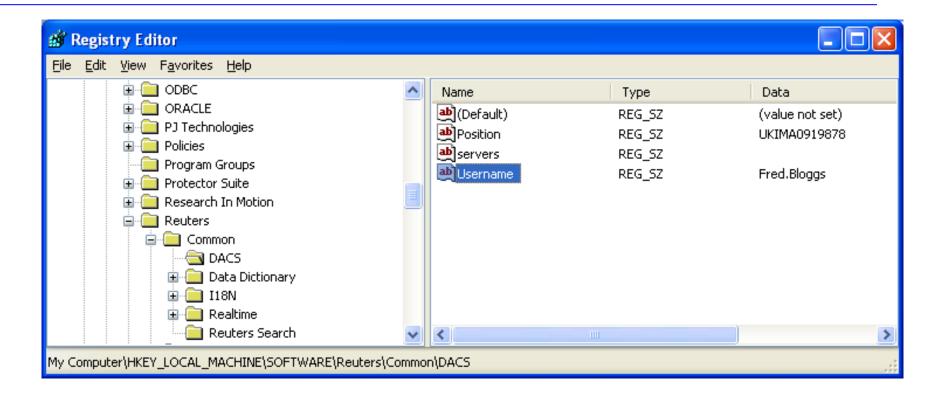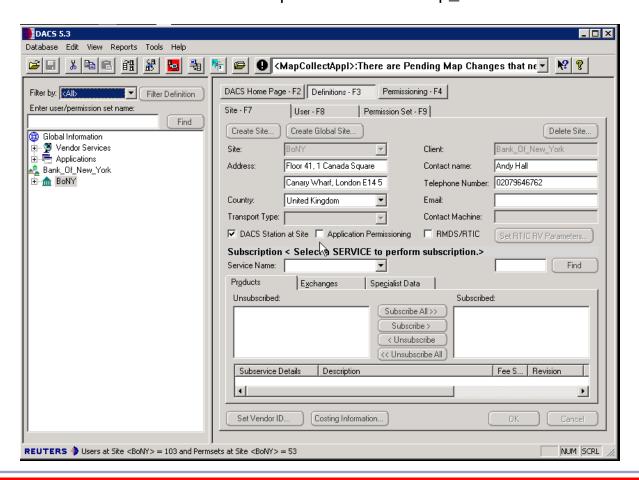
DACS Username – where does it come from?

Running the DACS UI

To start the DACS UI, click Start -> Programs -> DACS -> DACS Station Console

The default username/password: reuter / p_reuter

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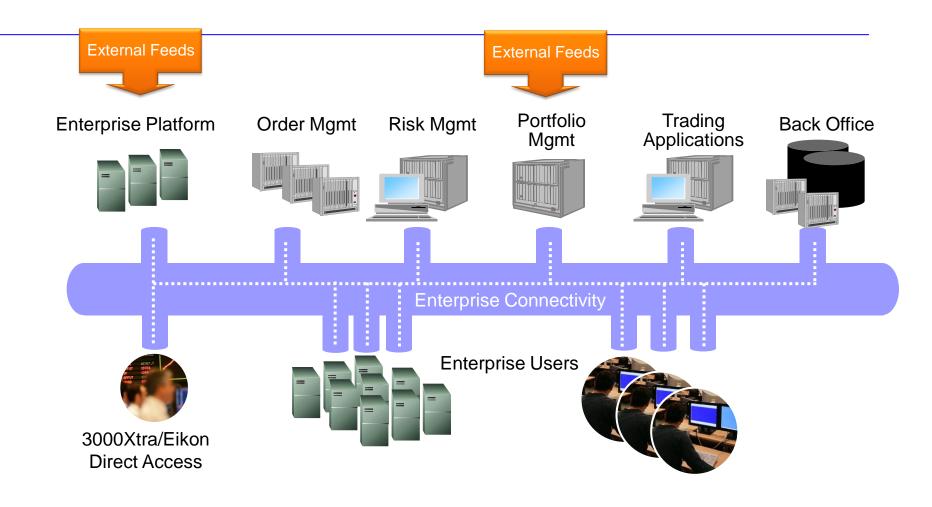
Importance of Data Transparency & Compliance

- Meeting contractual obligations with content providers

- Ensure the right users are receiving the right data on every application

- Ensure accountability and create an audit trail for administrator changes

- Need for cost optimisation

- Simplify administration and management

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Environment

External Feeds

External Feeds

Enterprise Platform

Order Mgmt

Risk Mgmt

Portfolio Mgmt

Trading Applications

Back Office

Enterprise Connectivity

3000Xtra/Eikon Direct Access

Enterprise Users

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Comprehensive Entitlements Solution

DACS Product Suite

DACS	Open DACS	Open DACS Permission Server
System - The most complete and widely accepted entitlement solution in the industry	**API** - Extend entitlements solution beyond the traditional market data distribution system	**Permission Server** – Simplify the way to incorporate entitlements into applications
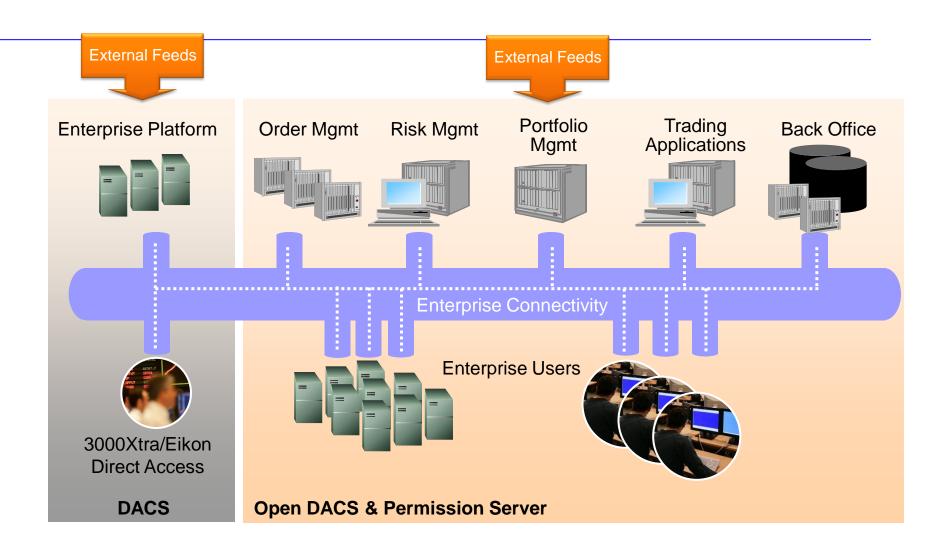
DACS On-Demand

Automated entitlement control to eliminate excess spend and reduce data spend per user / application to only what is truly needed

Applying the Solution

External Feeds

External Feeds

Enterprise Platform

Order Mgmt

Risk Mgmt

Portfolio Mgmt

Trading Applications

Back Office

Enterprise Connectivity

Enterprise Users

3000Xtra/Eikon Direct Access

DACS

Open DACS & Permission Server

Open DACS

TR Feeds

Feeds X

Non Enterprise Platform feed

Enterprise Platform

Permission Archive

DACS Station & Database

Permissions

Permission Profiles

DACS Servers

Usage

ADS

Open DACS

Portfolio Management

Access Control
Access Reports
Audit Reports
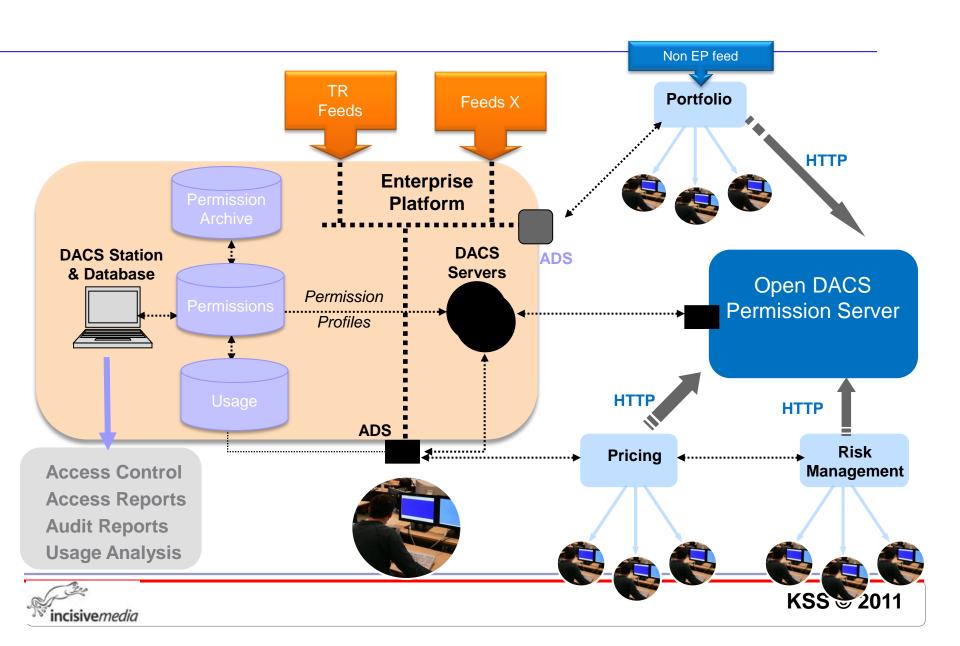Usage Analysis

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Open DACS Permission Server

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DACS on Demand

- A capability that enables the pro-active management of data entitlements

- Provides the necessary transparency to reduce total expenditure on data fee liabilities

- Only those entitlements that are needed will remain active

Delivering a large cost saving potential

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9) RMDS "hands on" Management

- General Maintenance and Administration Tasks
- Key Monitoring Utilities
- Troubleshooting Tips
  - Instrument & feed failure
  - User data issues
  - Using Unix commands for Diagnostics
  - Using the P2PS Monitor

General Maintenance and Administration
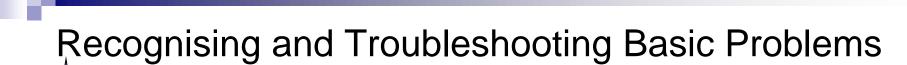
- **Basic Unix Utilities**
  - ☐ Server Resources
    - Memory
    - Diskspace
    - CPU Utilisation
  - ☐ Network & Overall Platform Performance
    - Network Component Monitoring
      - ☐ Corvil
      - ☐ TipOFF
  - ☐ SNMP Agents

Monitoring General System Resources

- vmstat – reports cpu, memory and swap utilization
- free – reports memory utilization
- uptime – reports system uptime and load averages
- dmesg – shows recent system messages
- netstat -ni – shows interface packet counts, errors and collisions
- netstat -an – shows all active network connections
- dladm show-dev (Solaris 10 only) – reveals network interface speed/duplex
- ethtool <device> (Linux only) – reveals network interface speed/duplex
- ps aux (Linux) (Solaris 10, located in /usr/sfw/ps) – shows all processes running including cpu and memory utilization
- ps -ef – shows all processes running

Recognising and Troubleshooting Basic Problems

How do I tell if Hot Standby is enabled?

• Running src_distmon on the IDN MDH, check the servers section. The service should have a 5 digit serverId (i.e. 45000) as opposed to a normal 3 digit serverId (i.e. 280).

• In addition, check the Hot Standby statistics to determine what state the MDH is currently running in (Active, Active/Peer or Standby)

A service is reporting as "DOWN", now what?

If IDN_SELECTFEED is reporting down, check the src_dist.log to determine when the problem started. The log will normally report two types of outages:

• "**Data feed links are bad**"

   The RDF lost its TCP connection to Reuters. This is usually indicitive of a problem upstream, such as an RSS failure or bandwidth overutilization.

• "**Loss of channel**"

   The MDH lost its TCP connection to the RDF.   This is usually an internal network problem, but problems with the RDF itself can cause the channel to be cut resulting in such an error.

Recognising and Troubleshooting Basic Problems (2)

An item (or multiple items are stale), what can I do?

- If multiple items are stale, be sure to check the RMDS environment health for any network issues or system utilization that could be effecting the binaries.

- Reuters issues alerts (RIC: ALERTS) signifying any problems currently being experienced at their ticker plant. These issued reactively and proactively by Reuters on a regular basis.

- Check against another site to ensure the issue is not a global problem. If the issue exists elsewhere, call Reuters support to inform them of the issue.

Trouble shooting (3)

- **User(s) are unable to mount.**

- Check the network connectivity to the user's workstation. Have the user run "ping" to the P2PS (will only work if ping is enabled on the network). In addition, the user can run "telnet" to port 8101 to verify the P2PS is responding.
- Have the client check the ipcroute file on the workstation to verify the network configuration is correct.
- If a user is unable to mount to a DACS enabled P2PS, check the DACS Station to ensure the user is configured properly to receive data. Be sure to verify the user's simultaneous mount limit has not been reached.
- Running p2psmon, verify the P2PS mount limit has not been reached. If the connection limit has been reached, have the user connect elsewhere.
- Double-check the DACS servers to confirm they are operational and DACS is active.

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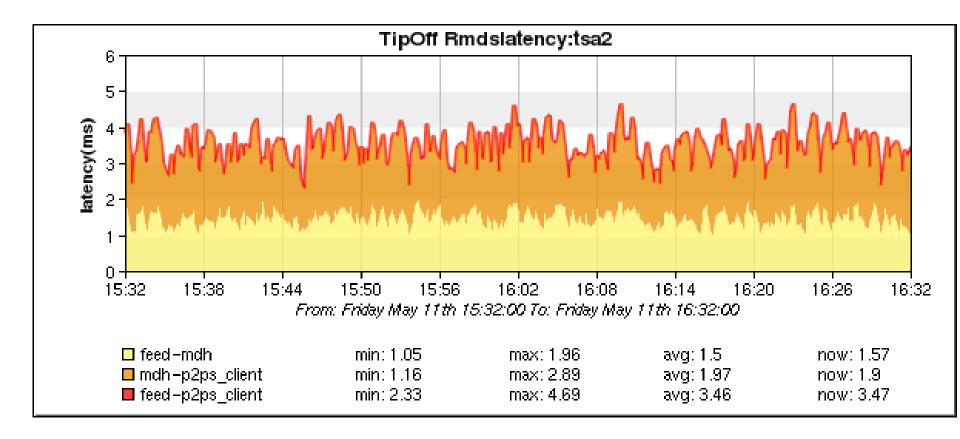
Managing Users on a P2PS

- System Mangers should keep a constant watch on P2PS loadings,
  - □ # mounts
  - □ # cache items
  - □ CPU load
- The most common cause of user complaints about data quality and speed of update is an over loaded P2PS
- Symptoms
  - □ Visible update differences for same instrument on different workstations
  - □ Some users unable to connect intermittently
- Techniques for resolution
  - □ Profiling users
  - □ Pooling P2PS's into groups
  - □ Be very careful with gold builds !

RMDS Latency

Key Monitoring Utilities

- ## ITRS
  - ☐ Widely Used 3rd Party system Monitoring
- ## Hawk
  - ☐ Reuters Licensed Monitoring tool
    - Supplied by TibCO
- ## Sentinel+
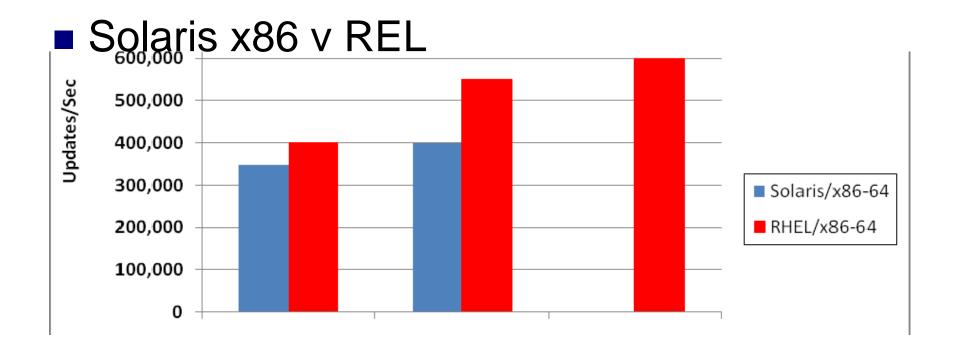
10) Performance Test Results

- IBM Initial Benchmarking
- Red Hat
- Solaris

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Stac Testing 2007

- Solaris x86 v REL

Stac testing 2008

- RMDS 6
- RHEL 5.1
- IBM Blade Centre H
- 10 Gb Ethernet Switch
- Chesio 10 GB Ethernet card

Results

- **1. Lowest mean latency ever reported with RMDS**
  - ☐ Less than 0.9 milliseconds of end-to-end infrastructure latency at up to
  - ☐ 600,000 updates per second in the low-latency configuration of RMDS
- **2. Lowest standard deviation of latency ever reported with RMDS**
  - ☐ Less than 0.5 milliseconds at rates up to 600,000 updates per second.
- **3. Very high output rate in the**
  - ☐ 5.8 million updates per second
  - ☐ 30% of this due to the TCP/IP Offload Engine (TOE) in the Chelsio NIC Blade Network Technologies 10GigE Switch
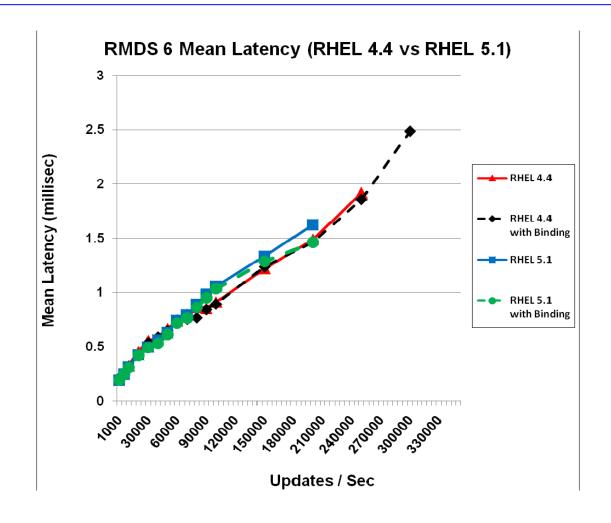
Red Hat Test Environment

- RMDS6
- RRCP
- Redhat Enterprise Linux 4/5
- Intel Xeon (x86-64)
- 1 Gb Ethernet

Test Results

RMDS 6 Mean Latency (RHEL 4.4 vs RHEL 5.1)

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Summary

- In the configurations tested, there is no statistically significant performance regression when going from RMDS 6 / RHEL 4.4 to RMDS 6 / RHEL 5.1

- • Process and Interrupt binding to cpu cores did not make any appreciable difference in performance

- • Setting TSO to "on" and "off" did not make any appreciable difference in performance

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Other Options TSO

- TCP Segmentation Offload (TSO) is used to reduce the CPU overhead of TCP/IP on fast networks. TSO breaks down large groups of data sent over a network into smaller segments that pass through all the network elements between the source and destination.

- This type of offload relies on the NIC to segment the data and then add the TCP, IP and data link layer protocol headers to each segment. The NIC must support TSO.

- [TSO is "off" by default in RHEL 4.4 and TSO is "on" by default in RHEL 5.1]

Interrupt Binding

- Tests have shown that there is less fluctuation in the update rate if the RMDS infrastructurecomponents are bound to individual CPU(s).

- In addition to such binding, Reuters has found that binding NIC interrupts to a single CPU helps achieve better CPU utilization on the System Under Test (SUT) node(s).

- [By default, on a dual NIC dual CPU SUT node, interrupts from eth0 are bound to CPU 0 and interrupts from eth1 are bound to CPU 1.]
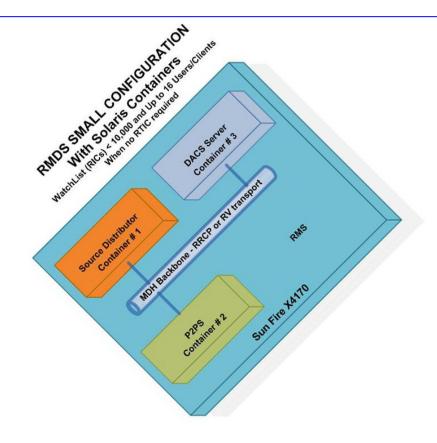
Sun Reccomendations (2009)

- RMDS 6
- Solaris 10 x86
- Sun Fire 4170 (Xeon)
- Solaris Containers

Small Site with Containers

RMDS SMALL CONFIGURATION
With Solaris Containers
WatchList (RICs) < 10,000 and Up to 16 Users/Clients
When no RTIC required

DACS Server
Container # 3

Source Distributor
Container # 1

MDH Backbone - RRCP or RV transport

RMS

P2PS
Container # 2

Sun Fire X4170
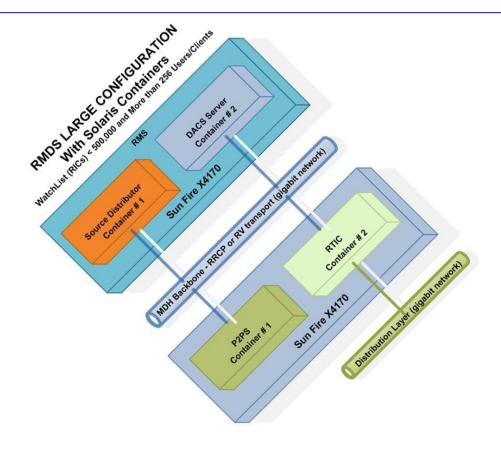
Small site HW

- **RMDS 6 Components Hardware Model Number of CPUs Memory Disk**

- Source Distributor , P2PS, DACS Server and RMS

- Sun Fire X4170 2 x QC Intel Xeon E5520 4GB 2 x 146GB

Large Site (>500,000 rics, 256 users)

Large Site HW

- **Source Distributor and DACS Server / RMS**
  - ☐ Sun Fire X4170 2 x QC Intel Xeon E5570 12GB 2 x 146GB
- **P2PS and RTIC**
  - ☐ Sun Fire X4170 2 x QC Intel Xeon E5570 12GB 2 x 146GB

Pushing the Limits (RHEL)

- **1. Highest Source Distributor throughput to date on a single 4-socket or 2-socket server**
  - ☐ 2.8 million updates per second
- **2. Highest Point-to-Point Server throughput to date on a single 4-socket or 2- socket server**
  - ☐ 2.2 million updates per second through a single Point-to-Point Server

- **http://www.STACresearch.com**

11) System Tuning

- Single threaded components
- New Multi-threaded RMDS Components
  - ADH – Advanced Data Hub
  - ADS – Advanced Data Server
  - ATS – Advanced Transformation Server
- User Load Balancing for Performance
- Performance Test Results

Single Threaded Applications

- First Generation of RMDS components are single threaded
    - Reuters recommended single applications to be run on single cpu servers
    - Note stability and performance of RMDS backbone can be compromised by a single poorly performing server
    - Where multiple cpu or cores are available then virtualisation can be used to increase performance

Advanced Data Hub

- Basically a multithreaded version of the Source distributor
- Able to handle higher capacity and updating feeds
  - Eg OPRA
- Supports new OMM data model

Advance Data Server

- Multithreaded version of P2PS
  - One thread used for interfacing to MDH
  - One thread allocated to each client connection

Advanced Transformation Server
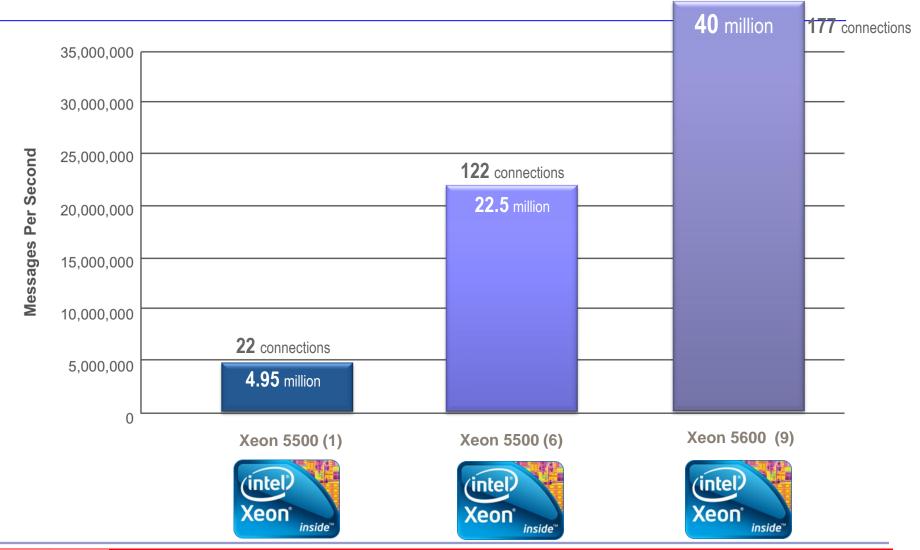
- Major Rewrite of DTS incorporating functionality from
  - DTS – Existing features
  - Gissing – Page Building/Shredding
  - Vhayu – Advanced Calculations
- Output in OMM formats
- Redesigned user interface

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Enterprise Platform
Scalability Performance
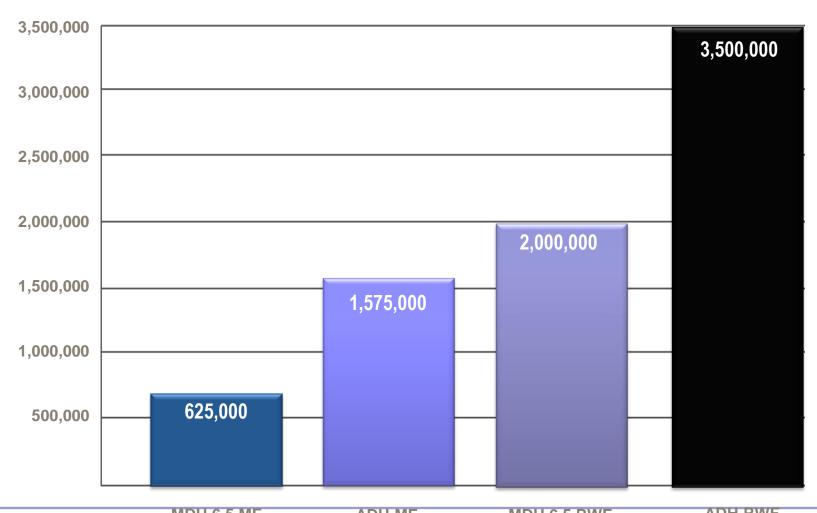
Scalability Performance - Distribution

Messages Per Second

- 35,000,000
- 30,000,000
- 25,000,000
- 20,000,000
- 15,000,000
- 10,000,000
- 5,000,000
- 0

22 connections
4.95 million
Xeon 5500 (1)

122 connections
22.5 million
Xeon 5500 (6)

40 million **177** connections
Xeon 5600 (9)

225K Input

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Scalability Performance - Backbone

	MDH 6.5 MF	ADH MF	MDH 6.5 RWF	ADH RWF
Value	625,000	1,575,000	2,000,000	3,500,000

Under the covers

- ## The New Reuters API
  - ☐ RFA
  - ☐ Legacy support
  - ☐ Direct Feed Connections

Break

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■ **Data Model Definition**
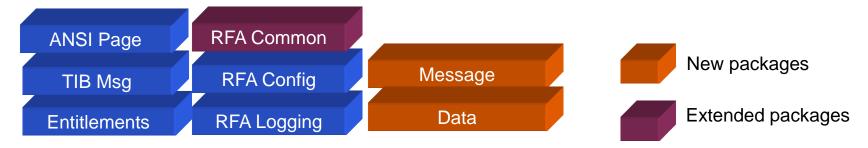
Reuters Domain Model	Content Definition Model	■Field Meanings ■Field Relationships
	Item Type Model	■Real World Objectives (i.e. Quotes, Order Books, etc).
Open Message Model	Data	■Data Containers ■Primitive Data Structures
	Transport	■Interaction Paradigms ■Symbology ■Qos ■Entitlements
Wire Format		■**Wire Encoding**

The solution is …

■**Reuters Wire Format (RWF)** is the physical way of expressing OMM data on the wire. RWF is not exposed to the application.

■**Open Message Model (OMM)** is a powerful capability that allows the representation of data using complex data structures and rich request paradigms.

OMM is composed of **Reuters SSL (RSSL)**, a new transport protocol, and **RFA interfaces** that allow the application to publish, subscribe and manipulate data

■**Reuters Domain Model (RDM)** is the definition of specific types of data. RDM specifies how request, response, and content messages are represented OMM for concrete data types (e.g. Order Book).

RFA 6

RFA Utilities

- ANSI Page
- TIB Msg
- Entitlements
- RFA Common
- RFA Config
- RFA Logging
- Message
- Data

New packages
Extended packages

RFA Session Layer

OMM | Market Data Pub / Sub | RV API

RSSL | SSLed Adapter | STIC Adapter | SASS Adapter | IFP Adapter

RDFDirect 1.2 | SrcDist 6 | P2PS 6 | Sink Dist | Src Dist | STIC | TMF | DTIC | TIC | RTIC | RDTIC | RSS | RVD

RFA 6.0
Platform Support
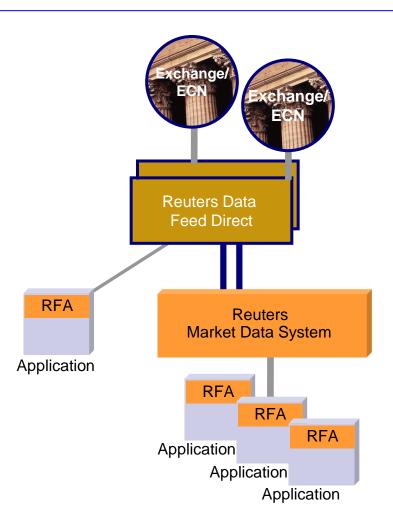
SOLARIS	**Solaris 10**	SPARC
SOLARIS	**Solaris 10**	x86
redhat	**Red Hat**	AS3/4
Windows Server 2003	**Windows**	Windows 2000 & XP

RFA C++ 6.0
New Interfaces & Capabilities

RFA C++ 6.0 provides…

- New **OMMConsumer** and **OMMProvider** interfaces

- New **Request and Response** classes

- New **Encoders/Decoders** for OMM Primitive Data Structures

- RFA5 interfaces to provide compatibility with existing applications and interoperability with new OMM interfaces. STL references are being removed from RFA5 interfaces, which may require some minimal application changes.

- Performance and latency enhancements

- Symmetric messaging paradigm

- Direct Connect capabilities

13) Examples of 3rd Party data Feeds

- **Limitations**
- **3rd Party Feeds Available**
- **Using data in 3000xtra and Excel**

Limitations and Cautions With 3ʳᵈ Party Data Feeds

- **Representation in Reuters Terminal Products**
  - ☐ Templates !
- **Mapping of data to Market Feed**
  - ☐ Limitations of FID Lists
  - ☐ Extensions of FID lists
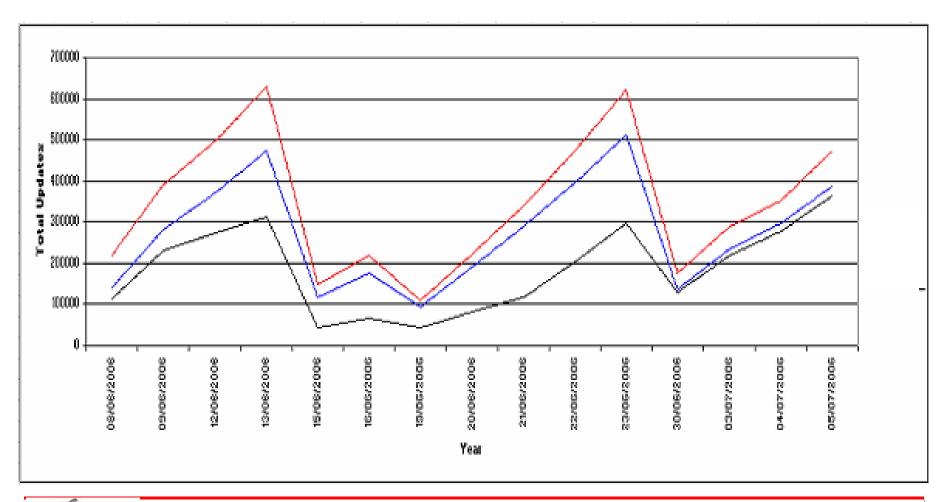
Direct Exchange Feeds

- ■ **Most Exchanges offer Direct Feeds**
  - ☐ At a Price !
  - ☐ Aimed at Alogo and DMA trading activities
- ■ **Major Feed Handler Suppliers**
  - ☐ Reuters
  - ☐ NYSE Technologies (Wombat)
  - ☐ InfoDyne (IBM)
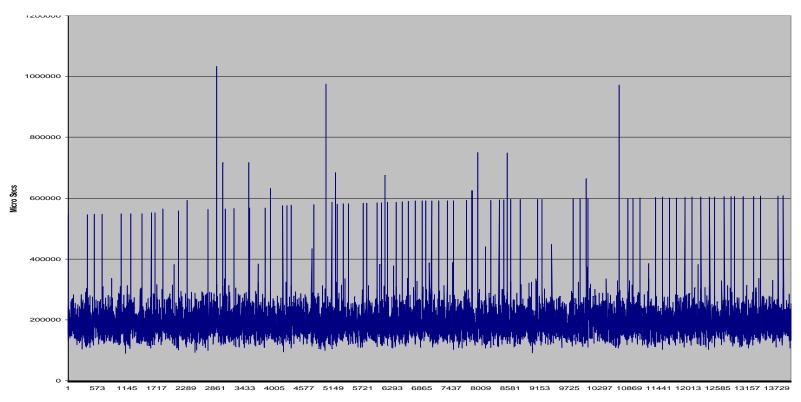
Differences Between Vendors 1

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Differences Between Vendors Delivery

Direct v Composite Feed on LSE – Direct is the baseline and Composite is on avg 250ms slower

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Aggregated Feeds
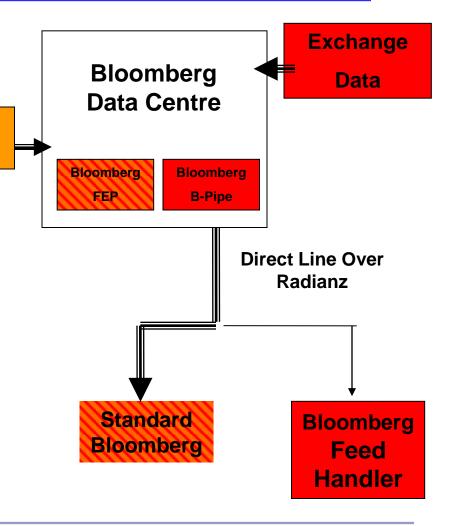
Bloomberg Feed Options Summary
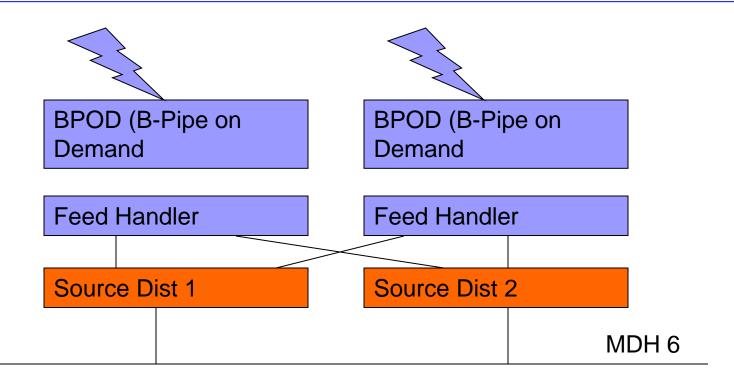
- **Two Approaches**
  - Bloomberg Server API
    - Full Content
    - Limited Capacity
  - Bloomberg Feed
    - Low Latency
    - Exchange Content

Arcontech	www.arcontech.com
Bloomberg	www.bloomberg.com
Infodyne	www.infodyne.com
Reuters	www.reuters.com
Wombat	www.wombatfs.com

Bloomberg Data Centre

Exchange Data

Other Data Sources

Bloomberg FEP

Bloomberg B-Pipe

Direct Line Over Radianz

Standard Bloomberg

Bloomberg Feed Handler

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B-Pipe Components

BPOD (B-Pipe on Demand

BPOD (B-Pipe on Demand

Feed Handler

Feed Handler

Source Dist 1

Source Dist 2

MDH 6

IDC Plus Feed

- ☐ Low Latency
- ☐ Global Exchange Coverage
  - ■ Also OTC, News
- ☐ Delivered as a server on Site
  - ■ Dell R610
- ☐ Optional
  - ■ Delayed Data Options
  - ■ Normalised Data
- ☐ Handlers available for/from
  - ■ Interactive Data Managed Solutions
  - ■ Interactive Data Real Time Services
  - ■ Arcontech / RMDS
  - ■ **TS Associates /RMDS**
  - ■ Wombat / RMDS

Interactive Data

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Six Telekurs

Telekurs Group

- **Historically**
  - End Of Day Pricing Service
  - National Naming Authority for Switzerland
  - All ATM's & Card Payment systems In Switzerland
  - Now Merged with Swiss Exchange & Clearing Services
- **Latest Products**
  - Valordata feed
    - Mifid Focus
    - Financial Instruments Data Model (FIDM)
    - > 7m Securities
    - Interest list or Market interest driven
  - Telekurs Market Feed
    - Real Time Data Feed
  - Terminal Product
    - Telekurs ID

Dow Jones

- Index Business sold off to CME
- Frustrated recently by loosing prime routes to market for news services
  - ☐ Telerate, Bridge, Thomson
- Still available on Reuters, Bloomberg, IDC etc.
- Now Distribution is also
  - ☐ Direct via BT, Savvis
  - ☐ Over Internet
  - ☐ Tradition wire services
  - ☐ RSS feeds
- Flagship product
  - ☐ Dow Jones Elementised News Feed

Factset - Marquee

- **Poor Mans Bloomberg !**
  - ☐ Research
  - ☐ Analytics
  - ☐ Pricing
- **Terminal business shown steady growth over last 5 years**
- **About to enter Feed Business**

SunGard

- Massively Comprehensive Front Middle and Back Office system supplier
    - □ Feed
    - □ Platform
    - □ Analytics
    - □ Time series Database
    - □ Trading
    - □ Settlement
- Currently in process of rationalising and merging its assets
- Partnered with SixTelekurs for real-time datafeed content (FAME)

Other Alternate Data Feeds

- Fidessa
  - About 90 exchanges
  - Custom Feed Packages
  - Cost + Pricing model

Fidessa

Specialist Bespoke Feed Suppliers

- ActivFinancial
- Quant House
- FixNetix

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Real World Challenges for Data Feed Replacement

- **Target Replacement Usage**
  - ☐ Workstations
  - ☐ Excel
  - ☐ Applications
- **Tools to Assist Replacement**
  - ☐ Dacs Reports
  - ☐ Spreadsheet Sniffers

Workstation Challenges

- **User Familiarity with new Symbology**
- **Data Representation in Alien Workstations**
  - ☐ Is it Allowed ?
  - ☐ How does it Look
    - Templates
    - Field Cross mapping
  - ☐ Cross linkages
- **Tools and Assistance ?**

Excel

- ## Can data be accessed ?
    - ☐ Default Data Source
- ## Existing spreadsheets
    - ☐ Changing spreadsheets is challenging
        - Do they still work
        - What if a record/field is not mapable
    - ☐ Identifying sheets to be changed

Applications

- So long as symbology and fields are user definable then relatively easy.
  - Note some systems assume Reuters rics etc.
- Case study
  - BGC replaced Reuters Rics in Gloss (equities trading platform) with IDC Plus Feed
    - saved 30% on data costs
    - Clearer Licensing agreement

Tools

- **DACS Reports**
  - ☐ Exchange utilisation by user
- **P2PS Cache**
  - ☐ Instrument lists
- **Spreadsheet sniffers**
  - ☐ Last Used
  - ☐ Addins
  - ☐ External links
  - ☐ Case studies Lehmans and Citi Group

14) Publishing Excel and Contributions

- Excel for Display of Realtime Data
- Excel For Publishing
- Contributions to Vendors

Don't Forget Excel

- Excel in Front Office
  - 91 % New business analysis and support
  - 89 % Investment appraisal
  - 82 % New Product/Investment creation
  - 82 % Position Management
  - 91 % Pricing and Valuation
  - 75 % Risk and/or Portfolio simulation
  - 79 % Risk calculation

- Excel in Mid and Back Office
  - 75 % Management Reporting
  - 89 % Financial Reporting and analysis
  - 67 % Post trade revaluation
  - 86 % Data aggregation
  - 80 % Reconciliation
  - 62 % Risk and portfolio simulation
  - 78 % P&L Calculatio

> **Source - Waters Magazine**
>
> **Figures show % IT and Business Respondants indicating Frequent or Very Frequent usage of Excel**
>
> **For Critical Business Functions**
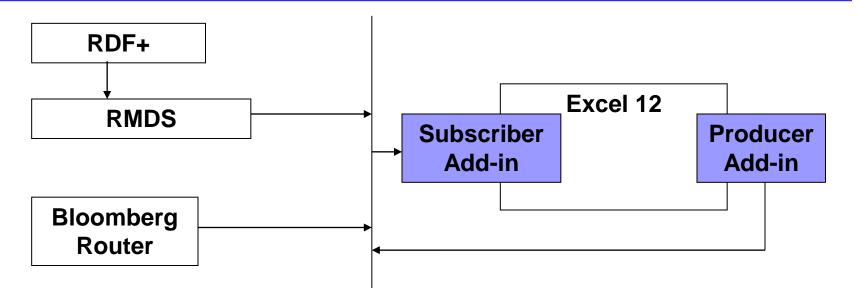
Next Generation Excel

- Excel V 12 (Office 2007/10)
  - Bigger Grid
  - Multi Threaded
  - RTD Engine
  - New Graphics Engine (from Office 2007)
- What does this mean
  - Handles More Input Data
  - Generated output faster
  - More complex models can be run
  - Doesn't crash as easily !
  - Interoperability with Other Office Products

- The Trader's Desktop/Workstation of Choice

KSS Testing Initial Findings
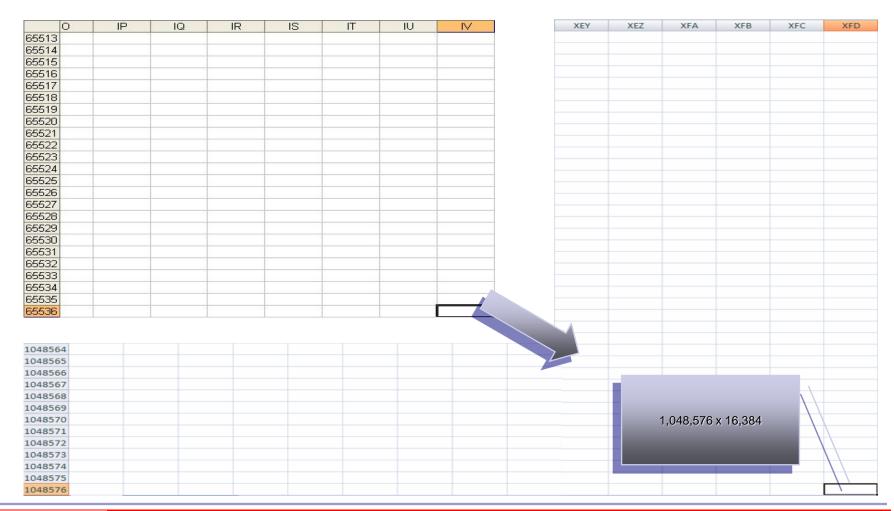
- Software tested
  - Arcontech Excelerator
  - Gissing RealTime Excel
  - PowerPlus Pro
- Latency Measurement Software
  - JPA DataQA

- Findings
  - Significant reduction in throughput delays
  - Increased number of Ticks Found !
  - Additional CPU's effectively used
  - RTD not fastest method
    - XLA most performant
  - Data tables preferable

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Excel 12 Size

	O	IP	IQ	IR	IS	IT	IU	IV
65513								
65514								
65515								
65516								
65517								
65518								
65519								
65520								
65521								
65522								
65523								
65524								
65525								
65526								
65527								
65528								
65529								
65530								
65531								
65532								
65533								
65534								
65535								
65536								

	XEY	XEZ	XFA	XFB	XFC	XFD

1048564							
1048565							
1048566							
1048567							
1048568							
1048569							
1048570							
1048571							
1048572							
1048573							
1048574							
1048575							
1048576							

1,048,576 x 16,384

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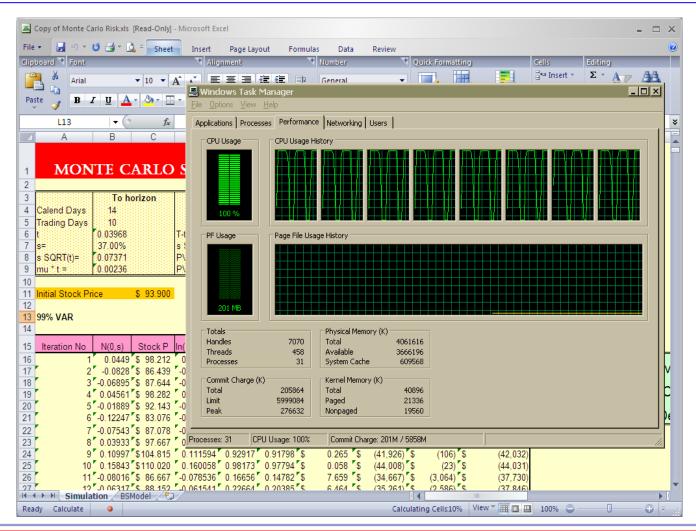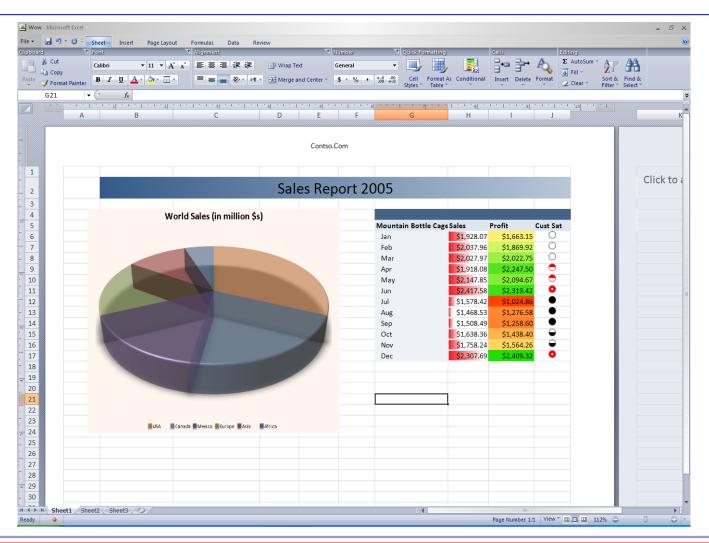
Excel 12 Threads
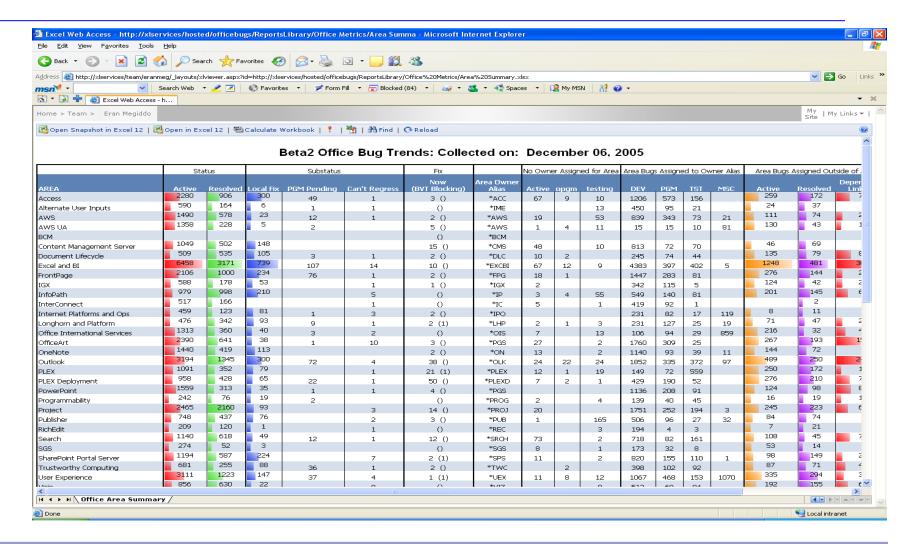
Excel 12 New Charts Rendering

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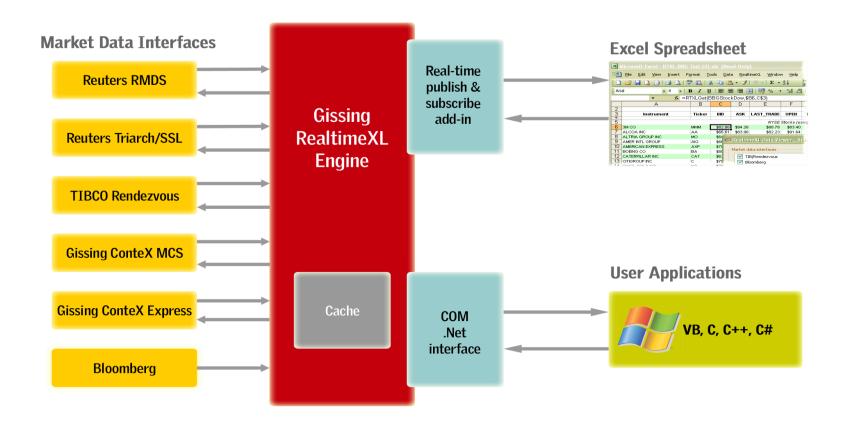
Excel 12 New In Cell Features

KSS © 2011
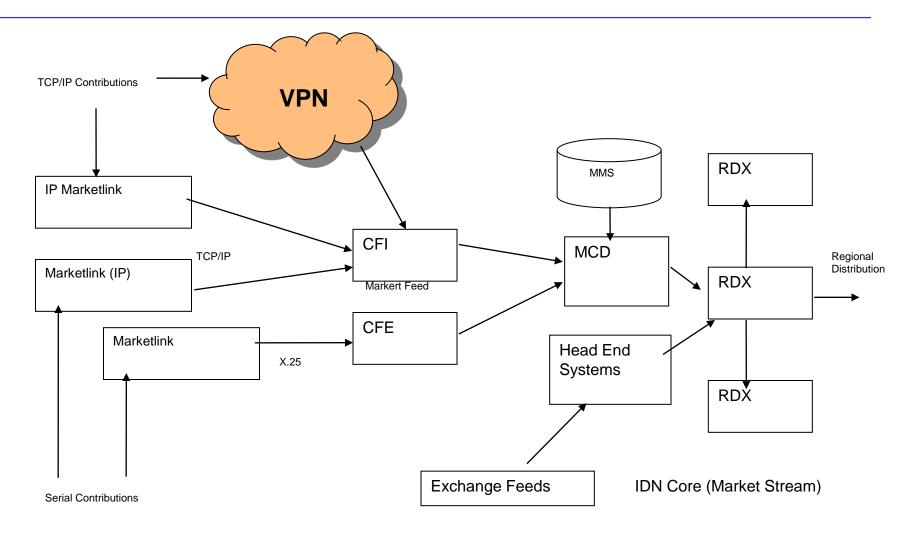
Gissing Excel Add-in

Reuters Regional Data Collection

TCP/IP Contributions

VPN

IP Marketlink

Marketlink (IP)

TCP/IP

Marketlink

X.25

CFI

Markert Feed

CFE

MMS

MCD

Head End
Systems

Exchange Feeds

RDX

RDX

RDX

Regional
Distribution

IDN Core (Market Stream)

Serial Contributions

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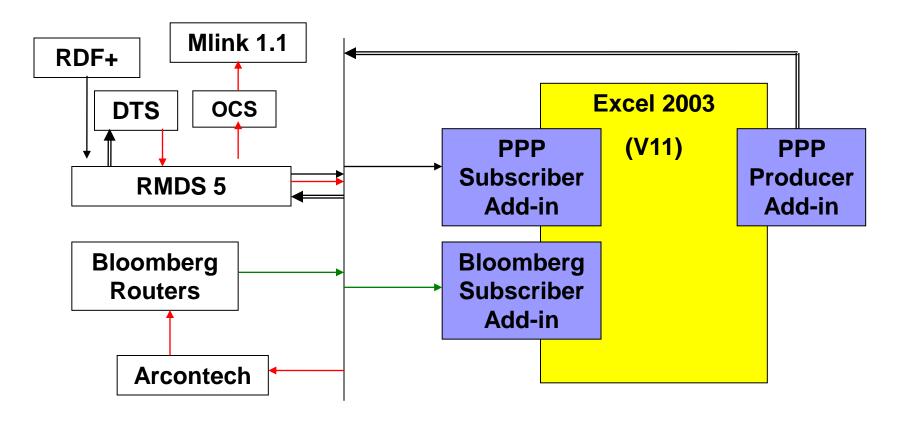
Excel 12 Case study (a large European Broker)

- ➢ Requirement
  - ➢ Increased update Rate on outbound IRS data to vendors
    - ➢ USD, Euro and GBP
  - ➢ Keep Flexibility of Spreadsheet Approach
    - ➢ Don't write dedicated application
- ➢ Known Issues
  - ➢ Spreadsheet Stability
- ➢ Baseline Exercise
  - ➢ Update rate comparison between 4 leading brokers
    - ➢ On Reuters
    - ➢ On Bloomberg
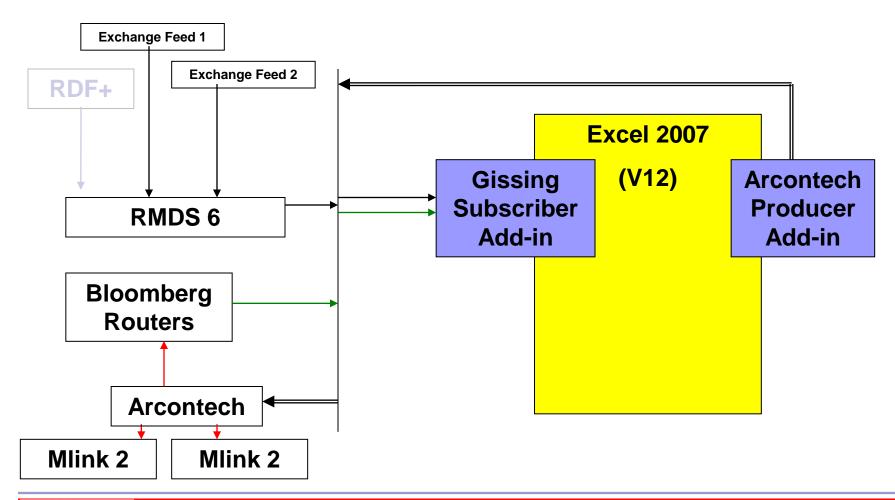
Existing Infrastructure

Low Latency Infrastructure

Spreadsheet Exposure

- To What extent does spreadsheet usage fall within your current regulatory initiatives

(Survey UK IT Finance Sector Directors - Waters)

Regulation	Significant + Moderate	Significantly	Moderate	Some	None
Basel II	88	63	25	12	0
FSA compliance	67	56	11	22	11
Operational Risk	89	44	45	11	0
MiFID	63	38	25	12	25
SOX	75	25	50	25	0

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15 New for 2011

- **Thomson Reuters**
  - Recent Developments
    - Project Eikon
    - Project Elektron
    - Thomson Reuters Enterprise Platform

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Project Eikon

- **Official name for Previous Utah Project**
  - New common user data presentation environment for all Thomson Reuters Workstation Products
    - 2010 – Merges some existing Reuters products
      - 3000Xtra, Trader, Wealth Manager
      - Status - Customer Beta as at Q1 2011
    - 2011
      - Reuters Knowledge
    - 2012
      - Thomson One

Project Elektron

- **Renewal of Thomson Reuters Infrastructure**
  - ☐ Collection
    - Direct Exchange Feeds
      - ☐ Full order book supported
    - Client Data (Contributions) via Gissing Software
      - ☐ Replaces
        - OCS, DCS
        - Marketlink
        - Marketlink IP
  - ☐ Distribution
    - Regional Hubs and Reduced Number of Data Centres
      - ☐ Mergers Reatime and Reference data distributiom
        - Ultimately Replaces IDN, RXN, BDN and TDN as main Distribution Networks

Reuters Enterprise Platform Versions

THOMSON REUTERS
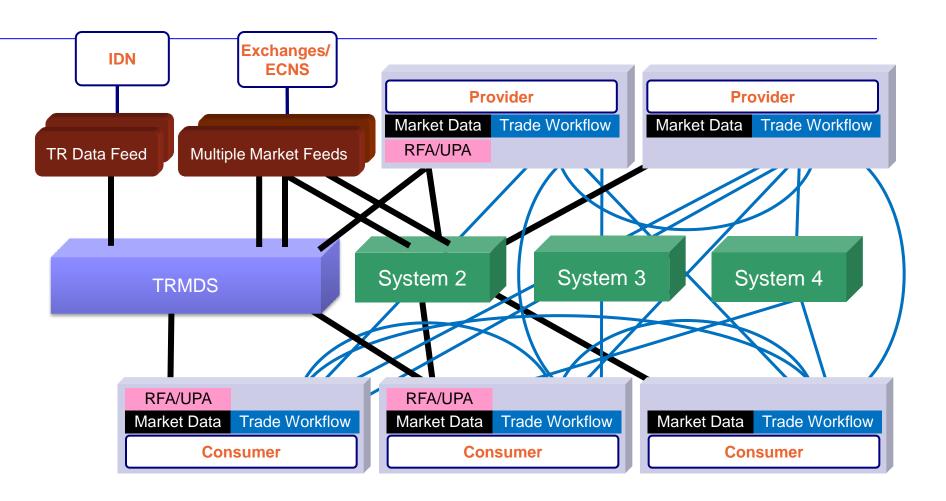
Thomson Reuters Enterprise Platform Versions

- **TREP for Real Time**
  - ☐ Upgrade to RMDS
- **TREP for Analytics and Trading**
  - ☐ Pricing
  - ☐ Tick storage
  - ☐ Interfaces to Order Routing and Execution services.
- **TREP for Reference Data**
  - ☐ Multi source storage and aggregation of Reference Data
    - Leverages Ex Thomson and Reuters Ref Data feeds and 3rd parties.
    - Data management with change control
    - Incorporates real time for evaluations

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Client Environment

The Enterprise Platform for Real-Time

IDN

Exchanges/
ECNS

Reuters Data Feed

Multiple Market Feeds

Provider

| Market Data | Trade Workflow |
| RFA | |

Provider

| Market Data | Trade Workflow |
| RFA | |

Enterprise Platform for Real-Time

RFA	
Market Data	Trade Workflow
Consumer	

RFA	
Market Data	Trade Workflow
Consumer	

RFA	
Market Data	Trade Workflow
Consumer	

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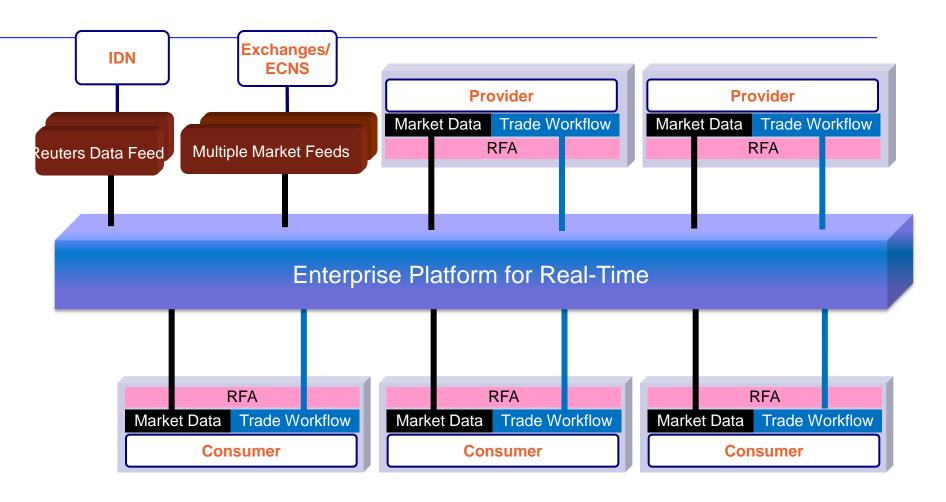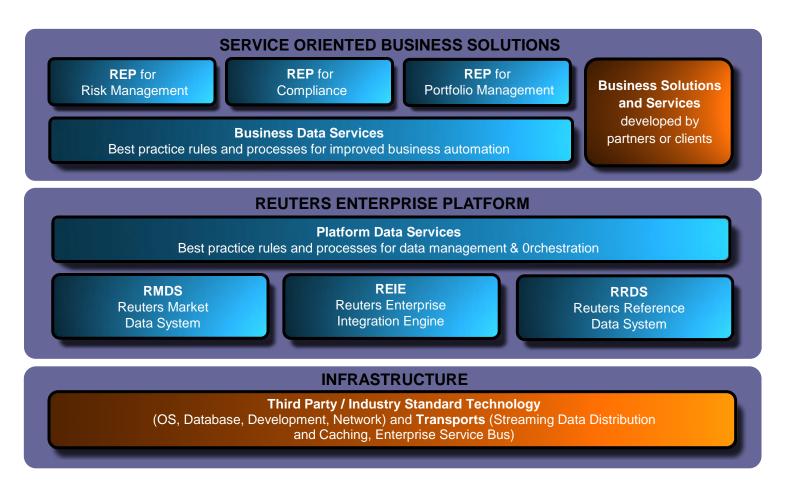
Thomson Reuters Enterprise Platform Versions

- **TREP for Reference Data**
  - Multi source storage and aggregation of Reference Data
    - Leverages Ex Thomson and Reuters Ref Data feeds and 3rd parties.
    - Data management with change control
    - Incorporates real time for evaluations
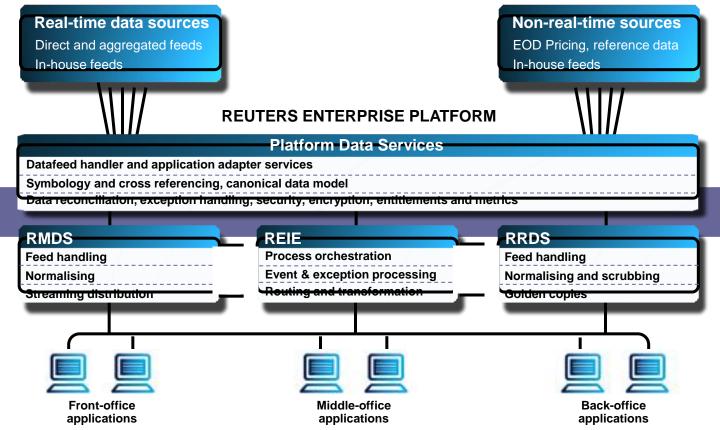
Information Services Framework

SERVICE ORIENTED BUSINESS SOLUTIONS

REP for
Risk Management

REP for
Compliance

REP for
Portfolio Management

**Business Solutions
and Services**
developed by
partners or clients

Business Data Services
Best practice rules and processes for improved business automation

REUTERS ENTERPRISE PLATFORM

Platform Data Services
Best practice rules and processes for data management & 0rchestration

RMDS
Reuters Market
Data System

REIE
Reuters Enterprise
Integration Engine

RRDS
Reuters Reference
Data System

INFRASTRUCTURE

Third Party / Industry Standard Technology
(OS, Database, Development, Network) and **Transports** (Streaming Data Distribution
and Caching, Enterprise Service Bus)

Empowers critical downstream business processes using flexible data services

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Enterprise Platform components

Real-time data sources
Direct and aggregated feeds
In-house feeds

Non-real-time sources
EOD Pricing, reference data
In-house feeds

REUTERS ENTERPRISE PLATFORM

Platform Data Services
Datafeed handler and application adapter services
Symbology and cross referencing, canonical data model
Data reconciliation, exception handling, security, encryption, entitlements and metrics

RMDS
Feed handling
Normalising
Streaming distribution

REIE
Process orchestration
Event & exception processing
Routing and transformation

RRDS
Feed handling
Normalising and scrubbing
Golden copies

Front-office applications

Middle-office applications

Back-office applications

Promotes accuracy, transparency and efficiency by standardising on a market standard data model

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Enterprise Platform - *Logical Architecture*

Role-based User Interfaces

(data management, business integration, systems administration, business analysis)

**Plug-in
Data Feed
Handlers**
(real-time, reference, historical)

| Thomson Reuters |
| Bloomberg |
| MarkIt |
| … |
| IDC |

| RDS |
| PDS |
| EDS |
| … |
| TDS |
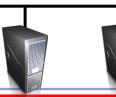
**Plug-in
Data Management
Repositories**
(reference, pricing, entities, transactions)

**Enterprise & 3ʳᵈ Party
Plug-ins**
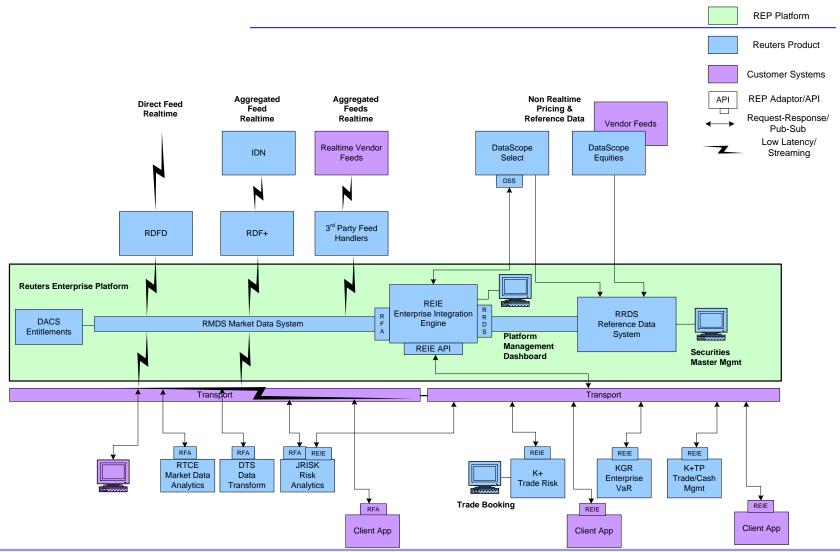
**Enterprise & 3ʳᵈ Party
Applications**

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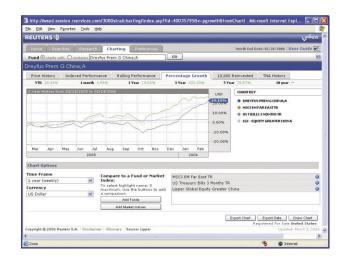
Reuters Enterprise Platform in more detail

Legend:
- REP Platform
- Reuters Product
- Customer Systems
- API — REP Adaptor/API
- Request-Response/Pub-Sub
- Low Latency/Streaming

Direct Feed Realtime — RDFD

Aggregated Feed Realtime — IDN — RDF+

Aggregated Feeds Realtime — Realtime Vendor Feeds — 3rd Party Feed Handlers

Non Realtime Pricing & Reference Data — DataScope Select (DSS) — DataScope Equities — Vendor Feeds

Reuters Enterprise Platform
- DACS Entitlements
- RMDS Market Data System
- REIE Enterprise Integration Engine
- REIE API
- RFA
- RRDS
- RRDS Reference Data System
- Platform Management Dashboard
- Securities Master Mgmt

Transport — Transport

- RTCE Market Data Analytics (RFA)
- DTS Data Transform (RFA)
- JRISK Risk Analytics (RFA) (REIE)
- K+ Trade Risk (REIE)
- KGR Enterprise VaR (REIE)
- K+TP Trade/Cash Mgmt (REIE)
- Trade Booking
- Client App (RFA)
- Client App (REIE)
- Client App (REIE)

Price & Liquidity Discovery/Realtime Analytics   **Order Management/Execution**   **Mid-Back Office Systems/Risk Management**

Reuters Market Data System

- **Industry leading platform** for high throughput real-time market data distribution - deployed at 2,800+ sites globally

- Robust Application Programming Interface – **Reuters Foundation API** (RFA) - extends support for diverse data types

- **Open Message Model** (OMM) allows representation and transmission of complex data structures with rich request paradigms
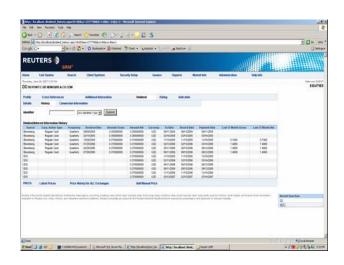
- Powerful modules can be introduced incrementally

    - User connectivity to desktops, browsers and wireless devices

    - Configurable filtering, integration, enrichment and analytics

    - Adapters to diverse information sources and contribution facilities

Reuters Reference Data System
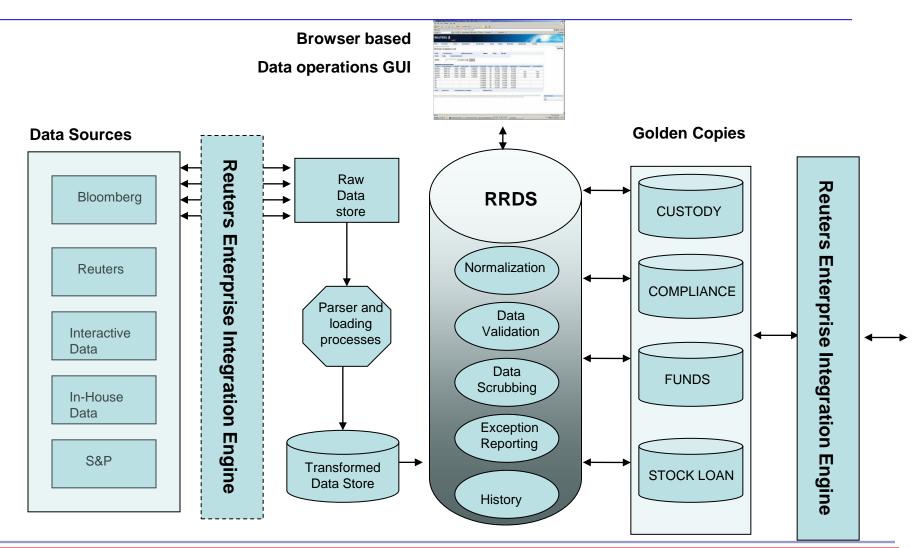
- **Reference Master Database** with an extensible data model that conforms to market data standards

- Integrates **consolidated** referential data from a wide array of the industry's most trusted vendors – more than 150 feeds from 18 vendors

- Integrates **silo'ed** referential data within the enterprise

- Centralised hub for **rule-based** data acquisition, cleansing, validation, enrichment, scrubbing and normalisation

- **Extensive** and **adaptable** user interface supports manual creation of data, data quality rule generation, decision trees and search

- Full user and feed management capabilities with built in reporting and exception handling

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RRDS Logical Architecture and Data Flow

Browser based

Data operations GUI

Data Sources

Golden Copies

Reuters Enterprise Integration Engine

- Bloomberg
- Reuters
- Interactive Data
- In-House Data
- S&P

Raw Data store

Parser and loading processes

Transformed Data Store

RRDS

- Normalization
- Data Validation
- Data Scrubbing
- Exception Reporting
- History

- CUSTODY
- COMPLIANCE
- FUNDS
- STOCK LOAN

Reuters Enterprise Integration Engine

Reuters Enterprise Integration Engine
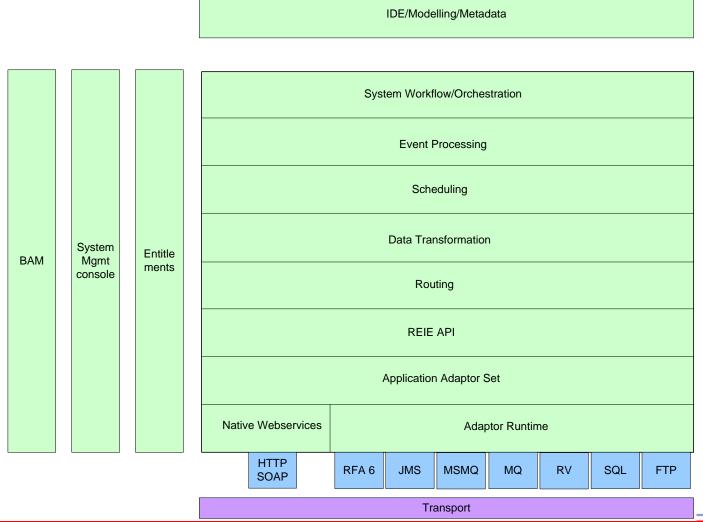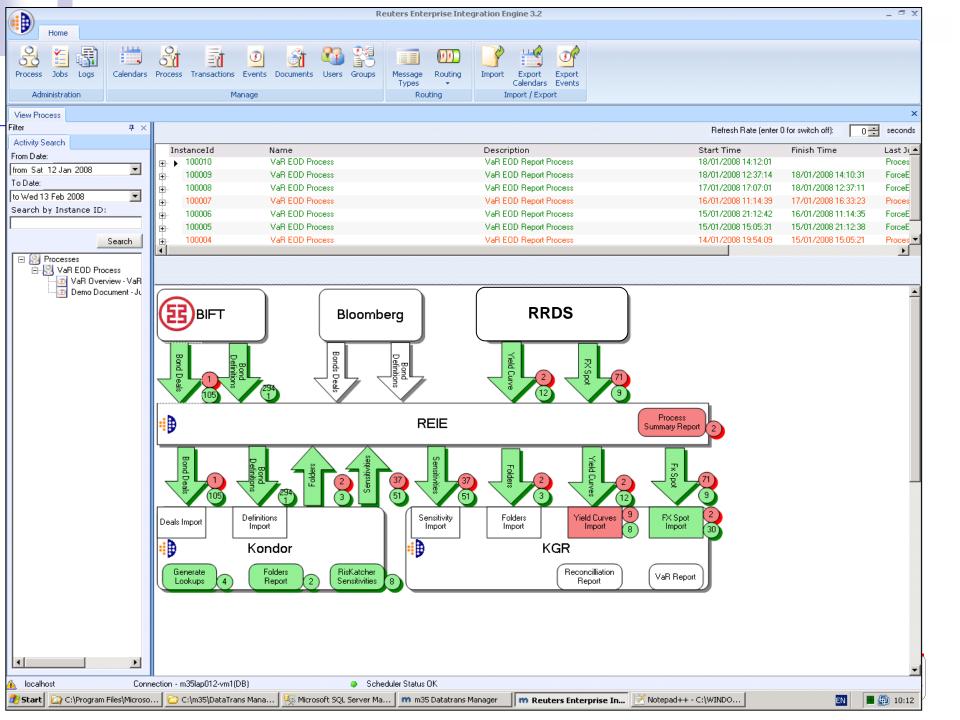
- Reuters Enterprise Integration Engine

  - **Integrates** RMDS and RRDS components to consolidate all data assets through a market standard holistic data model

  - **Orchestrates** data services and manages service operations with effective exception handling and reporting

  - Delivers **context specific** data views without compromising the integrity of the underlying data

- Component based approach

  - Ensures **interoperability** with existing systems architecture and avoids 'rip and replace'

  - Recognises **unique technical requirements** in support of real-time and non-real time data (persistence, transport etc.)

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REIE Layered Architecture

			IDE/Modelling/Metadata

BAM	System Mgmt console	Entitlements	System Workflow/Orchestration
			Event Processing
			Scheduling
			Data Transformation
			Routing
			REIE API
			Application Adaptor Set
			Native Webservices / Adaptor Runtime

HTTP SOAP	RFA 6	JMS	MSMQ	MQ	RV	SQL	FTP

Transport

Home

Process | Jobs | Logs | Calendars | Process | Transactions | Events | Documents | Users | Groups | Message Types | Routing | Import | Export Calendars | Export Events

Administration | Manage | Routing | Import / Export

View Process

Filter

Activity Search

From Date:
from Sat 12 Jan 2008

To Date:
to Wed 13 Feb 2008

Search by Instance ID:

Search

Processes
  VaR EOD Process
    VaR Overview - VaR
    Demo Document - Ju

Refresh Rate (enter 0 for switch off): 0 seconds

InstanceId	Name	Description	Start Time	Finish Time	Last Jc
100010	VaR EOD Process	VaR EOD Report Process	18/01/2008 14:12:01		Proces
100009	VaR EOD Process	VaR EOD Report Process	18/01/2008 12:37:14	18/01/2008 14:10:31	ForceE
100008	VaR EOD Process	VaR EOD Report Process	17/01/2008 17:07:01	18/01/2008 12:37:11	ForceE
100007	VaR EOD Process	VaR EOD Report Process	16/01/2008 11:14:39	17/01/2008 16:33:23	Proces
100006	VaR EOD Process	VaR EOD Report Process	15/01/2008 21:12:42	16/01/2008 11:14:35	ForceE
100005	VaR EOD Process	VaR EOD Report Process	15/01/2008 15:05:31	15/01/2008 21:12:38	ForceE
100004	VaR EOD Process	VaR EOD Report Process	14/01/2008 19:54:09	15/01/2008 15:05:21	Proces

BIFT

Bloomberg

RRDS

Bond Deals | Bond Definitions | Bonds Deals | Bond Definitions | Yield Curve | FX Spot

1 | 105 | 294 1 | 2 | 12 | 71 | 9

REIE

Process Summary Report | 2

Bond Deals | Bond Definitions | Folders | Sensitivities | Sensitivities | Folders | Yield Curves | Fx Spot

1 | 105 | 294 1 | 2 | 3 | 37 | 51 | 37 | 51 | 2 | 3 | 2 | 12 | 71 | 9

Deals Import | Definitions Import | Sensitivity Import | Folders Import | Yield Curves Import | FX Spot Import

9 | 8 | 2 | 30

Kondor | KGR

Generate Lookups | 4 | Folders Report | 2 | RisKatcher Sensitivities | 8 | Reconcilliation Report | VaR Report

localhost | Connection - m35lap012-vm1(DB) | Scheduler Status OK

Start | C:\Program Files\Microso... | C:\m35\DataTrans Mana... | Microsoft SQL Server Ma... | m35 Datatrans Manager | Reuters Enterprise In... | Notepad++ - C:\WINDO... | EN | 10:12

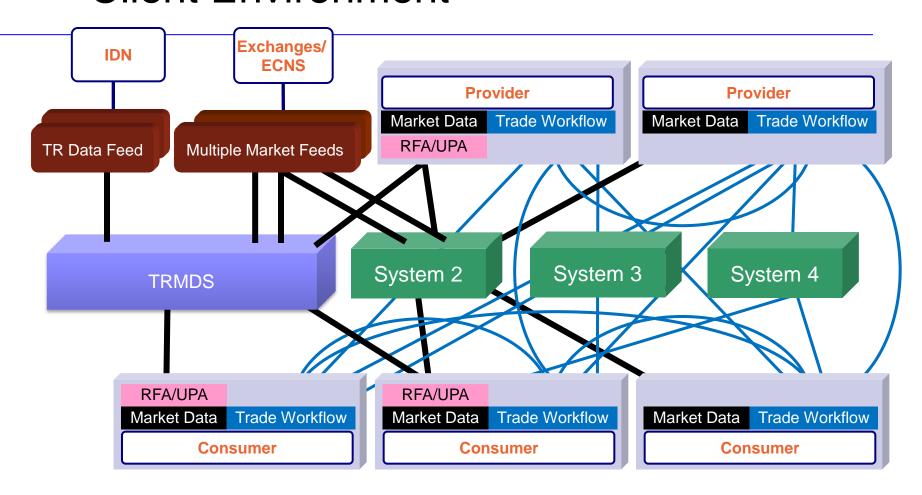# Thomson Reuters Enterprise Platform

- Enables business users and applications to share **accurate**, **consistent**, and **timely** data assets

- Leverages Reuters extensive and **well-proven** data delivery capabilities (RMDS) and developer community programmes (RDC)

- Addresses new and changing business needs by **empowering** critical downstream processes using flexible business data services

- Promotes **transparency** and **efficiency** by supporting a hierarchy of reusable and adaptable platform data services

- Exposes instrumented data services that support business-led **metrics** and **benchmarking**

- Supports incremental deployment to deliver immediate **return on investment** and durable **business transformation**

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ENTERPRISE PLATFORM – Beyond Market Data

Client Environment

IDN

Exchanges/ECNS

TR Data Feed

Multiple Market Feeds

TRMDS

System 2

System 3

System 4

Provider | Market Data | Trade Workflow | RFA/UPA

Provider | Market Data | Trade Workflow

RFA/UPA | Market Data | Trade Workflow | Consumer

RFA/UPA | Market Data | Trade Workflow | Consumer

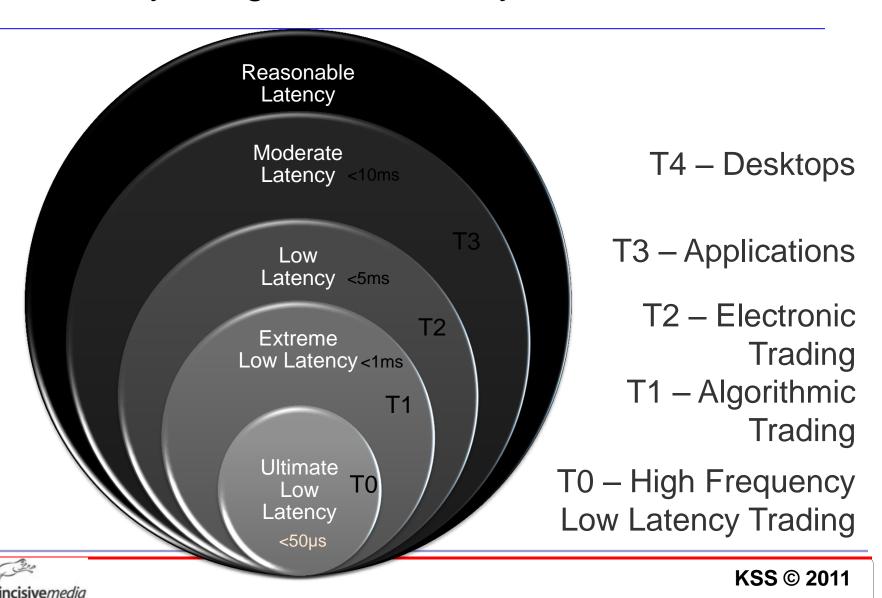Market Data | Trade Workflow | Consumer

Market Connect

- Provide integration within the enterprise using **private streams** and **generic messaging**
- Single platform that enables market data and transactional communication between front, middle and back office systems.
- Capability to onboard new clients using the platform without developing new gateways/networks
- **OMM Private streams**
  - One-to-one client server communications
- **OMM Generic Message**
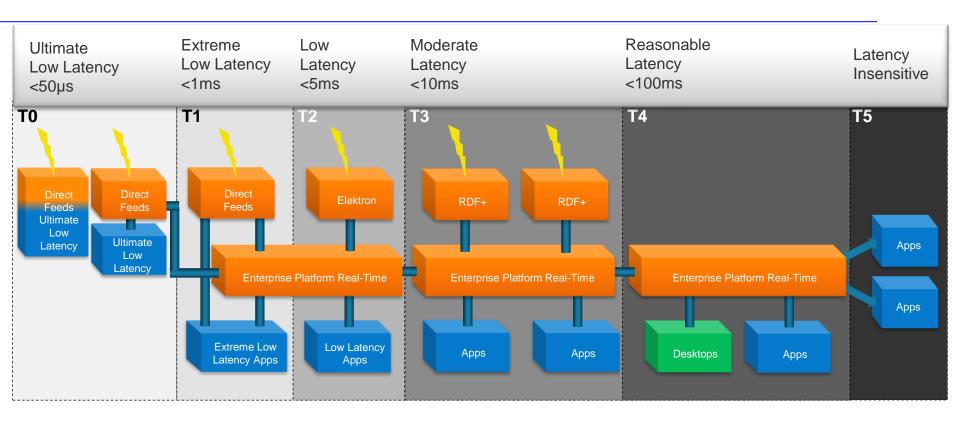 - Bi-directional data type agnostic messaging capability

Enterprise Platform Latency Performance
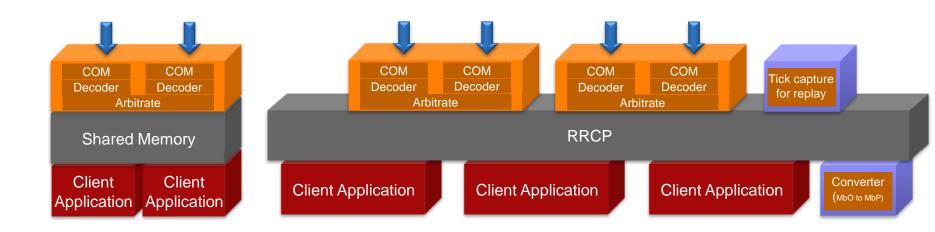
Latency – Right time delivery

Reasonable
Latency

Moderate
Latency <10ms

Low
Latency <5ms

Extreme
Low Latency <1ms

Ultimate
Low
Latency
<50μs

T3

T2

T1

T0

T4 – Desktops

T3 – Applications

T2 – Electronic
Trading
T1 – Algorithmic
Trading

T0 – High Frequency
Low Latency Trading

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Latency – Right time delivery

Tier 0

References

Additional Sources : **Jack Gidding, Dan Huckle, Dan Solack, Gareth Rees, JP Carbonier,**

Q & A

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