Wombat Data Fabric:
Bringing the Power of Native IB
To Financial Services…
(and beyond?)

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Shameless Chest Thumping

› Experts in high performance connectivity
› Focused on the “Algorithmic Trading” Market
› “Twice as fast” – Jerome Downey, MD Bear Stearns, WS&T magazine
› All of the top 13 banks are customers (US, Europe, Asia)
› 2 to 3X revenue growth YoY last 3 years
Gordon Moore Eat your Heart Out...

Source: Statistics compiled by the Financial Information Forum with data from SIAC, NASDAQ and NYSE Arca.
Innovation Driving Spikes

Source: Statistics compiled by the Financial Information Forum with data from NYSE Arca.
A Compounded Problem

Liquidity in GOOG

Nasdaq
NYSE
ISE
B-Trade
BATS
Regionals
Direct Edge
Broker Liquidity
SuperBook-Generates Insights...and MORE data still
Net Effect: Server Sprawl

› Hardware
› Rack Space
› Power
› Cooling
› Management
Retransmissions and the Crybaby Consumer

Waaaaa!!!! I can’t keep up!
I flushed my cache—so recap all my stocks NOW!!! Waaaaa!!!!
Now I can’t handle these recaps!!! I’m gonna flush my cache again!!
Boy even I’m stressing now!
Any more recaps and I’m gonna have to flush!

Waaaaa!!!! Now I can’t handle these recaps!!! I’m gonna flush my cache again!!
Market Data Middleware Evolution

1980’s

Prevailing Business Challenge: Application Integration; Efficient Trading Room Distribution

1990’s

Best Available Networking: 10 Base T Ethernet

2000’s

Speed & Access: Gig Ethernet

Capacity: 10gE

Native IB

Market Data Volume
Wombat Middleware Innovation: Addressing Market Data Business Issues

Design Goals

› Deliver world class performance
  (reliable speed)
› Minimize sprawl
› Enable business agility
Compute Consumption: 
The Problem’s in the I/O

Offload-able from CPU!
› General I/O
› Unnecessary QoS code
› Multicast channel overkill

Feed Handler Component CPU Consumption

- Line Handler: 48.9%
- Message Handler: 9.6%
- Record Handler: 5.3%
- Publisher: 17.0%
- Middleware: 19.1%
Latency Induction:
It’s in the Copies and CPU Interrupts

Ethernet Delivery vs RDMA over InfiniBand
InfiniBand:
Fast, Guaranteed Delivery

Comparative Latency in Nanoseconds

Source: NCSA

Mean latency histogram - all observations for all runs
4x Recorded Rate

Cisco DAL/InfiniBand mean latency: 0.05 ms
UDP/Ethernet mean latency: 0.24 ms

Source: STACresearch.com
Wombat Data Fabric: The Market Data over RDMA Solution

› World’s only Native IB/RDMA Middleware
› From publish to reads
› Throughput: 1 million messages/sec and beyond…
› Reduced CPU/Bandwidth consumption
   › Minimal CPU interrupts
   › Zero copies
   › I/O offload to the HCA
› No retransmissions / crybabies
› Commodity x86 servers; the flexibility of software
› New horizons for innovation

Just One 8-core 1U Server...

Can Deliver more than 500,000 messages/sec
Under 100u-secs
Sockets vs Shared Memory

Sockets - Ethernet
- Transient messages
- Retransmission handling
- Heavy context switching in the OS
- Multiple copies in the I/O stack
- 1 GB per sec
- Latency ~0.5ms
- Latency jitter (long tails)
- Saturation 625,000 messages per sec
- Streaming data required to maintain state

Shared Memory - Infiniband
- Data persisted in shared memory
- Consume at will
- OS bypass
- “Zero copy”
- 20-40 Gb per sec
- Latency ~0.065ms
- Tight latency distribution
- Saturation 10,000,000 per sec (per port)
- Zero latency snapshot
- Tick series in the fabric
Enterprise-Wide Enablement

Plug in >100 Wombat Feed Handlers

Direct Exchange / ECN / Broker Data Feeds

Aggregated Vendor Data Feeds

Feed Handlers

Choose from a range of off the shelf apps from Wombat and third parties

Value Added Servers
- SuperBook
- Wombat Acumen
- Third Party Apps

Wombat Data Fabric

Ultra Low Latency Applications

Local Trading Networks

Cascading Cache

Multicast over LBM, RV… or TCP over Wombat Middleware

GUI Excel Custom

Interoperate with Ethernet middlewares via caches to meet varying needs and constraints across the enterprise

Wide Area Network Caching & Distribution Servers

Cascading Cache

WAN Links / Internet

Remote Branches and Customers

Multicast over LBM, RV… or TCP over Wombat Middleware

GUI Excel Custom

Enterprise-Wide Enablement

www.wombatfs.com
Unification via MAMA 4.0

- Binds the Wombat Platform & abstracts underlying middleware
- Low overhead
- Multi Impl.
- Dynamically loadable
- Standard programming model

![Diagram showing integration of various technologies and platforms through MAMA 4.0](image-url)
Future Innovations:
Market Data Object RDMA

Order Books with
Traditional Middleware

Order Books with
Data Fabric

Feed Handler
Client App

Book state must be maintained
in subscriber

Feed Handler
Client App

Book state maintained in feed
handler & requested on
demand in “zero” latency
Future Innovations: Time Series in the Fabric

- Traditional middleware model: Last value erased on update
- Fabric model: create ring buffers
Future Innovations:
Local DMA with MAMA

› Port apps from remote machines to inside the publisher
› No recoding needed: still MAMA
In Summary

› IB is crossing the capital markets chasm now
› Wombat Data Fabric wraps the benefits of IB & RDMA under a pub sub-like middleware
› Now Alpha. Launch Dec 2007 in capital markets
› Looking for opportunities to add value beyond…
Supporting Materials
FPGA?

› A single node solution - not a platform solution
  › The handler may be faster - but what about your apps?
› Possible value but less than WDF provides
› VHDL programming - DANGER
  › How to handle exchange data changes?
  › C to VHDL tools are not proven to be mature
› Not supported by enterprise server community yet
› Yet still under Wombat exploration
Simple Physical Architecture

Data from feed enters as IP over IB. Exits as Native InfiniBand.

Ethernet (TCP or UDP)

InfiniBand Switch

Data feed link & router/firewall to Exchange

Feed Handler

HCA

Native IB communication with feed handler.

Client App

HCA
Rendezvous Hops