MxP – Media Express Processor for VoIP Networks

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empowered Network

- Free-Phone
- LNP
- Pre-Paid
- IVR
- Find-ME
- Follow-Me
- Mediated Access

SS7 Network

AIN Services

PSTN

SSP

ISUP

Q.931

VoIP Today

SS7 Network

Internet

New World Services

QoS Managed IP Network

VoIP

mediaExpress™

xDSL

Cable

H.323 Client

Netmeeting

3rd Party Gw/GK

STB

H.323 Client IP Phone

- Unified Messaging
- Single Number Service
- Multimedia Conferencing
- CD Quality
- Virtual Office/University
- IP Centrex
- Network ACD
- Remote Agent
- Voice Enhanced eCommerce
- Application Sharing

DS1/DS3

empowerTel

Voice over IP Switch

8/14/2000

Hot Chips 2000

SLIDE 2
MxP-based DS3 Board
MxP Features

• High-performance and high-capacity TDM/IP packet processing
• Industry standard interfaces
  – PCI Bus, Revision 2.2
  – H.100/H.110 CT Bus
  – IEEE 802.3 - Media Independent Interface (MII)
  – IEEE 1149.1 - Test Access Port and Boundary Scan (JTAG)
  – Compact PCI Hot Swap
• Four embedded Media Stream Processors (MSPs)
• Hardware assist for processing IP/UDP/RTP headers on Ethernet Receive Packets
MxP Features (cont’d)

- Embedded VoIPCAM Core for fast lookups with constant latency – O(1)
- Jitter Buffer Valid Bits for keeping track of valid voice samples in the Jitter Buffer Memory
- Large Time Slot Interchanger (TSI) to support CT Bus and Local Serial Streams for DS3 capacity
- Echo cancellation, voice activity detection, voice compression, DTMF, etc. supported by MSPs/external DSPs through CT Bus and/or Local Serial Streams
- Mailboxes for inter-processor communication
Media Stream Processors

- Four embedded MIPS32 4Km Processors
- Two cache configurations
  - 16KB I-Cache, 2KB D-Cache
  - 8KB I-Cache, 4KB D-Cache
- Executes ‘Media Flow’ code
- Collects metrics for supporting RTCP and implementing Quality of Service features - weighted fair queuing, weighted early discard
Layer Processor

- Hardware acceleration for packet reception
- Performs checksum on packet and checks for status errors
- Filters IP/UDP/RTP voice packets to be processed by a Media Stream Processor
- Pre-processes the IP/UDP/RTP header and aligns the payload to accelerate processing for the Media Stream Processor
VolPCAM

- Embedded Content Addressable Memory
- Supports up to 1024 channels
- Constant latency - O(1) for search operations
- 128-deep FIFO can store search results for the maximum number of channels in a Multiplexed RTP packet; allows search operations to the VolPCAM to be pipelined
Jitter Buffer Valid Bits

- Keeps track of valid voice samples in the Jitter Buffer
- Shadows Jitter Buffer Memory accesses
- Bit is set when Jitter Buffer is written; reset when Jitter Buffer is read
- Loss data recovery can be implemented when Jitter Buffer does not contain valid data; repeat playout of last voice sample or generate data based on last few voice samples
Gateway Software

- Gateway enables PSTN convergence over Public Data Networks
- Convergence requires Transport & Signaling
- Media Flow and Media Express Processor (MxP) – Transport GW between TDM & IP
- Media Flow converts between TDM voice samples and IP packets, and vice versa
- Media Flow runs on the Local Processor & MSPs
- Shared Memory paradigm
Media Flow Design

• **Egress Media Flow - TDM to IP**
  - Move data from TDM Receive Buffer to payload buffers (every 0.5 ms).
  - Packetize and transmit using the Transmit DMA (TDM Egress DMA).

• **Ingress Media Flow - IP to TDM**
  - Receive packets from Ethernet. Layer Processor Hardware distinguishes RTP vs. non-RTP packets.
  - Extract voice payload from RTP packet. Write data to Jitter Buffer (MSP).
  - Playout voice data by writing data to the TDM Transmit Buffer (MSP/TDM Ingress DMA).
TDM Ingress Data Flow

128 Groups max
Each Group has 32 Channels
Each Channel is 16/32/64/128 ms of data
(or # of ms*2 Super Frames)
TDM Egress Data Flow

Channel Info Descriptor

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<tr>
<th>Payload Pointer</th>
<th>Sample Size</th>
<th>Active</th>
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4K entries

TSC (Time Stamp Counter)

VPBM

REQUEST

GRANT

Data, Address

TDM Egress DMA

TDM Rx Local Buffer

Data
MxP Physical Data

- TSMC 0.25 um technology (one poly, 5 metals)
- 115 MHz (worst process, 2.25 volts, 125 degree C)
- Fault coverage for the full chip 98.65%
- 13.5 million transistors
- 10.93 mm x 10.93 mm die size
- 388 pin BGA (4-layer substrate) with an internal heat slug and an external heat sink.
- 7 watts
Future Research and Development

• Increase capacity to multiple OC-3s
• Terminate VoDSL traffic
  – Convergence between Narrowband, Broadband, and Network Core (Unified Network)
• Integrate high-capacity echo cancellation, voice activity detection, voice compression solutions
• Transport agnostic network interface