Motorola Quad-Core DSP

MSC8102

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Motorola Semiconductors
The Smart Networks Platform

- MSC81XX Family
- PowerQUICC, C-port, PowerPC, Medusa...
- Comm. Protocols, Vocoders Drivers, BSPs...
- Leading Alliance Program
- Easier & Faster learning curve
- Customers’ Infrastructure Applications
- Compilers, IDE and Simulation tools from leading vendors
- Smart Networks Connections
- Digital Signal Processors, RF, High-Speed Interconnects
- Communications Processors
- Communications Applications Library
- Smart Networks Alliance
- Third-Party Software, Hardware, and Tools Solutions
- Customer Value-Add
Motorola DSPs Bring Intelligence to Network Infrastructure Connectivity

Smart Networks Systems
MSC81XX DSPs for the Infrastructure

Internet Service Providers

IP Network

RAS (ISP)

MEDIA GATEWAY

G3 FAX

MODEM

H.323 TERMINAL

WORK STATION

SERVER

IP/ATM Telephony

Narrowband / Broadband Gateway

Narrowband Access Networks

Internet Service Providers

Broadband Access Networks

IP Network

Central Office

ATM/IP SWITCH

Packet

3rd Generation

xDSL Modem

DSLAM

xDSL Modem

MSC

BSC

BTS

Node B

MSC

MSC

2G & 2.5G

Wireless Infrastructure

Target Markets

Motorola

digital DNA

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Packet Telephony Infrastructure

**Remote Access Market**

- Full Modem (V.92/90, V.34) termination: Data extraction, VOIP (G.7xx), FOIP (T.30/T38)

**Enterprise Market**

- Voice, Fax, Modem relayed in H.323 packets
  - VOIP (G.7xx), FOIP (T.30/T38), V.MOIP

**Trunk Replacement Market**

- G711 Voice, Fax, Modem carried in Packets/ATM Cells using AAL1,2 & 5
Wireless Infrastructure

Wireless Transcoding

Encode/Decode using AMR/EFR/FR/HR with connectivity to Packet and Switched networks

Wireless RNC/BTS

Symbol Rate (Turbocoding, Viterbi) and Chip Rate Assist

Demod  Deint  Rate Unmatch  TrCh Demux  Rf De-equalize

To CR ASIC/Antenna  To Network
The StarCore Alliance

Knowledge and Resources

Powerful DSP Core Technology for Communications SoC Solutions
SC140 - MSC81XX Core

ALU
- add, max

MAC
- mpy, mac

BFU
- and, asr
SC140 Core Advantages

Performance Cube
- StarCore SC140
- ‘Competitor1
- ‘Competitor2

Lower is better in each dimension

Plus Efficient Compilability
MSC8102 - Highest Performance DSP from Motorola

- Delivers market highest channel density with very low power dissipation
- MSC8102 will be sampled at Q2/2002
- Motorola’s 2nd StarCore-based DSP after MSC8101
- Market’s best comprehensive set of development tools from industry leading vendors
- Seamlessly Integrated with Motorola’s Networking Devices
- Enabling the Next Generation of Smart Networks
MSC8101 to MSC8102 Compatibility

• **MSC8101 Industry’s First StarCore-based DSP**
  - MSC8102 uses same proven extended Core

• **Industry’s Most Powerful Network-ready DSP**
  - MSC8101 uses MPC8260 CPM
  - Enables network interface for DSP farm of MSC8102 devices (Ethernet (10/100), ATM, TDM...)

• **Industry’s First PowerPC™ Bus-Compatible DSP**
  - MSC8102 uses same 60x bus interface

• **Using the same development tools set**
  - MetroWerks & Green-Hills in production now

• **Motorola 2nd DSP to use 0.13 micron, Copper Process Technology**
  - MSC8102 uses the same process technology as 8101

Now Shipping
MSC8102 Features

- **Industry’s Highest Performance DSP**
  - Four 300 MHz StarCore SC140 DSP Cores (= 1200 MHz)
  - 16 ALUs –> 4800 MMACs
  - 6000 MMACs with 300 MHz EFCOP

- **Very Large On-chip SRAM**
  - 1.436 Mbyte unified SRAM (11.488 Mbit)
  - Efficient, multi-level memory hierarchy

- **Industry’s Highest I/O Throughput**
  - PowerPC 60x system, 32/64 bit Interface @ 100MHz
  - Four serial TDM interfaces @ 50 Mbps
  - Host port Interface – 64/32bit @ 100MHz

- **Advanced technology with Very Low Power Dissipation in a small FC-PBGA Package**
  - 0.13 micron HiP6 Copper Process Technology
  - Power dissipation - 1.6 Watts
  - Package size – 20x20 mm @ 0.8mm ball pitch
MSC8102 Features (cont’d)

- Each SC140 Extended Core
  - 224 KB L1 SRAM private memory
  - 16 KB of real-time Instruction Cache
  - Enhanced Filter Coprocessor (EFCOP) NMLS support and matrix multiplication
  - 16 KB Instruction cache
  - 4 entries write buffer
  - Program Interrupt Controller (PIC)

- High-Density unified SRAM
  - 476 KB L2 shared SRAM @ 300 MHz

- Highest Bus Throughput
  - System bus - 32/64 bit PowerPC 60x System Bus Interface @ 100MHz
  - Host port – 32/64 bit Direct Slave Interface @ 100MHz

- 200 Mbps Serial Data Throughput
  - Four Independent Time Division Multiplex interfaces – core

- 16 Channel DMA Controller - Core-independent
EFCOP – Enhanced Filter Coprocessor

Both 8101 and 8102 integrate one EFCOP per Core

**EFCOP advantages**

**IP Telephony, Wireless Transcoder and DSP farms**
- Performs all types of FIR and IIR filtering within a vocoder, as well as LMS or NLMS type echo cancellation

**Wireless transceiver BTS for GSM, EDGE, 3G**
- Performs complex matched filtering to maximize the SNR in an equalizer as well as the channel correlation

**Smart Antennas Arrays**
- Performs all types of matrix multiplication with 32 bit resolution

**EFCOP generations**

**MSC8101 EFCOP**
- 32x32 bits matrix multiplication & accumulation
- FIR, IIR acceleration
- Adaptive FIR filters for LMS
- Multi-channel filters support

**MSC8102 enhanced EFCOP**
same as MSC8101 plus:
- 16 x 16 and 16 x 32 bits matrix multiplication & accumulation
  - best memory granularity
  - optimized memory usage

- LMS & NLMS algorithms
  Upgrade HEC algorithms performances

intelligence everywhere

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Multi-Channel Applications: Where Density Rules

- **Wireline Packet Telephony (VoIP Gateways and Modems)**
  - Universal/Voice Channels - Voice, FAX, Modem

- **Wireless Transcoding**
  - GSM, IS-136, IS-95, EDGE, CDMA2000/W-CDMA, 3GPP/UMTS
Boosting Channel Density for VoIP Carrier Class Applications

- TDM Serial Backplane
- 100 Mbps Packetized Network Interface
- C-Port C-5
- CPM
- MPC74XX
- 60x
- CPM
- MSC8101
- HI16
- 60x
- SDRAM Memory
- Optional SDRAM (for V.9x)
- 1Gbps Packetized Network Interface
- Network Processor

DSP Farm
- Voice
- Fax
- Data

Processing up to OC-12/STM-4 rates per board
Enabling Smaller Form Factor Systems for Residential/Business/Enterprise Applications

Communications Processor
- Network Protocol Stack

Maintain channel count while:
- Reducing board space
- Reducing power consumption
- Reducing system cost

Optional SDRAM (for V.9x)
### MSC8102 - Channel Densities

<table>
<thead>
<tr>
<th></th>
<th>MSC8101</th>
<th>MSC8102</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Port (V/F/D)</td>
<td>20</td>
<td>72</td>
</tr>
<tr>
<td>High Density Voice (G.711)</td>
<td>86</td>
<td>336</td>
</tr>
<tr>
<td>Premium Voice (G.723.1A, G.729AB)</td>
<td>39</td>
<td>156</td>
</tr>
</tbody>
</table>

All channel densities include VAD, CNG, G.168 EC with 128msec tail, DTMF, CPTmon, and jitter buffer
Raw DSP MIPS Applications: Where Performance Rules

- **Displaces ASICs and FPGAs**
  - Enabling New Features and Standards via Software

- **High-Performance BTS Programmable Engine**
  - 3G BTS Chip-Rate assist processor
  - 3G BTS Symbol-Rate software based processor
  - EDGE BTS multi-carrier software based processor
Next Generation 3G BTS Applications

1st Generation BTS
- 1 carrier/board
- 128ch/board
- Multiple ASICs
- Multiple DSPs

Symbol Rate
- CR ASIC
- SR ASIC

Chip Rate
- Control SW

2nd Generation BTS

Smart Antenna
- CR ASIC
- MSC8102 DSP

Multi-User Detection
- CR ASIC
- MSC8102 DSP

Chip Rate
- CR ASIC
- MSC8102 DSP

Symbol Rate
- Control SW
- MSC8101 DSP
- MSC8102 DSP

- Enables new features
- Added flexibility - programmable
- Reduce cost/channel
- Reduce power consumption
- Reduce board space

- 128 ch/board
- Reduce or eliminate hard-wired ASICs
- Reduce number of DSPs
- 128 ch/board
- Reduce number of DSPs
- Added flexibility - programmable
- Reduce cost/channel
- Reduce power consumption
- Reduce board space

- 1 carrier/board
- 128ch/board
- Multiple ASICs
- Multiple DSPs
3G - Distributed DSP Architecture for Multi-Sector (6/12 sectors) Cells with MSC8102

- SDRAM System Memory
- MPC8260 or MSC8101
- Packetized Backplane Ethernet / HDLC
- TDM Backplane
- Host Protocol Stack
- From Antenna & RF Demodulator
- CR/SR ASIC
- 64/32 TDM
- 60x PPC
- SDRAM (Optional)
MSC8102 Development Tools

- **C/C++ Compiler with in-line assembly.**
  - Enables developers to generate highly optimized DSP code.
  - Translates code written in C/C++ into parallel fetch sets and maintains high code density.
- **Librarian**
  - Enables the user to create libraries for modularity
- **ANSI-C libraries**
  - Collection of C/C++ functions for the developer’s use
- **Linker**
  - Highly efficient linker to produce executables from object code
- **Multi-Core Debugger**
  - Seamlessly integrated real-time, non-intrusive multi-mode debugger that enables debugging of highly optimized DSP algorithms
  - Developer can choose to debug in source code, assembly code, or mixed mode.
- **Integrated Simulator**
  - Device simulation models, enables design and simulation before the hardware arrival.
- **Profiler**
  - An analysis tool that enables the developer to identify program design inefficiencies.
- **Version control**
  - Includes plug-ins for ClearCase, Visual SourceSafe and CVS.
MSC810X IDE & RTOS - Partners

Integrated Development Environment

- C/C++
- Compiler
- Assembler
- Debugger
- Librarian
- Libraries
- Profiler
- Linker
- RTOS Debugging Utilities
- Integrated Device Simulator
- ABI standard compliance

Tasks Debug Awareness

- Preemptive multitasking
- True real-time behavior
- Fully interrupt /event driven
- Small memory requirements
- Dynamic memory allocation
- Support tasks priorities
- Inter process /cores communication

RTOS

- CodeWarrior
- OSE-DSP
- Multi
- RTXC-DSP
- Tornado
- Virtuoso
MSC8102 Development Support

• **Software Simulator:**
  - Simulates device at a block level with particular focus on 4 core interaction, memory hierarchy (L1, L2 and I-cache) and buses
  - Internal testing and evaluation using Prototype now (not customer ready)
    • Command line interface - no IDE support
  - Alpha release scheduled for August 2001 (customer ready)
    • Command line interface - no IDE support
  - Working with Metrowerks and Green Hills Software to provide alpha support with respective IDEs in Q4 2001
    • First integration with software development tools

• **Hardware Platform:**
  - MSC8101 platforms available now

• **Enables software development to begin immediately!**
**Integrated System Solutions**

- **Customers demand an integrated approach at both the hardware and software levels**
  - Addressed by the Smart Networks Platform
  - Software: Integration of key 3rd parties for protocol stacks, Vocoders, development tools, drivers....
  - Hardware: Board level products or reference designs

### Diagram

- **System**
  - **Network Services Integration**
    - Voice
    - FAX
    - Modem

- **Software**
  - **Software Integration and Scheduling**
    - Communications Processors
    - Digital Signal Processors

- **Silicon**
  - Boards
Integrated Software Solutions

Router/Bridge Applications (Web/Java support, Management I/F)

- UNI & NNI Signaling Layer
  - Q.2931/Q.2971
- Signaling Layer
  - Q.2931/Q.2971
- Applications
  - Telnet, TFTP, SNMP, etc
- Spanning Tree

- ATM Adaptation Layers / SSSAR

Network and Signaling S/W Stacks

- H.323
- H.248/
- MGCP
- SIP
- MARS
- LANE
- IPSec
- ILMI
- SNMP
- PNNI
- RFC 2364
- RFC 1577
- RFC 1483
- PPPoE
- AAL-1/AAL-2/AAL-5

RTOS and Routing S/W

- RTP
- RTCP
- LEC
- Spanning Tree

DSP S/W

Communications Processors

Modem
- V.90
- ECDC
- V.92
- T.30
- T.34HD
- T.38

Fax
- V.17
- V.29
- T.30
- T.34HD
- T.38

HEC
- V.17
- V.29

Wireless
- G.165
- G.168
- VAD
- Call Id
- DTMF
- ANSD
- AMR
- HR/FR/EFR
- G.728
- G.729/a/b
- G.723.1a
- G.726
- G.711

VOIP
- G.728
- G.729/a/b
- G.723.1a
- G.726
- G.711

intelligent everywhere

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### Available MSC810X Transcoding/VoIP Software

<table>
<thead>
<tr>
<th>GSM Vocoders</th>
<th>GSM – AMR/EFR</th>
<th>GSM – FR</th>
<th>GSM – HR</th>
<th>GSM-WB AMR</th>
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<tbody>
<tr>
<td>CDMA Vocoders</td>
<td>CDMA – IS 96-A</td>
<td>CDMA – IS 127</td>
<td>CDMA – IS 733</td>
<td>SMV</td>
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<tr>
<td>TDMA Vocoders</td>
<td>TDMA – IS 641-A</td>
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<tr>
<td>ITU G.7 Vocoders</td>
<td>G.711 encoder</td>
<td>G.711 decoder</td>
<td>G.711 (enc. + dec.)</td>
<td>G.722</td>
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<td>G.723.1</td>
<td>G.726</td>
<td>G.728</td>
<td>G.729B</td>
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<td>G.729AB</td>
<td>G.729E</td>
<td>G.715</td>
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<td></td>
<td>G.165/G.168 (32 ms)</td>
<td>G.165/G.168 (64 ms)</td>
<td>MGCP, MEGACO, SIP, H323</td>
<td>SS7</td>
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<tr>
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<td>V21, V27ter &amp; V29</td>
<td>V21, V27ter &amp; V29 &amp; V17</td>
<td>V110 V120 HDLC for PPP</td>
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<td>V21</td>
<td>V22/V22bis</td>
<td>V34</td>
<td>DTMF (RX and TX)</td>
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<td>V23</td>
<td>V32/V32bis</td>
<td>V34</td>
<td>DTMF Detection</td>
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<tr>
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<td>V90 V91 V92</td>
<td>V44 V42bis MNP5</td>
<td>VAD, CNG</td>
<td>Tone relay</td>
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<td>Bell212 203</td>
<td>V8 V8bis</td>
<td>Cell support</td>
<td>Adaptive Jitter</td>
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<tr>
<td></td>
<td>V44 V42bis MNP5</td>
<td>Asynchronous PPP</td>
<td>Lost Packet Recovery</td>
<td>Voice over ATM</td>
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<tr>
<td></td>
<td>V8 V8bis</td>
<td>Asynchronous PPP</td>
<td>IP/ TCP &amp; UDP</td>
<td>Cell support</td>
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<td>T.38</td>
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<td></td>
<td>V.17, V.27Ter, V.29bis, V.21</td>
<td>V.34HD, T.30, T.4, T.38</td>
<td>Ethernet drivers</td>
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<td>TDM drivers</td>
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<td>V.21</td>
<td>V.34HD, T.30, T.4, T.38</td>
<td>ATM AAL1,2,4,5 drivers</td>
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</table>
MSC810X Transcoding/VoIP - Partners

- **Speech/Fax Coders**
  - Surf Communications
  - Signals+Software

- **Data Modems**
  - Lake Communications
  - Hughes Software Systems

- **Networking Protocol Stacks**
  - Aisys
  - WindRiver

- **Drivers**
  - Trinity Convergence
  - OSE Systems
  - Delphi Communication Systems, Inc.
  - Lineo

- intelligence 
  - Motorola

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Motorola Networking Infrastructure
DSP Products

SC140 Core

Onyx Core

1 x 300 MHz CPM

MSC8101

MSC8102

4 x 300 MHz

56311

150 MHz

56321

200 MHz

Raw MIPS DSPs

Network-Ready DSPs

Application Specific DSPs

Low-Cost DSPs
Summary

- The MSC8102 - Industry’s Highest Performance DSP
- Building on the success of the MSC8101
- Enabling the Next Generation technologies of 3G BTS/Transcoding, VoIP/VoATM Gateways and RAS/Data Modem.....
- Integrated with Motorola’s Smart Networks Platform