Enablement for StarCore DSP Products

FTF-NET-F0459

Mrinmoy Purkayastha – Tata Elxsi Ltd
John Dixon – Freescale Semiconductor
Agenda

► Freescale DSP Roadmap
► Target Markets
► Tools and Software
► Tata Elxsi Software Enablement
Freescale DSP Roadmap
1986
DSP 56k targeted for audio apps

1998
StarCore® architecture

2008
Change of corporate management
- March 2008 – Rich Beyers (CEO) joins Freescale
- Sept. 2008 – Lisa Su DSP (SVP) joins Freescale
  - Focus on core markets - prioritize strategic markets for Freescale
    - Exit other non-strategic markets
    - Increased investment for DSP, architecture, tools

2009
Focus on core market – base station
- 2009 – SC3850 core released
- 17 DWINs including 8 of top 10 customers
  - Replaced TI in all these customers

2010
Using FSL winning technology to focus on other markets
- Medical, aerospace, defense and test and measurement markets
- Use Freescale’s differentiated technology in other markets
- Freescale brings a new era of stability, drive and success in the DSP market

1986 1998 2008 2009 2010

Freescale DSP Evolution
Freescale SC3850 DSP core earns highest BDTImark2000™ score to date

Freescale StarCore SC3850 core technology used in the MSC8156 multicore DSP has garnered leading benchmark results from independent signal-processing technology analysis firm, Berkeley Design Technology, Inc. (BDTI)

20+ design wins at base station customers in 2009

8 out of the top 10 base station customers chose Freescale in 2009

Beat out Texas Instruments in all cases
MSC815x/ MSC825x Family – Value Proposition

The industry’s highest performance programmable DSP families, targeted for the aerospace, defense, medical imaging and test and measurement markets

Half the Price of Competition

- Half Price - MSC8251 is $75 in 1ku volumes vs. Texas Instruments TMS320C6457-12 at $145.45
- 40% lower Price - MSC8256 is $124.20 in 1ku volumes vs. Texas Instruments TMS320C6472-7 at $210.00

2x Performance of Competition

- Freescale MSC8256 has 2x higher core performance over closest DSP competitor
- Richest and highest performance DSP I/Os accelerating system performance

Fully Scalable and Flexible

- Industry’s most scalable and fully programmable DSP family with 1, 2, 4 and 6 core pin compatibility, solving the customer need to scale from a single-core device to a multicore device.
StarCore DSP Devices Roadmap

**Accelerated Performance**
- Base station
- Medical

**Optimized Performance**
- Aerospace and defense
- Test and measurement

**Cost Efficient Performance**
- Medical
- General purpose

**New Products - Pin compatible**
- MSC8156
  - 4/6 DSP Cores
- MSC8154
  - 4/6 DSP Cores
- MSC8144
  - 4 DSP Cores
- MSC812x
  - 4 DSP Cores
- MSC8113/2
  - 3/2 DSP Cores
- MSC711x
  - 1 DSP Core

**Available Now**
- MSC8156
- MSC8154
- MSC8144
- MSC812x
- MSC8113/2
- MSC711x

**2010**
- MSC8256
  - 4/6 DSP Cores
- MSC8254
  - 4/6 DSP Cores
- MSC8152
  - 1/2 DSP Cores
- MSC8151
  - 1/2 DSP Cores
- MSC8252
  - 1/2 DSP Cores
- MSC8251
  - 1/2 DSP Cores

**2011**

**Pin for pin compatible Families:**

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Target Markets
MSC8156/5/4 DSP - Focus Market Segments

Wireless Access

- Multi-standard wireless base stations
  - FDD-LTE
  - TDD-LTE
  - HSPA+
  - TD-SCDMA
  - WiMAX

- Multiple base station form factors
  - Macro
  - Micro
  - Pico

- SDR – Software Definable Radio
  - Deploying different base stations standards by using same hardware design enabled by different underlying software
<table>
<thead>
<tr>
<th>Market</th>
<th>End Application</th>
<th>MSC8251</th>
<th>MSC8252</th>
<th>MSC8254</th>
<th>MSC8256</th>
<th>MSC8154</th>
<th>MSC8156</th>
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<td>Aerospace &amp; Defense</td>
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</table>

FSL will have block diagrams of all the above End Equipments on the Freescale Webpage in 2Q10.
MSC825x Tools and Software
Hardware Tools
- $3900 (includes one year free CodeWarrior tools subscription)

Software Tools
- New Eclipse IDE
- Build tools
  - Performance C/C++ compiler
- Trace and profile
- SmartDSP OS
- Debugger

Software migration tools
- Texas Instruments C64x+ to Freescale SC3850 migration tools
- DSP libraries

Documentation and available support
www.freescale.com/dsp
- Device and tool fact sheets
- Product data sheets
- Freescale DSP forums
- System block diagrams on all target end equipments
Product Design Services - Overview

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25 May, 2010
© Tata Elxsi Limited
• India’s largest business group
• Turnover > 70 Billion USD
• Significant presence in 7 Sectors
• Est. in 1868 – Leadership with Trust
• India’s most valued corporate brand
• 250,000+ employees - Largest private Indian Employer
• Operations in over 40 Countries
• Products and services exported to 120 countries
• Leading CSR initiatives over 100 years – 66% of Tata Sons holdings in charitable trusts
• Established educational institutions of international repute such as IISc, Bangalore

Group Companies
• Tata Motors
• Tata Steel
• Tata Sky
• Tata Communications
• Tata Teleservices
• Tata Tea
• Tata Power
• Creative and technology arm of the TATA group
  • Core practice areas:
    • Embedded product design and development services
    • Industrial design and user interaction design
    • Animation, special effects and game assets
  • Mature quality processes and methodologies - evolved over two decades

• Global delivery & reach
  • 3,500+ consultants, designers and engineers
  • 20 offices (13 countries), corporate office at Bangalore, India
  • Six global design and delivery centers in India
  • Technology labs for multimedia, convergence, wireless and automotive
  • Leading Creative and interaction design studio in Asia
    • Design studios for interaction and UI design in UK and Bangalore
  • Flexible business models to meet customer and geography specific needs
Product Design Services
Embedded Software and Hardware
- Broadcast
- Communications
- Transportation

Industrial Design Engineering
Product Concept, Industrial Design, Styling, Detailing, Rapid Prototyping, Analysis and Structural Packaging

Visual Computing Labs
Animation, VFX, Games and Pre-Visualization

Systems Integration and Professional Services
CAD/CAM, Broadcast, Storage, HPC and Networking Solutions
Commissioning and Maintenance
Tata Elxsi offerings
- Market study
- Competitive analysis
- Architecture exploration
- Proof-of-Concept (PoC)

Tata Elxsi offerings
- Software IP
- System architecture consulting
- Turnkey SoC, Board design, FPGA’s
- BSP, firmware and device drivers
- Connectivity and protocol stacks
- Application development
- User interface design
- Mechanical design
- Functional and product testing
- Test automation

Tata Elxsi offerings
- Functional and specialized testing
- Test automation
- Migration
- Feature enhancements
- Sustenance engineering
- Bug fixing and configuration mgmt.
- Technical support – problem escalation, trouble shooting

Idea/Concept validation | Design and development phase | Product sustenance phase
**Broadcast**
- Cameras, Ingest Servers
- Authoring/Editing Tools
- Streaming Media Servers
- VoD Servers
- Set-top Boxes, Digital TVs
- Portable / Handheld / Mobile DTV Products
- DTV Test and Measurement Equipments

**Communication**
- Routers, Switches
- Aggregation Products
- Enterprise WLAN
- Voice and Video Conferencing
- Media Gateways
- Wireless Base stations
- CDMA, WiMAX, LTE Femtocells

**Transportation**
- ECU and Embedded software
- Diagnostics, HILS
- Navigation
- In-Car entertainment
- Model based Development
- Automated Testing and Validation
Engineering partner for more than 50 companies worldwide

**HD cameras ➔ Ingest servers ➔ Editing tools ➔ Video Servers ➔ Set-top boxes**

Differentiated application development for Cable and Satellite TV

### Core expertise

- Audio/Video compression
- Image processing
- Content authoring
- Visualization Tools
- Transport streams
- Streaming
- Digital TV middleware
- CAS / DRM
- Set-top boxes
- tru2way applications
- Games
- Triple play

<table>
<thead>
<tr>
<th>IP offerings (1)</th>
<th>IP offerings (2)</th>
<th>Processor expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MPEG2 MP@ML</td>
<td>• MPEG2TS decoder</td>
<td>• MSC8122</td>
</tr>
<tr>
<td>• H264 Main profile</td>
<td>• Streaming server stack</td>
<td>• MSC8144</td>
</tr>
<tr>
<td>• H264 High profile</td>
<td>• DVB-S middleware</td>
<td>• MSC815x</td>
</tr>
<tr>
<td>• AVC Intra</td>
<td>• IP-STB middleware</td>
<td>• MSC825x</td>
</tr>
<tr>
<td>• JPEG2000</td>
<td>• DVB-H CBMS (IPDC) and OMA-BCAST middleware</td>
<td>• FPGAs</td>
</tr>
<tr>
<td>• Transcoding frameworks</td>
<td></td>
<td>• ASSPs</td>
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Key service areas

- End-to-end product development:
  - Hardware, Firmware, Connectivity, Middleware, UI, Applications
  - User interaction design
  - Industrial design and styling, Engineering detailing, Analysis

- IP licensing:
  - Audio/Video codecs, Media player framework,
  - DLNA stack, Mobile TV middleware, etc.

- Mobile handset integration and testing
- Game porting, Game development
- Video surveillance and Video analytics

Processor expertise

- i.MX21, i.MX27
- i.MX31, i.MX35
- i.MX233
- i.MX51
- MSC81xx
- MSC82xx
Consumer Electronics - IP offerings

**Audio codecs**
- MP3, MP3Pro
- WMA, WMAPro
- AAC-LC, AAC-LD, eHE-AAC
- DTS family (strategic partner)
- FLAC, Ogg Vorbis, etc.

**Speech codecs**
- G.722.1, G.723.1, G.726, G.728
- G.729 AB, G.729.1, MPEG4 CELP
- AMR-NB, AMR-WB, AMR-WB+

**Video and Image codecs**
- H.264 SVC (spatial, temporal and quality scalability up to 1080p)
- H.264 High profile
- H264 Baseline profile
- AVC-Intra 100/50
- MPEG4 Simple profile
- MPEG4 SP (H.263+)
- MPEG2 MP@ML
- JPEG / JPEG2000
- DTS family (strategic partner)

**Audio pre/post processing**
- Graphic equalizer
- Acoustic echo canceller (AEC)
- Automatic gain control (AGC)
- Dynamic equalizer and Limiter

**Video pre/post processing**
- Segmentation
- Feature extraction
- Noise removal
- Fuzzy filter, De blocking filter, etc.

**Protocols / Frameworks**
- RTP/RTCP, H223 (A/B), FlexMux
- Packetizers / De packetizers
- MPEG2TS decoding / encoding
- Media player framework
- DLNA and UPnP stack
- SIP based IP video phone
- Mobile TV middleware (DVBH CBMS / OMA-BCAST)
- Video Analytics library

**Video Analytics library**
- Abandoned and Removed object detection
- Virtual line crossing detection
- Human loitering/ running/ walking detection
- Motion tracking
- Face detection
- Fire detection
- Number plate recognition*

* Under development
**Player features:**
- Music and video player
- Image viewer
- Streaming media player
- Audio/Video recorder
- DVB-H stack for Mobile TV
- Streaming media server
- DLNA stack for seamless plug-and-play
- Embedded database
Engineering partner for more than 30 companies worldwide

<table>
<thead>
<tr>
<th>Data Networking</th>
<th>CPE</th>
<th>Access Edge</th>
<th>Metro Ethernet</th>
<th>Core Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing &amp; Switching</td>
<td>FTTH Gateways, Residential Gateways</td>
<td>Enterprise L2 / L3 Switches, Routers, WLAN controllers</td>
<td>Metro Aggregation, DSLAMs, CMTS</td>
<td>Core Switches, Routers, Backhaul equipment</td>
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<tr>
<td>(L2-3)</td>
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<tr>
<td>Deep Packet Inspection</td>
<td>DPI Switches, Security Boxes, Packet Analysis, Application Classification, QoS</td>
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<td>(L4-7)</td>
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<tr>
<td>Network Security</td>
<td>Device level, Network level Security Solutions - IDS, IPS, User trust &amp; Identity, Firewalls</td>
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</table>

**Convergence**

<table>
<thead>
<tr>
<th></th>
<th>Endpoints</th>
<th>Gateways</th>
<th>IP PBX, TDM-to-IP</th>
<th>Call Servers &amp; Soft switch solutions</th>
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<tbody>
<tr>
<td></td>
<td>IP Phones, Video Conferencing Endpoints</td>
<td>Residential Gateways, IAD, EMTA, IMS</td>
<td>Mid-to-High end IP-PBX, Trunking Gateways</td>
<td>SIP servers, Signaling Gateways, Media Gateways</td>
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**TECHNICAL CONSULTING**  **PRODUCT DEVELOPMENT**  **TESTING & TESTAUTOMATION**  **PRODUCT SUSTENANCE**
### Voice Codecs
- G.711 codec
- G.711 Appendix I (PLCO)
- G.711 Appendix II (VAD/CNG)
- G.722 codec
- G.723.1 codec
- G.726 codec
- G.726 w/ Annex A
- G.729 AB codec
- AMR NB codec
- iLBC codec
- AMR-WB encoder
- AMR-WB+ encoder
- AMR-WB decoder
- AMR-WB+ decoder
- MPEG-4 CELP decoder
- QCELP
- G.729.1 codec
- G.7291
- G.729A w/ Annex B and Appendix III
- G.722.1 codec
- G.722 w/ Annex IV
- G.722.1 including Annex A
- G.728 Annex G
- EVRC-A
- EVRC-B
- EVRC-C
- GSM-HR
- GSM-FR
- GSM-EFR

### Fax/Modem Standards
- V32/V32 bis (aka ter)
- V.34
- V.90
- V.92
- V.27ter
- V.17
- V.21
- V.29
- CallerID including V.23

### Audio Codecs
- MP3 Decoder
- MP3 Encoder
- MP3 Pro Decoder
- MP2 Multi Channel Decoder
- AAC LC Decoder
- HEAAC Decoder
- eHEAAC Decoder
- AAC LD Decoder
- AAC LC 5.1 Ch Decoder
- HEAAC 5.1 Ch Decoder
eHEAAC 5.1 Ch Decoder
- AAC LC Encoder
- HEAAC Encoder
eHEAAC Encoder
- AAC LC Encoder 5.1
- HEAAC Encoder 5.1
eHEAAC Encoder 5.1
- WMA 9 Decoder
- WMA 10 Pro Decoder
- FLAC Decoder
- FLAC Encoder
- Ogg Vorbis Decoder
- DTS 5.1 Surround Decoder
- DTS Hi Res Decoder
- DTS HD Decoder
- DTS LBR Decoder
- DTS Neo6 Matrix Decoder
- DTS Encoder
- DTS Surround Sensation

### Post Processing Components
- Graphic Equalizer
- Fast Play
- PitchShift
- Mixer
- Parametric Equalizer
- Mute Control
- DRC
- DownMix (5.1 Ch To 2 Ch)
- AEC
- VAD/CNG
- PLC
- AGC
- SRC
- Volume Control
- Noise Reduction
Unified Communications - IP offerings

**IP-to-IP Video Media Gateway**
- Real time conversion of video formats, resolution and bit rate
- Optimized for maximum channel density

**Codecs supported**
- H264 Baseline profile - all levels up to level 13 (1, 1b, 11, 12, 13)
- MPEG-4 Simple profile, single object, level 0, 0b, 1, 2 and 3
- ITU-T H263 profile 0 (baseline), all levels up to and including level 30; with support for H263+

**Other Features**
- Lightweight framework
- Efficient memory management
- Scalable for multi-core implementation
- Supports various Transcoding API’s
- Low latency
- Error resilient
- Optimized for sc3400
10 years in wireless product development covering broad spectrum of products
CDMA 1x / EV-DO | UMTS | TETRA | xG-PHS | WiMAX | 3G | LTE
Leading IP provider in Mobile WiMAX and LTE

Key service areas
- Product conceptualization and rapid prototyping
- L1 / L2 / L3 development, integration & testing
- RF integration and IOT
- Pre-certification / certification support
- Product re-engineering and platform migration
- Maintenance and sustaining engineering

IP portfolio
**WiMAX (802.16e)**
- MAC and PHY layer for Base station and Mobile station
- Reference designs
  - 5/10 MHz 2x2 Base station
  - 5/10 MHz Mobile station

**LTE**
- PHY and L2/L3 stack for eNodeB and UE
- Reference designs
  - 10/20 MHz 2x2 eNodeB
- eNodeB and UE Test Infrastructure

Markets addressed
- Pico/Macro base stations
- Femtocells
- Tactical communications
- Smart grid Utility networks
- PMR/DMR and Public safety radios
- Test and Measurement
20MHz, 2x2 MIMO, 100/50 Mbps eNodeB reference solution

Salient features
- 10 / 20 MHz, 2x2 MIMO
- FDD 2.6 GHz, RF integrated
- CPRI interface to Third Party RRH
- Throughput = 75 Mbps (10 MHz), 150 Mbps (20 MHz)
- S1-APP, X2-APP, GTP v1-U interfaces
- Designed for multi-core platforms
- Supported by Tata Elxsi for IOT, customization and certification
- Available Q4 2010
Elxsi - Key Differentiators

- Technology arm of TATA Group - one of India's largest and most respected business conglomerates
- 2 decades of leadership in embedded product design
- Focus on end-to-end product engineering including hardware, software, UI and enclosure design
- Rich portfolio of IP and reference solutions to enable faster time-to-market
- Technical consulting capabilities in high growth markets:
  - Automotive
  - Broadcast infrastructure
  - Consumer Electronics
  - Unified Communications
  - Wireless infrastructure
- Mature quality processes tailored to meet product engineering needs
- Partnerships and alliances with leading technology providers – effort to develop an end-to-end ecosystem to support OEMs
Thank you

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