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Highlights of the 2009 International Solid State Circuits Conference (ISSCC)
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Highlights of the 2009 International Solid State Circuits Conference (ISSCC)

“The International Solid-State Circuits Conference is the foremost global forum for presentation of advances in solid-state circuits and systems-on-a-chip. The Conference offers a unique opportunity for engineers working at the cutting edge of IC design and use to maintain technical currency, and to network with leading experts.” - ISSCC Vision Statement

The theme of this year’s ISSCC was “Adaptive Circuits and Systems”. Though semiconductor manufacturing technology may be close to reaching the physical limits of Moore’s Law, ISSCC-2009 showed that we are clearly not there yet. Progress continues to be made in shrinking transistors, with Intel disclosing the first use of 32nm technology, while also providing a vision for achieving the next step down to 22nm.

Presenters at ISSCC-2009 demonstrated how advances in technology and circuit innovation can be combined to make more adaptable devices, using digital control and programmability to provide benefits for many applications. This report highlights the most significant innovations from ISSCC in the areas of consumer electronics and digital media.

1. Advances in semiconductor technology lead to lower energy consumption in consumer electronics.

Reducing wasted power in LCD Flat Panel TVs

In his plenary talk “Leaner and Greener: Adapting to a Changing Climate of Innovation”, Rene Penning de Vries (CTO of NXP Semiconductors) showed how backlighting in LCD TVs is the major source of wasted power in flat-panel televisions. In a conventional LCD flat-panel TV employing cold fluorescent light (CFL), only 7% of the backlight energy reaches the viewer. Second-generation LCD TVs have now been introduced that achieve lower black levels, and save power, by replacing CFL with white LED backlights. Segmented LED backlighting utilizes sophisticated processing algorithms to analyze picture content, instantaneously detecting light/dark areas and applying localized modulation to optimize light output. (see digdia report: CES 2009 – Top 10 Trends).

The next step in LCD backlighting is to replace the white LEDs with clusters of red, green and blue LEDs – eliminating the need for color filters. A few high-end models employing this
technique are just coming on the scene, such as the Sony BRAVIA KDL-55XBR8\(^1\). While this approach is more expensive, requiring more sophisticated image processing, power savings are also significant since 70% of back lighting illumination is absorbed in the color filters.

**Impact:** Silicon content in LCD TVs will increase substantially as more complex SoCs will be required to execute segmented image brightness and color control. Digital control of analog electronics in driver circuits will increase, with more sophisticated local optimization performed to compensate for display uniformity, local heating, and aging effects.

2. **New design techniques enable multi-band 3G wireless applications.**

**Reducing cost while increasing features in 3G cell phones**

**ST-NXP Wireless** and **Ericsson Mobile Platforms** (now merged as ST-Ericsson), collaborated to produce a tri-band WCDMA/HSPA and quad-band GSM/GPRS/EDGE receiver in a single chip. Cost is reduced by eliminating the external SAW filters that would typically be required to prevent inter-band interference in 3G receivers. On-chip internal calibration of critical circuits eliminates the production cost of calibration during handset manufacture.

Though it was withdrawn from presentation at the conference, **Skyworks Solutions** also submitted a paper that demonstrated a multi-band 3G receiver, eliminating the external SAW filters. The paper, which is titled “*Single-Chip Multiband WCDMA, HSDPA, HSUPA, EGPRS Transceiver with Diversity Receiver and 3G DigRF Interface Without SAW Filters in Transmitter / 3G Receiver Paths*”, shows results meeting the specifications for WCDMA and GSM standards, for a chip manufactured in a low-cost 0.13\(\mu\)m CMOS process.

**Qualcomm** also showed a new chip that reduces (but does not eliminate) SAW filters; claiming the “*first multiband WCDMA/HSPA/EGPRS single-chip transceiver with GPS and receiver diversity*”. As with the Skyworks chip, Qualcomm used an older-generation low-cost 0.18\(\mu\)m RF CMOS technology, while making extensive use of on-chip digital calibration to meet multi-band performance requirements.

On the more aggressive end of the technology spectrum, **NXP Semiconductors** showed a test chip for “*A 45nm Low-Power SAW-less WCDMA Transmit Modulator...*”, as a building block for integration of WCDMA and GSM in an SoC. In this example, the scaling down of transistor switches provides a benefit of reduced noise and power reduction, facilitating a more highly integrated solution to reduce component costs and extend battery life.

**Smaller, lower power chips for Mobile TV in Japan**

While deployment and adoption of mobile TV in the U.S. lags other regions of the world, semiconductor vendors are competing to supply chips for ISDB-T equipped handsets that have been available in Japan since 2006. **MaxRise** of Taiwan announced development of a Mobile ISDB-T Tuner at ISSCC which they claim offers the smallest chip size and lowest

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power consumption to date. As a standalone tuner for ISDB-T, this chip fabricated in a mainstream 0.13µ process would be used as an add-on feature in cellular handsets.

Impact:

- Size and power requirements for 3G handsets will be reduced.
- Cost will be reduced by eliminating manufacturing steps, reducing component count and providing global coverage for multi-band standards in a single SoC.

3. Advances in Multi-media processors

*Ultra low-power JPEG processor for digital cameras and portable devices*

**NXP Semiconductors**, along with university researchers, announced a 65nm CMOS JPEG co-processor that operates with a power supply of only 0.45 volts. The design innovations permit extending battery life while supporting still image and 15fps/30fps VGA applications.

**Single-chip SoC integrates all of the functions for multi-format Blu-ray Disc players**

**MediaTek** (Taiwan) presented a highly integrated 90nm CMOS SoC for Blu-Ray disc players; incorporating a General Copy Protection unit, and support for multiple video and display formats. Some of the key features incorporated in this chip:

- Integrates AES, CSS, CPPM/CPRM, DES, SHA-1/MD5 copy protection algorithms
- A dedicated MMU to support multiple video standards (MPEG-1/2/4, H.264, VC-1)
- Supports two display outputs simultaneously
- AACS decryption, 60fps H.264 decode, 1080p HD with 480p SD picture overlay (PIP)
- HDMI-1.3 12b deep color-mode output
- Streaming/serial-ATA interfaces, USB 2.0, 10/100M Ethernet MAC

Cost reduction for integrating all the Blu-ray player functionality in a single SoC is claimed to be 32%.

*Adding High Definition video to cellular handsets*

**Renesas Technology** took the approach that dedicated processors are preferable to single-chip SoCs for minimizing power consumption in cellular handsets. The 65nm chip achieves a power dissipation of 342mW, integrating a video codec for recording and playback of full-HD video. Eighteen programmable video processing elements can be reconfigured for applications such as video-telephony or digital video recording by downloading firmware frame-by-frame.

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2 See [http://www.digdia.com/glossary.htm#HD](http://www.digdia.com/glossary.htm#HD)
Beyond HDTV... 3D and quad HDTV

**MStar Semiconductor**, along with designers from the National Taiwan University, described a 90nm SoC that pushes HDTV to another level; 3D and “quad HDTV”. According to the designers, to implement 3D 1080p video with today’s processing techniques would require 82.4TOPS computing power and 54.6TB/s memory access. Through a number of architectural innovations, such as “View-parallel macro-block interleaved (VPMBI)”, this design claims to support single-view 4096×2160p to 7-view 720p videos.

Extending wireless handset battery life through sophisticated power management

**Panasonic** presented “A 45nm Single-Chip Application-and-Baseband Processor Using an Intermittent Operation Technique”, a complex approach to minimizing power consumption in wireless handsets by selectively turning off an unnecessary circuits “on the fly” during light-load applications. Four different circuit design techniques for power management are employed to maximize battery life. An overall power reduction of 79% was claimed. The aggressive 45nm process allows integration of 280M transistors with 25Mb of on-chip SRAM, support for GSM/GPRS/EDGE, HSDPA, and WCDMA, with H.264/VC-1/MPEG-4 video codecs.

**Impact:**
- Consumption and creation of multimedia content moves further into mobile devices.
- Blu-ray disc players will be quickly driven down in cost to replace DVD players.
- High-definition video, recording and playback, moves into mobile devices.
- Developments for 3D video are accelerating.

4. Innovations in Digital Wireless Applications

**Cheaper, low power GPS**

**MediaTek** developed a high performance dedicated GPS SOC using 0.11µ RF-CMOS. The design reduces cost by eliminating external SAW filters, and by achieving a first by integrating a switching mode power supply (SMPS) on the same chip with the sensitive RF circuitry. The device is designed primarily for portable navigation devices, or as an add-on in CDMA handsets, with power consumption of 34mW during tracking stage and 45mW during acquisition.

**Reconfigurable Software-Defined Radios (SDR)**

Researchers at **IMEC** and **KU Leuven** in Belgium showed a prototype receiver design for a single-chip radio that is reconfigurable via digital programming for GSM, DVB-H, LTE, WiMAX and WLANg/n applications. By exploiting the speed and density of 45nm digital CMOS, the design is suitable for inexpensive complete single-chip integration with a digital processor.
Wireless connectivity for consumer electronics, PCs, and mobile applications

Ultra-WideBand (UWB) is an emerging broadband wireless technology for personal area networks (PAN), providing a common platform for integrating technologies such as Bluetooth, wireless USB, and other proprietary wireless implementations to support high data rate (up to 480Mb/s) multimedia connectivity. NXP Semiconductors (Netherlands) and the ST-NXP Wireless partnership (Singapore) presented the first fully integrated physical-layer (PHY) SoC fabricated in a baseline 65nm CMOS process that supports all three frequency band groups of WiMedia v1.2 without requiring any on-chip inductors for the RF circuits.

Ubiquitous broadband internet connectivity

Marvell Semiconductor described a dual-mode WiMAX/WLAN (802.16e and 802.11b/g/n) dual-band direct-conversion radio in 90nm CMOS. This chip addresses the challenge of providing for seamless switching from WiFi to WiMAX networks while co-existing with Bluetooth/GPS/cellular transmissions, through circuit innovations such as smart blocker detection. The current version of the device is constructed with all pins on the right hand side for easy connection to digital baseband interfaces, but future integration with a companion DSP chip is anticipated for a complete SoC WiMAX/WLAN solution.

Intel has been the leading proponent of mobile internet devices (MIDs). As a step toward high integration in state-of-the-art manufacturing processes, Intel presented “A 1.1V 5-to-6GHz Reduced-Component Direct-Conversion Transmit Signal Path in 45nm CMOS” that supports co-existence of WAN (WiMax, LTE, GPRS) and WLAN/PAN (Bluetooth, WiFi) applications on the same IC. By demonstrating performance from a 1.1V supply, in a 45nm process, this prototype shows the potential for size and power reductions in comparison to Marvell’s 90nm design.

Impact:

- The number of wireless applications in handheld devices continues to increase.
- Speed of downloading digital media files is enhanced.
- Transfer of media between devices is enabled, while eliminating cables.
- Wireless connectivity enables adoption of new consumer electronics devices.
- Mobile broadband internet connectivity with seamless switching from LANs to WANs.

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