

ASTRI's R&D Groups

Communications Technologies

The Communications Technologies Group (CTG), themed WM7F (Wireless/Mobile Miniaturized Multi-Mode Multi-Media Multi-Function), aims at addressing key issues in wireless communications, such as ubiquitous radio access, high data rate transmission and reception, and small form-factor for sustaining and disruptive innovations. The Group provides world-class and competitive wireless technologies and IPs (intellectual property) for direct industrial impacts in the Pearl River Delta and Greater China.

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Introduction

CTG has initiated four Key Technology Initiative Groups (KTIGs) — Multimode Multifunction Systems (KTIG1), Low Power High Spectral Efficiency Radio Access (KTIG2), Miniaturization (KTIG3), and Service and Application Enabling Technology Platform (KTIG4). Under this structure, CTG has delivered a wide variety of technology solutions to many local industry players.

During the year, CTG added multiple wireless IC/chip design programmes to support different initiatives. These include the topics of DTMB BB, Multimode Mobile TV, UWB MAC and RF, and CWPAN/Zigbee RF. Responding to market needs, KTIG1 added three new tracks including DTMB Core, ASTRI-Tsinghua Multimedia Broadcast and Communications (MBC) Joint Lab, and Multimode Mobile TV. In KTIG3, RFIC and Antenna Subassemblies were added to expand the scope of wireless system solutions. In KTIG4, Advanced MRI was added to support high value-added medical and healthcare applications.

In this year, CTG filed 24 patents, compared with 28 for the previous two years. Also, six patents were approved, including one which was restricted by the United States Department of Defence for military and national security purpose due to its importance and technology significance. These technical breakthroughs enabled ASTRI and its licensees to receive two important awards during the year: the Best Innovation Award in China National Information Technology Standardization Award 2007; and the Grand Technology Innovation Award of Hong Kong Industry Award 2007. These awards are in addition to the four awards received previously: Gold Awards in Asia Pacific ICT Award 2006 and three Gold Awards in Hong Kong ICT Awards 2006.

On industrial support, it has been a very successful year, with CTG securing industry contribution of HK\$8.49 million — HK\$6.47 million in cash through 23 technology licensing and contract services, and HK\$2.02 million worth of in-kind contribution from nine projects. The total industry contribution to CTG this year accounted for 14 per cent of the total ITF fund expenditure and 12 per cent of the total project expenditure. CTG made great strides in leveraging local and external resources to expedite its R&D pace. In addition to active and close partnership with universities in Hong Kong (HKU, CUHK, HKUST, CityU, PolyU), it established ASTRI-Tsinghua (MBC) Joint Lab in December 2007 to serve local and the Mainland's digital TV market, and to deliver direct industrial impact in terrestrial applications and in mobile TV and Broadband Wireless Multimedia applications.

Together with TVB, ATV, Hong Kong Science and Technology Parks Corporation (HKSTP), and Rohde & Schwarz, CTG founded the Hong Kong Digital Television Test Group (DTTG) in October 2007. With strong support from the BMC Joint Lab, DTTG provided critical and urgently needed DTMB STB voluntary testing in compliance with the Office of the Telecommunications Authority's Basic-tier and Higher-tier DTT receiver requirements. It also intends to support specific features/functions and Greater China's future specifications. Partnering with FHKI, HKEIA, WTIA, and HKPC, it co-founded the Hong Kong WIMAX/DTV Industry Consortium early this year to develop technology, service and products for these two important areas.

Meanwhile, CTG has been actively contributing to and playing significant roles in many important committees under the Hong Kong Government, universities, industry associations in Hong Kong, the Mainland, and worldwide to facilitate information and communication technology industry growth in Hong Kong.

In March 2007, CTG successfully organized the IEEE Wireless Communications and Networking Conference (WCNC), the flagship IEEE Communications Society annual wireless event, to be held in Hong Kong, the first time the event was held outside the U.S.



Measuring the 3D radiation pattern of a phone next to a phantom head

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Developments

To meet industry needs, broadband access and digital broadcast technologies were selected as current major application vehicles for core technology developments. They included Reconfigurable OFDM Core, Practical MIMO Core, RF & Antenna and Material & Miniaturization.

To serve the fast growing broadband wireless market, CTG started with a fixed WiMAX BTS-based technology platform to create valuable core IPs. Currently, CTG is developing a mobile WiMAX BTS design with compact and customizable system partition which can be easily adapted to various application and capacity configurations (macro, micro, pico, femto).

CTG's CWMS is an Element Management System for managing WiFi and WiMAX wireless networks. The System can be flexibly customized to support and manage more than 20 models of WiFi and WiMAX BTS from 10 different vendors. Based on the technology established in-house, CTG is developing a WiMAX ASN-GW platform to handle the mobility requirement in an IP-based mobile WiMAX network.

Since the early 1990s, many Multiple-Input-Multiple-Output (MIMO) "innovations" can be found in patents and dissertations. However, these have not been practical on portable devices. CTG's Practical MIMO programme focuses on approaching this new area in a holistic manner. For example, our MIMO WiFi USB dongle design licensed to a world leading WiFi chipset company in Silicon Valley performs 50 per cent better than the company's own design. On top of the competitive MIMO technology for WiFi, we are now focusing on developing the Practical MIMO design for mobile WiMAX and LTE devices. We will be among the first in the world to deliver TD-LTE devices and chips.

On digital broadcast, the ASTRI-Tsinghua Joint Lab was established to support the Digital Terrestrial Multimedia Broadcast (DTMB), the designated terrestrial digital TV standard in Hong Kong and the Mainland. R&D efforts in the Joint Lab cover technologies in transmission, Single Frequency Network (SFN) Adaptor, field testing instrumentation, testing and verification, receiver chipset and STB reference design. Most of these technologies and products for the DTMB chain were not mature when Hong Kong launched the service at the end of 2007. The Joint Lab has significantly contributed to the deployment of DTMB in Hong Kong by providing receiver testing methodology and software to a leading test equipment provider and HKSTP, broadcast transmission technology to a major local equipment vendor, as well as consultations to broadcasters and the Government.

Multimode wireless terminals have become a major market trend in providing more flexible and cost effective mobile TV handsets. CTG's Multimode Mobile TV baseband demodulator supports multiple standards for different regions: DVB-T/H (Europe), T-DMB (Korea, Europe), and CMMB (China). Compared with a single mode chip, the 3-in-1 chip can be fabricated with only a small increase in size, power consumption and cost. The team is also developing a multimode tuner RFIC and a single chip SoC (system-on-a-chip).

CTG is developing the world's first dual mode CWPAN/ZigBee RFIC Transceiver to support both the Mainland and international standards. With its extremely low power consumption and low cost, CWPAN/ZigBee can find important applications in wireless sensor network, home network, commercial and industry control, building automation and automatic metering.

RF & Antenna is an indispensable ingredient in all wireless devices and is critical to system performance. While an internal antenna has advantages over traditional external antenna due to its multiband design



- 01 Using advanced SAR equipment to measure the radiation absorbed in a brain from a Nokia mobile phone
- 02 UWB MAC Chips
- 03 A demonstration on the design of mobile phone antenna for RTHK

and better performance in practical environment (multi-path), it requires an in-depth design know-how and sophisticated techniques in order to come up with a high performance implementation. Internal antennas can be further categorized as one of the three types/applications: passive, active/reconfigurable, or multiple. We have developed new technologies such as utilizing novel elements of the wireless device as part of the passive antenna; ultra low-power, low-profile switch to re-configure an active antenna with high efficiency and bandwidth without an increase in antenna size; and advanced element isolation methods in MIMO system on small form factor devices across different physical locations.

Material science also plays a key role in miniaturizing communication systems. Thermal management, data storage, and energy storage technologies are crucial to wireless equipment and devices. The efficiency of the innovations in thermal dissipation can reach more than 50 times of traditional methods. The multiple level data storage technology developed will provide a memory device with potentially more than 200GB memory capacity in USB dongle size with a comparable cost of current 1GB flash. Our energy storage technology will reach 2X energy capacity compared to conventional products with high C-rate and low cost.

Currently, CTG is also leveraging the core technologies established in-house to develop high value-added parts in medical and health equipment and devices, including MRI/MRE, and portable non-invasive diagnosis apparatus. CTG will further extend the scope to cover wireless home-health-care applications.

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Achievements

This year, the Group has conducted many industry transfers. The following is a partial list of such transfers: On broadband wireless, the WiMAX base station platform technology was licensed to a locally based multi-national telecom equipment company to establish its technical foundation in broadband wireless edge equipment.

- The CWMS team provides support to a local operator to address the WiFi network performance management issues for the widely publicized Government WiFi programme.
- CWMS technology was licensed to a local telecom company to establish WiFi networks in more than 100 local secondary schools to improve students' information and education environment.
- CWMS technology managing more than 20 models of WiFi and WiMAX BTS was licensed to telecom edge equipment vendors on the Mainland and other parts of Asia.
- CTG established close partnership among two leading companies and ASTRI utilizing CTG's Practical MIMO technology.
- On digital broadcast, the Joint Lab, through collaboration with Hong Kong DTTG and WiMAX/DTV Consortium, effectively supported the Mainland's DTMB commercial service deployment in Hong Kong. The Joint Lab also transferred its DTMB transmission technology to a local telecom equipment vendor to expand its business scope; transferred DTMB receiver test methodology and software solutions to a top test instrument vendor and provided the technology to the HKSTP's Wireless Communication Test Laboratory to facilitate DTMB STB testing service in Hong Kong and Greater China.
- In the area of material and miniaturization, ASTRI's enhanced thermal management technology was licensed to two LED developers and manufacturers for high-power general lighting applications. ASTRI's high-density data storage technology has attracted two customers and initiated close collaborations with industry through the Industry Collaboration Project established in the current fiscal year.



FPGA testing for the development of DTMB Demodulator Chip

Project Highlights

	Project Name	Description	Date
1	Advanced Broadband Wireless Technologies Platform (Full)	This project aims at establishing an OFDM/OFDMA based broadband wireless access technology platform through developing WiMAX base station platform technologies including basic physical layer and medium access control layer.	Jul 06 ~ Dec 07
2	Customizable Element Management System (EMS) for Wireless Networks (Full)	The project targets an Element Management System, which can be rapidly and cost-effectively customized to manage WiFi (802.11 series) and WiMAX (802.16 series) network BTSs.	Jul 06 ~ Dec 07
3	Access Service Network Gateway (ASN-GW) Platform (Seed)	This project explores the most cost-effective design approach of ASN-GW Platform compliant with WiMAX Forum (NWG) standard specifications.	Feb 08 ~ Jul 08
4	T-DMB Digital TV/ Audio Baseband Demodulator (Seed)	As the starting point of establishing a reconfigurable OFDM core for multimode mobile TV device, the project explores the architecture, reusable building blocks, and realization methods for the design.	Nov 07 ~ Apr 08
5	DVB-H Core for Multimode Mobile TV (Seed)	Working with the TDMB project, this project explores the cost-effective methods to facilitate reusability and re-configurability through innovations in architecture, module and interface design.	Nov 07 ~ Apr 08
6	ASTRI-Tsinghua BMC Joint Lab-Foundation Platform Technologies (Full)	The Joint Lab facilitates development of DTMB industry, including service and equipment sectors, in Hong Kong and the Mainland.	Jan 08 ~ Dec 10
7	DTMB Set-Top-Box Reference Design (Seed)	The project aims at implementing the Set-Top-Box (STB) reference design, compliant with the Basic-tier receiver specification in Hong Kong OFTA's Digital Terrestrial Television Specification (HKTA 1108 ISSUE 01).	Sep 07 ~ Mar 08
8	ASTRI-Tsinghua BMC Joint Lab-DTMB SFN Technology Adaptors and Systems (Full)	The project targets developing key technologies in synchronization signal generation, transmitter synchronization, and deployment strategies & methodologies of DTMB single frequency network.	Jan 08 ~ Jan 09
9	OFDM Core for Digital TV Applications (Full)	The project focuses on developing technology in system algorithms and circuit design IPs for the Mainland terrestrial DTV standard DTMB.	Oct 07 ~ Apr 09
10	Advanced Indoor MIMO Platform (Full)	The project develops core technologies of Practical MIMO design, with a holistic approach and integrated with IEEE 802.11g/n WiFi devices.	Dec 06 ~ May 08
11	Wireless PAM and Streaming Media Access Control (Full)	The project aims at developing IPs and technologies of a MAC (Medium Access Control) design solution that is compatible with UWB related standards (WiMedia, IGRS, and DLNA) and interfaces.	Nov 06 ~ Apr 08

Project Highlights

	Project Name	Description	Date
12	RF Design for WPAN Core Technology Platform (Full)	The project develops WiMedia MB-OFDM based UWB RFIC design, IP, and solutions.	Nov 07 ~ May 09
13	Surface Mount RF Switches for Reconfigurable Antennas (Seed)	This project investigates the feasibility of a new type of RF switch, explicitly designed for reconfigurable antenna applications.	May 07 ~ Nov 07
14	Next Generation Antenna Sub-Assemblies (Full)	This project focuses on developing a new intelligent antenna sub-assemblies platform technology which can be applied across: (1) Multi-band/mode & Miniature antenna sub-assemblies for future wireless devices; (2) Beam-forming antenna sub-assemblies at low-cost, while increasing range of the system; (3) MIMO antenna sub-assemblies for high data rate applications.	Feb 08 ~ Jul 09
15	Advanced & Affordable MRI Systems (Seed)	Making use of our RF, antenna, array and signal processing know-how, the project constructs a prototype 0.3T affordable low field MRI system. We are working on the industrial design and specific antenna coil arrays for different parts of the body: wrist, hip, shoulder, head, ankle, knee, foot and hand for greater resolution.	Dec 07 ~ Jun 08
16	Feasibility of Piezoelectric MRE Driver Array (Seed)	This project explores the feasibility of developing a new piezoelectric driver array featuring light weight, small size and user-friendly interface to facilitate early detection of diseases in brain, liver and other portions of the body.	Feb 08 ~ Aug 08
17	Dual-mode CWPAN/ZigBee RFIC Transceiver (Full)	The project aims at developing the world's first dual-mode RFIC transceiver supporting CWPAN (low-rate China wireless personal area network) at 780MHz and ZigBee at 868/915MHz bands.	Jan 08 ~ May 09
18	Recordable Electrical Memory (REME)/Single Address with Multiple Data Storage(SAM) (Seed)	The project investigates methods to develop novel low-cost and ultra-high density recordable memory devices through building multiple storage stages in a single cell.	Apr 07 ~ Jan 08
19	Cost Effective Fabrication for Antenna-and-RF Module (Seed)	The project explores the feasibility of developing a mass producible plating technology to produce conductive metal layer onto the affordable substrates followed by the thin film photo-patterning technique to fabricate Antenna-and-RF components / modules cost-effectively.	May 07 ~ Oct 07
20	Thermal Energy Management with Advanced Materials and Structures (Full)	This project develops a method dealing with the heat dissipation hurdle, a problem that current and future wireless communication equipment and devices are facing.	Dec 07 ~ Aug 09