Institute for Infocomm Research
for the
Telecommunications Industry
The Institute for Infocomm Research (I²R) integrates R&D in communications and information technology to develop holistic solutions across the ICT value chain. The Institute’s research capabilities are in wireless and optical communications, and information technology and science. We seek to enable technologies and processes that will drive new and enhanced services for Singapore’s knowledge-based economy.

Technology Capabilities

I²R’s technology capabilities for the telecom sector encompasses:

**Radio Systems Technology**
- Small, low-profile antennas
- Broadband antennas
- Low power, low cost radio transceivers for WLAN and RFID
- Radio-over-fibre technology
- Ultra Wide Band localization techniques

**Networking Technology**
- Protocols and Algorithms for Mobile adhoc sensor network technology
- Next-generation IP, end-to-end QoS, mobile ad-hoc networks

**Digital Wireless Technology**
- Modem technology
- Smart Antenna systems.
- UWB data communications

**Embedded Systems Technology**
- Multimode Radio (3G, Beyond 3G)
- Software Defined Radio.

**Lightwave Technology**
- Fibre-based components
- Wavelength Division Multiplexing systems
- Optical network design for optical access network.

**Media Technologies**
- Advanced Video and Audio Coding techniques
- Audio Noise Reduction
- Speech Processing
Multimode 3G Terminal Design

With changes in the 3G market where several modes were competing for market acceptance and for 3G-spectrum allocation, there is a growing requirement for multiple mode FDD/TDD/GPRS systems on silicon capability, which can be utilized in families of terminals for diverse markets. This design emphasis on the new TD-SCDMA mode indigenous to China, which has been accepted by the ITU-T as the prime candidate for the low chip rate version of TDD (Time Division Duplex) mode operation worldwide. This niche competency was developed with an industry partner as it addressed regional demands and standards. The TD-SCDMA mode allows for simultaneous two-way communication between base station and mobile terminal on the same frequency, utilizing time-division multiple access methods. It is potentially cheaper than FDD modes, in which the duplex communication requires different radio frequencies for the uplink and downlink, but guarantees higher performance.

High-data-rate wireless local area network (WLAN) radio transceiver system

The I2R 5 GHz radio transceiver system will employ state-of-the-art direct conversion architecture that reduces power and eliminates off-chip components such as filters. Jointly developed with our partners, this technology will enable significant CMOS (Complementary Metal-Oxide Semiconductor) logic integration, with high performance SiGe HBT (Hetero-junction Bipolar Transistors) devices. The SiGe technology has been adopted for many leading-edge WLAN solutions as it provides increased integration capabilities, enabling designers to reduce the size and cost of electronics products.

High Data Rate Broadband Global Area Network Terminal

I2R assisted an industry partner in the design of a low-cost Broadband Global Area Network receiver with voice and data capabilities. This design supports transmission data rates that are 2 times better than current solutions in the market. Advanced I2R modem technologies have been used in order to fulfill the stringent performance requirements for mobile applications.

Broadband Packet Wireless Access System

Today’s mobile communication systems are primarily designed to provide cost efficient wide area coverage but rather moderate bandwidth (voice + low rate data) to a limited user capacity. Following the expansion of internet and innovative multimedia services, tomorrow’s consumers will expect to receive same telecommunication service in a wireless fashion as it is from a fixed network - higher bandwidths, mobility, service quality all at a lower cost. Through a joint project with a Telcom partner, we developed a broadband packet wireless access system that can accommodate as many user with different QoS and data rate requirement, up to 1Gbps under isolated hot-spot environment. This is achieved through the use of advanced smart antenna & MIMO algorithms, novel multiple access schemes for IP-based mobile multimedia packet data transmission, to improve power / bandwidth efficiency and system throughput.
**Advanced Video Coding (AVC)**
AVC give broadcasters compression efficiency gains over today’s optimized MPEG-2 bit rates, and is an integrated part of the MPEG-4 system. This allows users to increase the quality and quantity of video services and make more use of their bandwidth to get more revenue-spinning services on the air. I²R’s novel fast mode decision algorithm for intra prediction reduces the implementation complexity and increases the coding speed by 2 times. The technology is adopted by the H.264 standard as a recommendation for Telecom and Broadcast industry.

**Lossless bit-rate scalable audio compression**
Lossy compression techniques eliminate audio information in order to achieve compression ratios of up to 20 times. They preserve the essence of the sound but do not restore the precise bits; thus the higher the compression, the lower the sound quality. Lossless techniques restore, after compression, every bit of the original audio data. Nothing is lost or distorted. However, it achieves only limited compression ratios of between 1.5 and 3.0. I²R’s Advanced Audio Zip technology merge the benefits of these two isolated, incompatible compression formats. It allows users to vary the quality of digital sound by compressing the sound signal by 1.5-40 times, depending on the core. The core is Advanced Audio Coding (AAC), or MPEG4 Audio codec, in which AAZ is backward-compatible. In addition, its finegranular- scalability (FGS) feature enables the bit-rate of the AAZ bit-stream to be scaled easily from lossless to high-compression lossy in very small step size (<0.4kbps). This feature is extremely useful for applications of varying quality of service requirements, for example, an audio-streaming application with time-varying channel conditions. AAZ technology was submitted and evaluated by independent testing determined by MPEG. Under scalable lossless coding evaluation, the AAZ system had the best performance in terms of the mean lossless compression ratio for all word length and all sampling rates for all sequences in the test set.

**Semiconductor Optical Amplifier (SOA) based on WDM transmission**
The demonstration of our 8x10 Gb/s transmission on single mode fibre over a distance of 1050km without regeneration, was a significant improvement over the previous international record which achieved 4x10Gb/s transmission over a distance of 500km by using a wavelength modulation technique. Our record was achieved by using differential phase-shift keying modulation, which greatly reduced impairments due to cross-gain modulation.

**Equipment and Facilities**
By working with I²R, telcom industry partners have access to its state of the art equipment and facilities which include Antenna Measurement Chamber and Specific Absorption Rate (SAR) investigations for Mobile Phones.

**Partners in Success**
STMicroelectronics
IBM
NTT DoCoMo
Siemens
Ericsson
Panasonic Labs
Sony

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