

Mobile Communications (1)

Class Overview

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Wireless LAN

	802.11	802.11b	802.11a	802.11g	802.11n
year	1997	1999	1999	2003	2009
frequency	2.4GHz	2.4GHz	5GHz	2.4GHz	2.4GHz & 5GHz
bitrate	1 – 2 Mbps	1 – 11 Mbps	6 – 54 Mbps	1 – 54 Mbps	1 – 600 Mbps
multiple access, and modulation	DSSS, FH, IrDA	DSSS, CCK	OFDM	DSSS, CCK, OFDM	DSSS, CCK, OFDM, MIMO

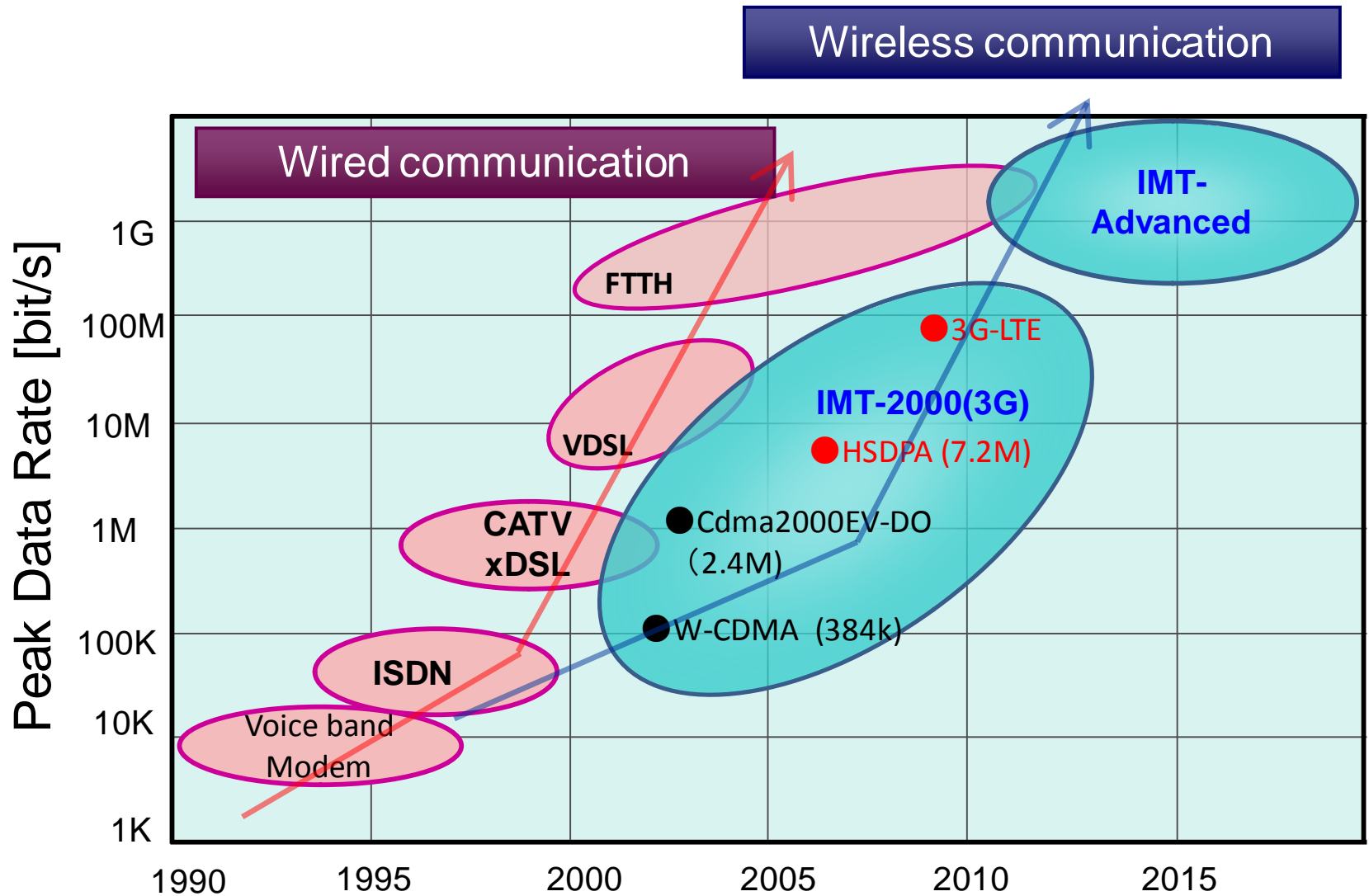
Wireless PAN/BAN

	802.15.1	802.15.3a	802.15.4a	802.15.4	802.15.6
name	Bluetooth	UWB	UWB	ZigBee	BAN
year	1999	--	2007	2003	2012?
frequency	2.4GHz	3.1 – 10.6GHz	2.4GHz	2.4GHz 868MHz 915MHz	400MHz 2.4GHz
bitrate	720kbps- 24Mbps	480Mbps	1Mbps	20-250 kbps	~10Mbps
multiple access, and modulation	FH GFSK	OFDM or DSSS	DSSS BPSK	DSSS BPSK/QPS K	?
distance	1-100m	4-10m	10m	10-75m	3m
power	1-100mW	< 100mW	1mW	< 60mW	< 1mW?

Cellular

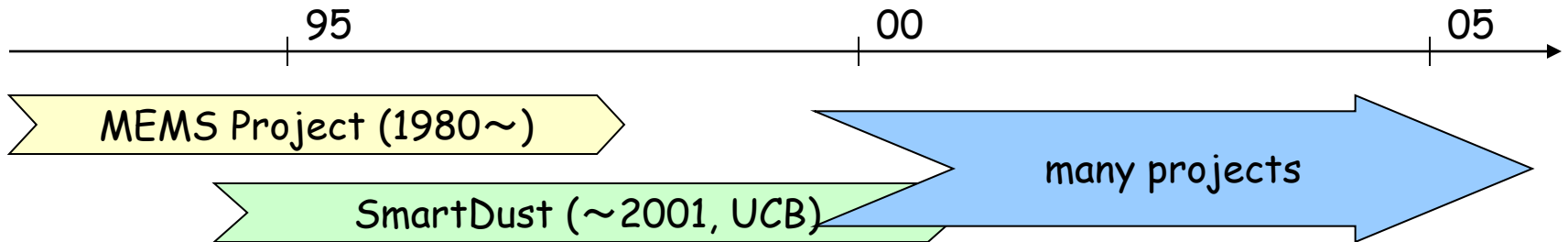
generation	name	frequency	multiple access	modulation	bitrate (downlink)	speech codec
2G	PDC	800MHz / 1.5GHz	FDD-TDMA	$\pi/4$ -DQPSK	9.6 - 28.8 kbps	ACELP, PSI-CELP
	cdmaOne	800MHz	FDD-CDMA	$\pi/4$ -DQPSK	14.4 - 64 kbps	EVRC
	GSM	--	FDD-TDMA	GMSK	9.6 - 171.2 kbps	ACELP
	PHS	1.9GHz	TDD-TDMA	$\pi/4$ -DQPSK	32-256 kbps	ADPCM
3G (IMT-2000)	W-CDMA	800MHz / 1.7GHz / 2GHz	FDD-CDMA	$\pi/4$ -DQPSK	384kbps	AMR
	CDMA2000	800MHz / 2GHz	FDD-CDMA	$\pi/4$ -DQPSK	144kbps	EVRC
3.5G	HSPA	1.7GHz	(W-CDMA)	QPSK~16QAM	1.22 -14 Mbps	--
	EV-DO	800MHz / 2GHz	(CDMA2000)	QPSK~16QAM	2.4 -3.1 Mbps	--
3.9G (Super3G)	LTE	800MHz / 1.5GHz / 2GHz	OFDMA/SD-FDMA/MIMO	QPSK~64QAM	100 - 326.4 Mbps	--
4G (IMT-Advanced)	LTE-Advanced	3.4~3.6GHz	?	?	~1Gbps	--

IMT-Advanced (4G)



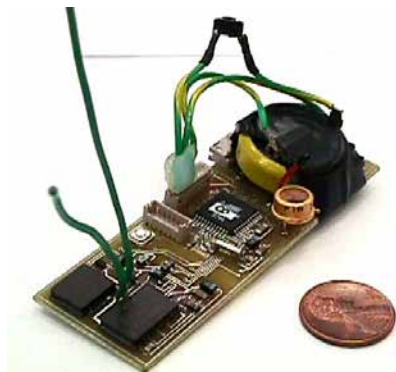
Sensor Networks

- history



Sensor(s) + MPU(s) + Networking → On-board → On-chip

RF Mote



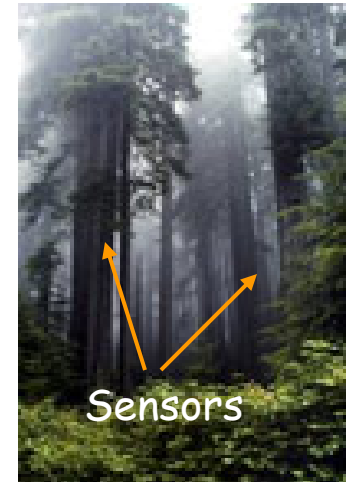
- Prototype ▲ COTS Dust, Tiny OS
- Companies ▲ Crossbow, Dust, Ember, Senticast, ...
- Conferences ▲ IEEE Sensors, ACM SenSys, ...
- Standards ▲ IEEE 802.15.4 (ZigBee)

a slide five years ago

Sensor Networks

- (1) factory
 - (2) maintenance
 - (3) military, national security
 - (4) automation
 - (5) environment monitoring
 - (6) ubiquitous
-
- (7) smart phone

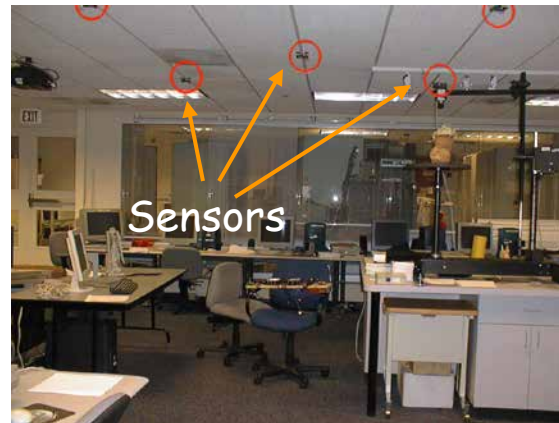
monitoring (UCB)



tracking (UCB)



smart room (MIT)



robot (USC)



Smart Phone



- Communication
 - 3G/LTE, WiFi, Bluetooth, WiMAX, ...
- Audio and Visual
 - microphone, speaker, camera, display, ...
- Sensors
 - accelerometer, gyroscope, magnetic, proximity, light, temperature, ...

Android APIs

android.hardware.Sensor

Summary		
Constants		
int	TYPE_ACCELEROMETER	A constant describing an accelerometer sensor type.
int	TYPE_ALL	A constant describing all sensor types.
int	TYPE_AMBIENT_TEMPERATURE	A constant describing an ambient temperature sensor type
int	TYPE_GRAVITY	A constant describing a gravity sensor type.
int	TYPE_GYROSCOPE	A constant describing a gyroscope sensor type
int	TYPE_LIGHT	A constant describing a light sensor type.
int	TYPE_LINEAR_ACCELERATION	A constant describing a linear acceleration sensor type.
int	TYPE_MAGNETIC_FIELD	A constant describing a magnetic field sensor type.
int	TYPE_ORIENTATION	<i>This constant was deprecated in API level 8. use SensorManager.getOrientation() instead.</i>
int	TYPE_PRESSURE	A constant describing a pressure sensor type
int	TYPE_PROXIMITY	A constant describing a proximity sensor type.
int	TYPE_RELATIVE_HUMIDITY	A constant describing a relative humidity sensor type.
int	TYPE_ROTATION_VECTOR	A constant describing a rotation vector sensor type.
int	TYPE_TEMPERATURE	<i>This constant was deprecated in API level 14. use Sensor.TYPE_AMBIENT_TEMPERATURE instead.</i>

This Year's Schedule

(tentative)

4/12	Class overview
4/19	Self-study (CourseN@vi) Android SDK
4/26	Chap 4: Radio Communication Basics (1)
5/10	Self-study (CourseN@vi) Android Programming (1)
5/17	Chap 4: Radio Communication Basics (2)
5/24	Chap 6: Wireless LAN Standards
5/31	Chap 7: Implementing Wireless LANs
6/07	Chap 8: Wireless LAN Security
6/14	Android Programming (2)
6/21	Chap 10: Wireless PAN Standards
6/28	Chap 12: Wireless MAN Standards
7/05	Chap 14: Leading Edge Wireless Networking Technologies
7/12	TBD
7/19	TBD
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3G/LTE
Sensors

Preparation

- Tools
 - Android SDK
 - Android Phone / Tablet