

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

802/11ac

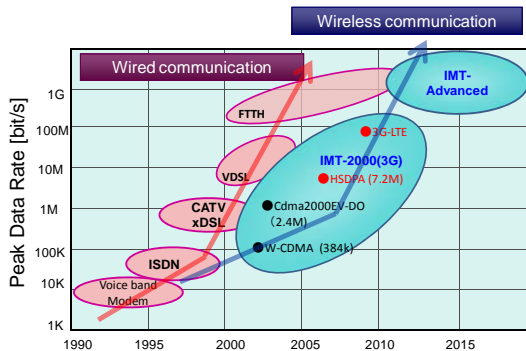
Wireless PAN/BAN

	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	$\pi/4$ -DPSK	9.6 - 28.8 kbps	ACELP, PSI-CELP
	cdmaOne	800MHz	FDD-CDMA	$\pi/4$ -DPSK	14.4 - 64 kbps	EVRC
	GSM	--	FDD-TDMA	GMSK	9.6 - 171.2 kbps	ACELP
	PHS	1.9GHz	TDD-TDMA	$\pi/4$ -DPSK	32-256 kbps	ADPCM
3G (IMT-2000)	W-CDMA	800MHz / 1.7GHz / 2GHz	FDD-CDMA	$\pi/4$ -DPSK	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	--

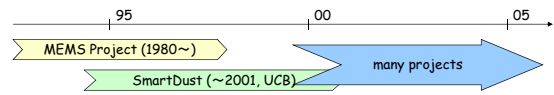
IMT-Advanced (4G)



Sensor Networks

a slide five years ago

• history



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



- Prototype: Δ COTS Dust, Tiny OS
- Companies: Δ Crossbow, Dust, Ember, Senticast, ...
- Conferences: Δ IEEE Sensors, ACM SenSys, ...
- Standards: Δ 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


tracking (UCB)




smart room (MIT)



robot (USC)




monitoring (UCB)



now

Smart Phone

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



smart phone is sensor network

now

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	This constant was deprecated in API level 2. Use <code>Sensor.TYPE_ORIENTATION2</code> instead.
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	This constant was deprecated in API level 14. Use <code>Sensor.TYPE_AMBIENT_TEMPERATURE</code> instead.

http://developer.android.com/reference/android/hardware/package-summary.html

This Year's Schedule

		(tentative)
4/11	Class overview	
4/18	Chap 4: Radio Communication Basics (1)	
4/25	Chap 4: Radio Communication Basics (2)	
5/09	Chap 6: Wireless LAN Standards	
5/16	Self-study	
5/23	Chap 7: Implementing Wireless LANs	
5/30	Self-study	
6/06	Chap 8: Wireless LAN Security	
6/13	Chap 10: Wireless PAN Standards	
6/20	Chap 12: Wireless MAN Standards	
7/27	Chap 14: Leading Edge Wireless Networking Technologies	
7/04	TBD	
7/11	Self-study ?	
7/18	TBD	
---	Examination	

3G/LTE
Sensors

Preparation

- Tools
 - Android SDK
 - Android Phone / Tablet