Mobile Middleware Course

Introduction and Overview

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Contents

- Course outline
- Motivation
- Mobile middleware overview

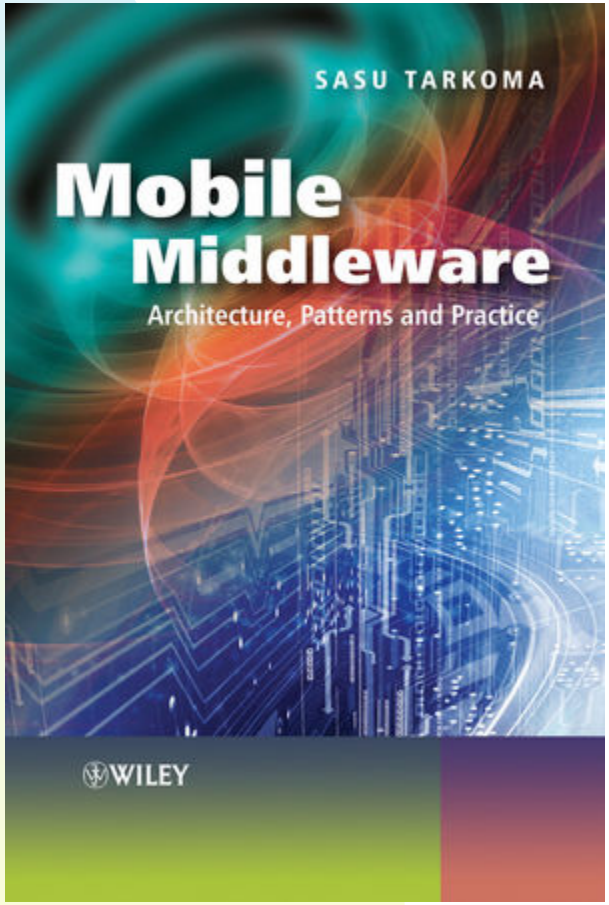
Course Overview

- 4 credit course
- Three components
  - Lectures
  - Assignment
  - Literature (three papers and course book)
- Grading based on
  - Exam (60%)
  - Assignment (40%)

Timetable

- 13.3. Introduction and assignments.
- 20.3. Platforms, Middleware
- Assignment slot 1: Simple video player
- 27.3. Assignment slot 2: Video transmitter
- 3.4. easter
- 10.4. Patterns
- Assignment slot 3: Video server (video list/selection)
- 17.4. Applications: Carat
- 24.4. Applications and Summary
- 8.5. Assignment slot 4: Mixing table (video mixer)
- Final submission in May
- Exam 14.5. 16:00 in T1

Course Book



- Mobile Middleware – Architecture, Patterns, and Practice published by Wiley
  - Publication date 27.3.2009
  - Available in digital form
- Several papers to read

Included chapters

- Chapter 1: Introduction
- Chapter 2: Architectures (note 2.6 described old systems)
- Chapter 3: 3.1-3.3, 3.6
- Chapter 4: Principles and Patterns
- Chapter 8: Data Synchronization
- Chapter 10: Application and Service Case Studies

Additional reading

- Mobile platforms survey, 2011.
- Carat: Collaborative Energy Diagnosis for Mobile Devices. UCB Tech report, March 2013.
- Analyzing Inter-Application Communication in Android. Mobisys 2011.
- K. Kumar and Y-H. Lu. Cloud computing for Mobile Users: Can Offloading Computation Save Energy? IEEE Computer, 2011.

Exercises

Introduction to Mobile Middleware

Motivation

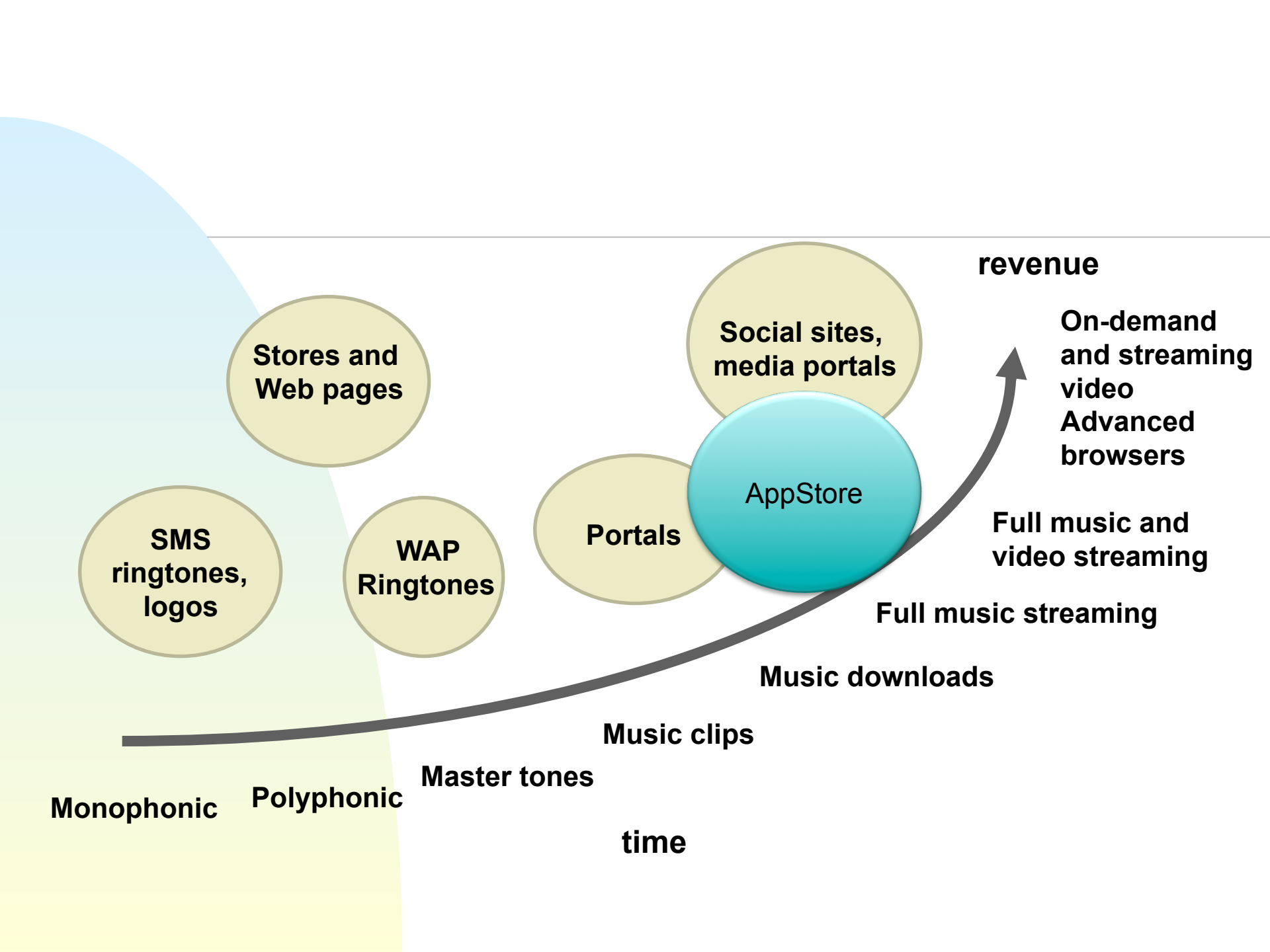
- Mobile computing has become one of the breakthrough technologies of today
  - Over 4 billion mobile phones in use
  - Tens of billions of downloads from Apple Appstore
  - Current trend is converged communications
  - Web resources integrate seamlessly with mobile systems
  - Mobile systems are increasingly dependent on software
- We give an overview of mobile middleware technology

Mobile software

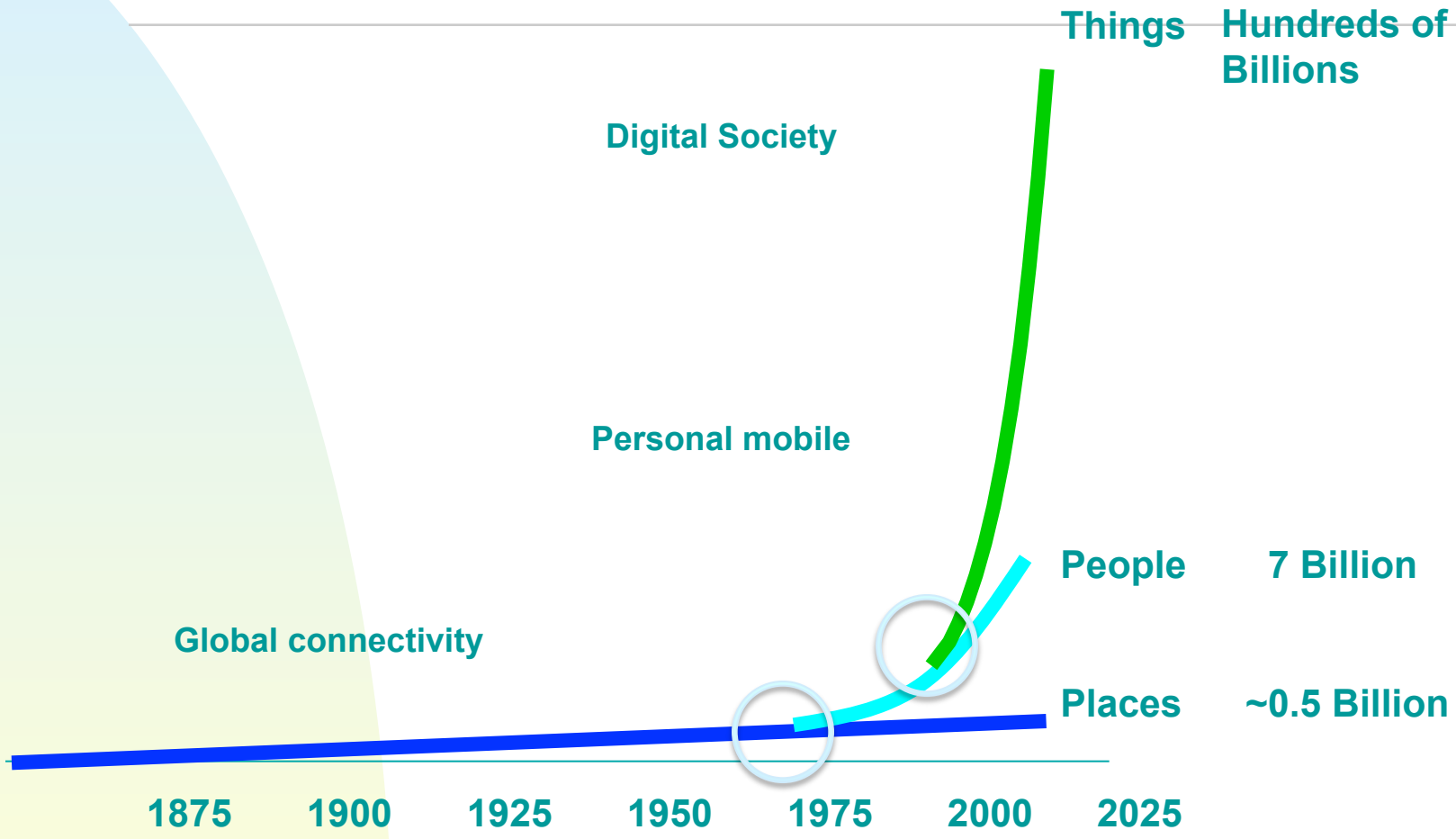
- Mobile software is a growing area
  - Development processes, tools, APIs are crucial for the ecosystem
  - Integration with Web resources
- Key applications
  - Voice
  - Multimedia
  - Messaging
  - Web sites, mashups, services
  - Location-based services
- Forthcoming features
  - Context-awareness, adaptability, smart spaces
  - Internet of Things

Mobile Evolution

- 1st generation (1990-1999)
  - Text messages (SMS) and mobile data. Speeds up to tens of Kbps.
- 2nd generation (1999-2003)
  - Limited browsers, WAP, iMode, and MMS. Speeds up to 144Kbps.
- 3rd generation (2003-2008)
  - Mobile platforms, middleware services. Series 60, J2ME, Android, iPhone. Speeds up to several Mbps.
- 4th generation (2008-)
  - Adaptive services, user interfaces, and protocols. Context-awareness, always-on connectivity. Speeds up to hundreds of Mbps.
  - Emergence of app stores.
  - Versatile devices: smartphones, pads.
  - Cloud-assisted applications with social networks.

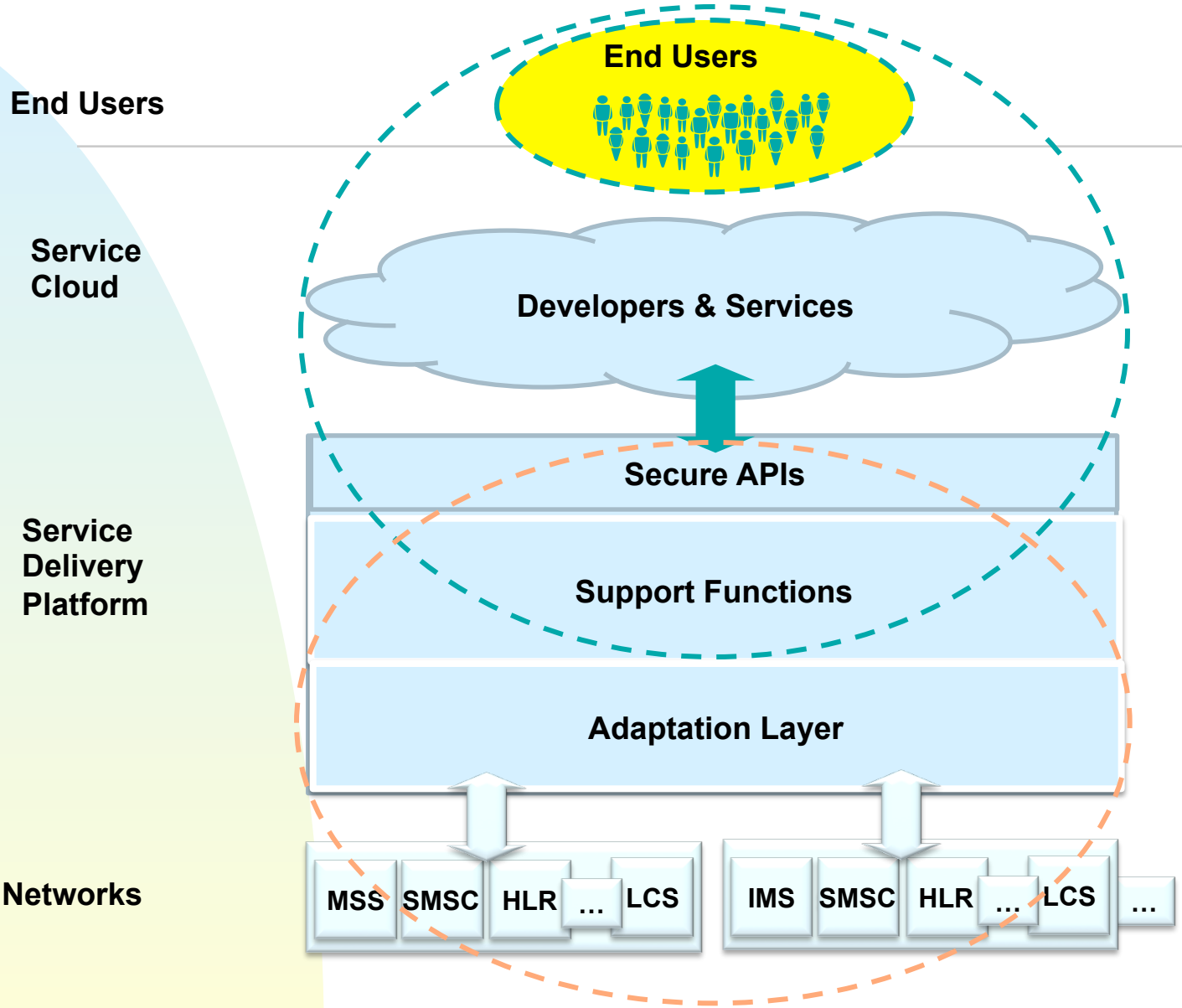

revenue
Social sites, media portals
On-demand and streaming video
Advanced browsers
Stores and Web pages
AppStore
Portals
Full music and video streaming
SMS ringtones, logos
WAP Ringtones
Full music streaming
Music downloads
Music clips
Master tones
Monophonic
Polyphonic
time

Toward Internet of Things



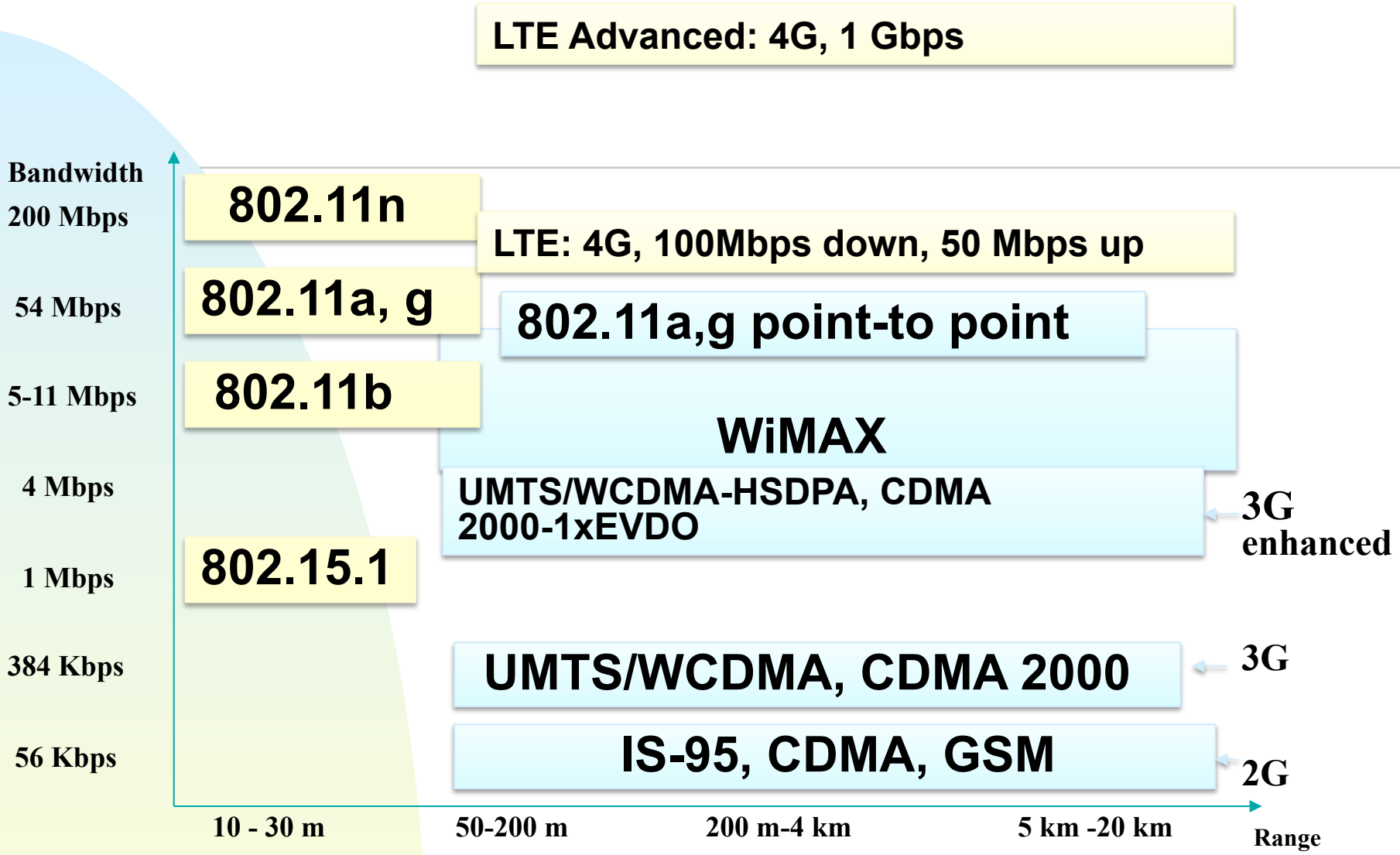
Example IoT products and services

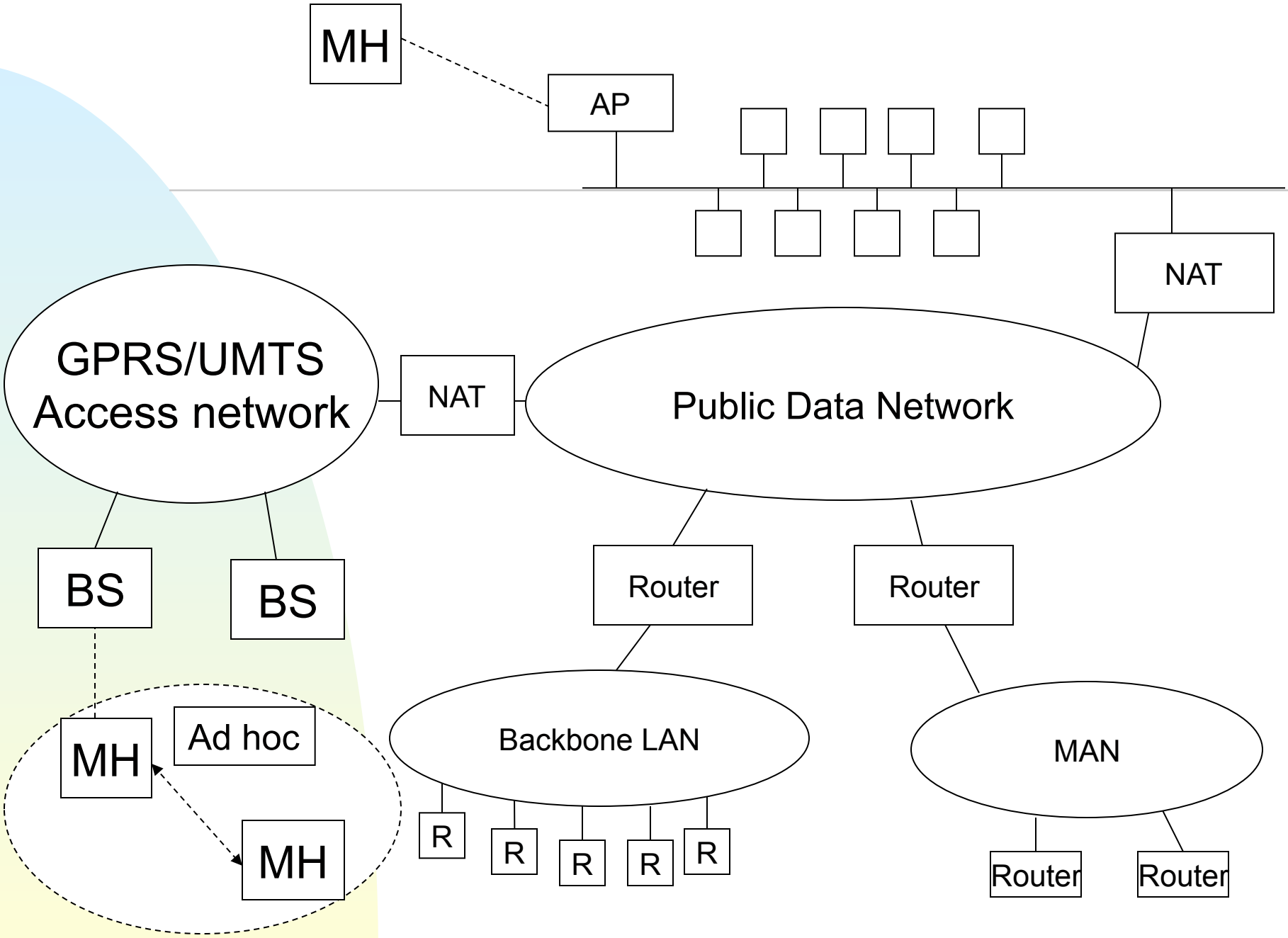
- M2M traffic solutions (security, healthcare, energy, …)
- Cosm (Pachube) Web service for connecting sensor data
  - www.cosm.com
- There gateway for home automation and monitoring
  - http://therecorporation.com/fi
- Rymble By Symplio
  - http://www.rymble.com/
- NEST learning thermostat
- Withings products
  - http://www.withings.com/en/bodyscale
- Karotz By Aldebaran Robotics
  - http://www.karotz.com/home
- Green Goose
  - http://greengoose.com/
- Google Q
- And many emerging products based on 802.15.4, WiFi, RFID and NFC, and the power of the cloud

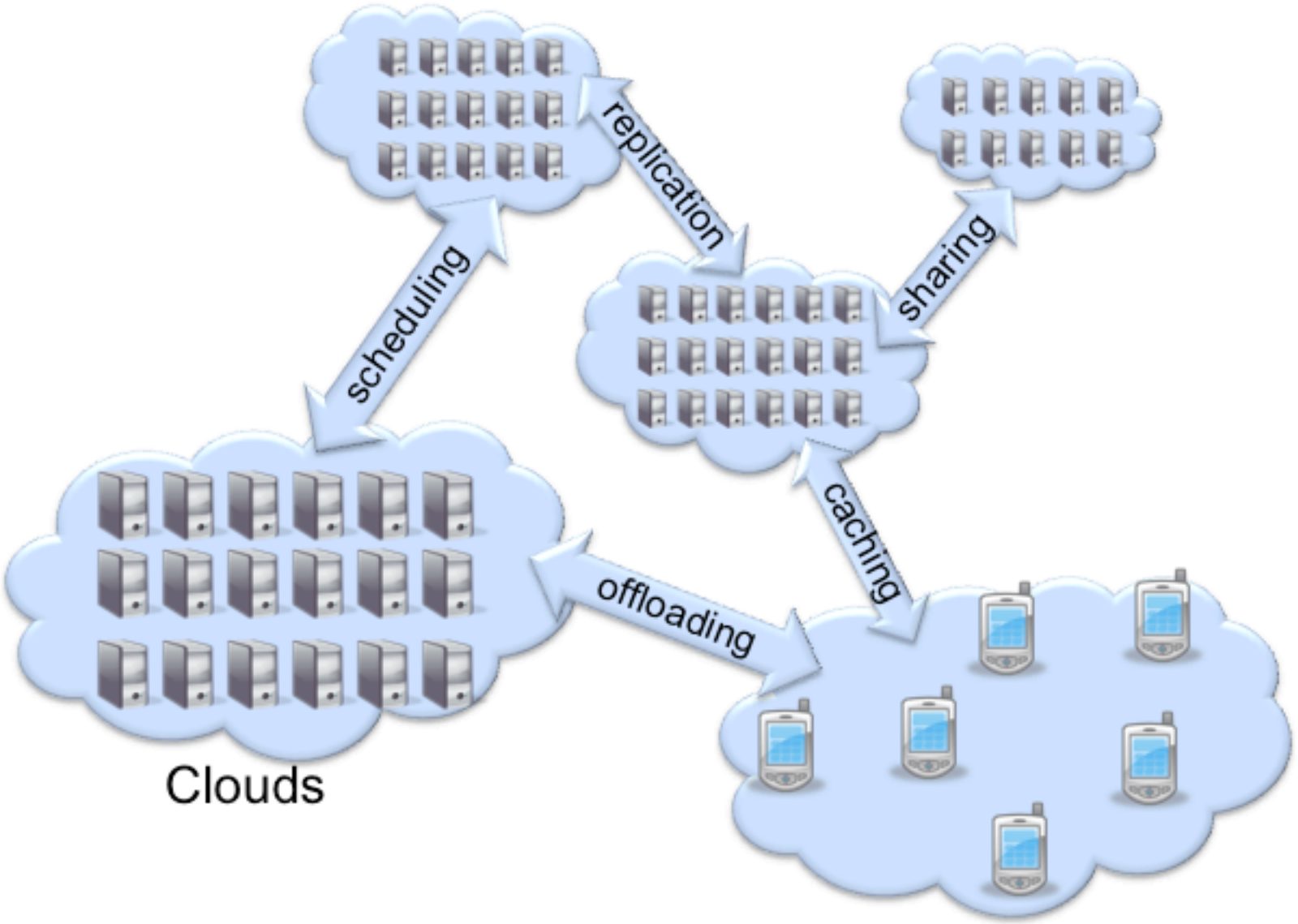

End Users
End Users
Service Cloud
Developers & Services
Secure APIs
Service Delivery Platform
Support Functions
Adaptation Layer
Networks
MSS
SMSC
HLR
...
LCS
IMS
SMSC
HLR
...
LCS
...

Wireless Technologies

- Global System for Mobile (GSM),
- General Packet Radio Service (GPRS)
- Universal Mobile Telecommunications System (UMTS)
- Long Term Evolution (LTE)
- Wireless LAN (WLAN)
- Worldwide Interoperability for Microwave Access (WiMax)
- Ultra-wideband (UWB)
- Wireless Personal Area Network (WPAN)
- Bluetooth, Wibree
- RFID


LTE Advanced: 4G, 1 Gbps
Bandwidth
200 Mbps
802.11n
LTE: 4G, 100Mbps down, 50 Mbps up
54 Mbps
802.11a, g
802.11a,g point-to point
5-11 Mbps
802.11b
WiMAX
4 Mbps
UMTS/WCDMA-HSDPA, CDMA 2000-1xEVDO
3G enhanced
1 Mbps
802.15.1
384 Kbps
UMTS/WCDMA, CDMA 2000
3G
56 Kbps
IS-95, CDMA, GSM
2G
10 - 30 m
50-200 m
200 m-4 km
5 km -20 km
Range


MH
AP
NAT
GPRS/UMTS
Access network
NAT
Public Data Network
BS
BS
Router
Router
Ad hoc
MH
MH
Backbone LAN
MAN
R
R
R
R
R
Router
Router


replication
scheduling
sharing
caching
offloading
Clouds

Current state of the art

- Communications
  - WiFi and LTE for mobile data
  - WiFi and Bluetooth for local communications (also NFC)
- Applications
  - More APIs available, cloud integration
  - Fragmentation and control challenges
- Cloud-based APIs, storage, control functions
  - Cloud offerings from operators and manufacturers
  - Cloud in the access network
- Mobile traffic
  - Machine-to-machine as a new component in mobile traffic
  - Increasing video component

Views to Mobile Software

- Distributed
  - Device
  - Device neighbourhood
  - Web and the Cloud
- Current topics
  - Sensing (pollution, health, medical, …)
  - Offloading and partitioning
  - Energy consumption
  - Indoor positioning
  - Cloud integration
  - Software defined networking (SDN)
  - Wireless video
  - …

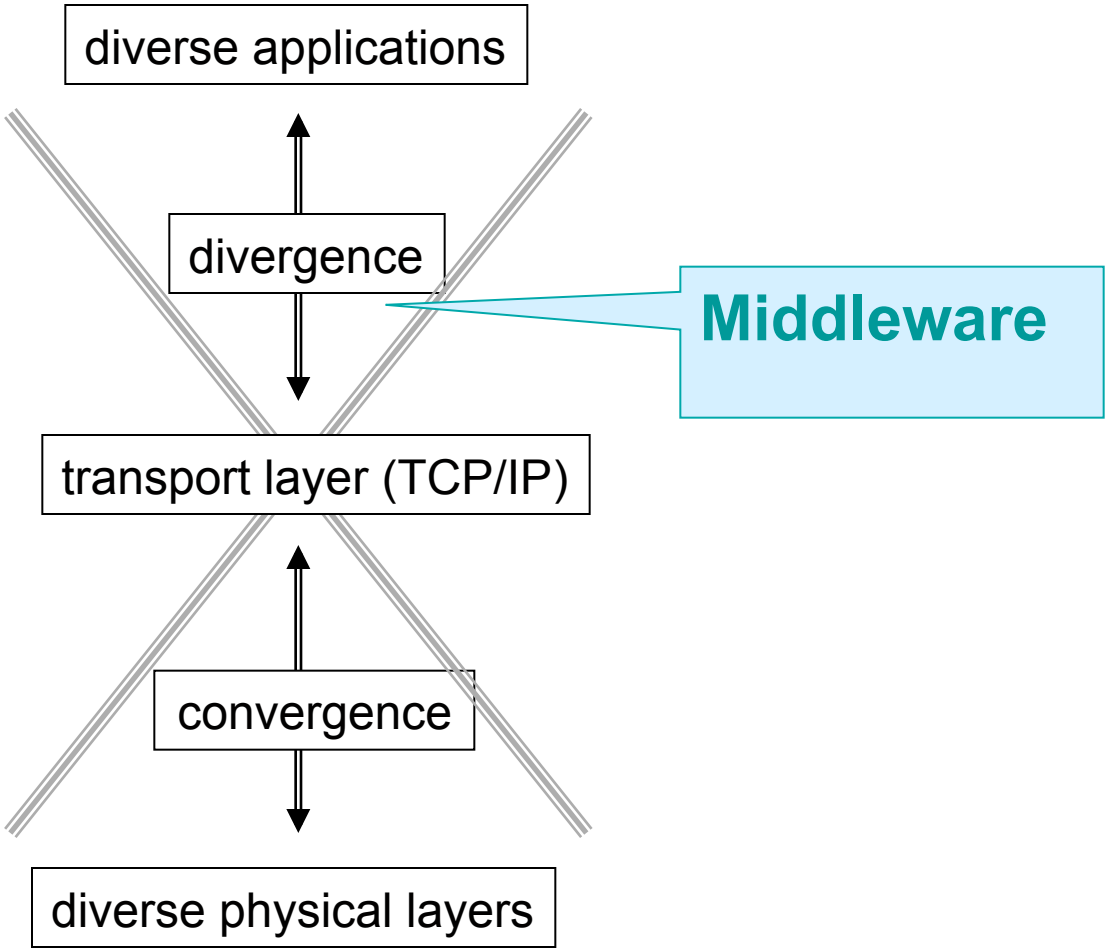
Mobility in the Internet

- This topic pertains to mobility of
  - Networks
  - Hosts
  - Transport connections
  - Sessions
  - Objects (passive, active)
  - Services
  - Users
- Many solutions are needed on multiple layers
  - Link layer, network, transport, application

Role of Software and Algorithms

- Software has an increasingly important role in mobile devices
  - Increase in device capabilities
  - Interaction with sensors and other devices
  - Integration with the Web and cloud
- Applications and services
  - Development processes
  - Testing of mobile sw
  - Deployment and management

The Hourglass



Middleware

- Widely used and popular term
- Fuzzy term
- One definition
  - “A set of service elements above the operating system and the communications stack”
- Second definition
  - “Software that provides a programming model above the basic building blocks of processes and message passing” (Colouris, Dollimore, Kindberg, 2001)

Why Middleware?

- Application development is complex and time-consuming
  - Should every developer code their own protocols for directories, transactions, ..?
  - How to cope with heterogeneous environments?
    - Networks, operating systems, hardware, programming languages
- Middleware is needed
  - To cut down development time
    - Rapid application development
  - Simplify the development of applications
  - Support heterogeneous environments and mask differences in OS/languages/hardware

Middleware cont.

- Middleware services include
  - directory, trading, brokering
  - remote invocation (RPC) facilities
  - transactions
  - persistent repositories
  - location and failure transparency
  - messaging and events
  - Security
  - synchronization
- Network stack (transport and below) is not part of middleware

Mobile Platforms

- Collections of central services and libraries with both reactive and proactive functions
- APIs typically logically centralized
- Distributed between elements of the environment
  - Multi-tier client-server
  - Peer-to-peer
  - Hybrids
- The platform running on the mobile terminal and the characteristics of the device determine how service is rendered for the end user

Platforms

- 2009
  - Java Micro Edition (Java ME)
  - iOS
  - Symbian and Series 60
  - Windows Mobile
  - Linux Maemo (MeeGo)
  - Android
  - BREW
  - WAP
- 2012
  - iOS
  - Android
  - Windows Phone 7 and 8
  - HTML5 web apps

Next

- Platforms, middleware, protocols
- Principles and Patterns
- Examples