# Mobile Computing Architecture

UW Bothell, WA

Lecture 1: Introduction

# How are you feeling today?

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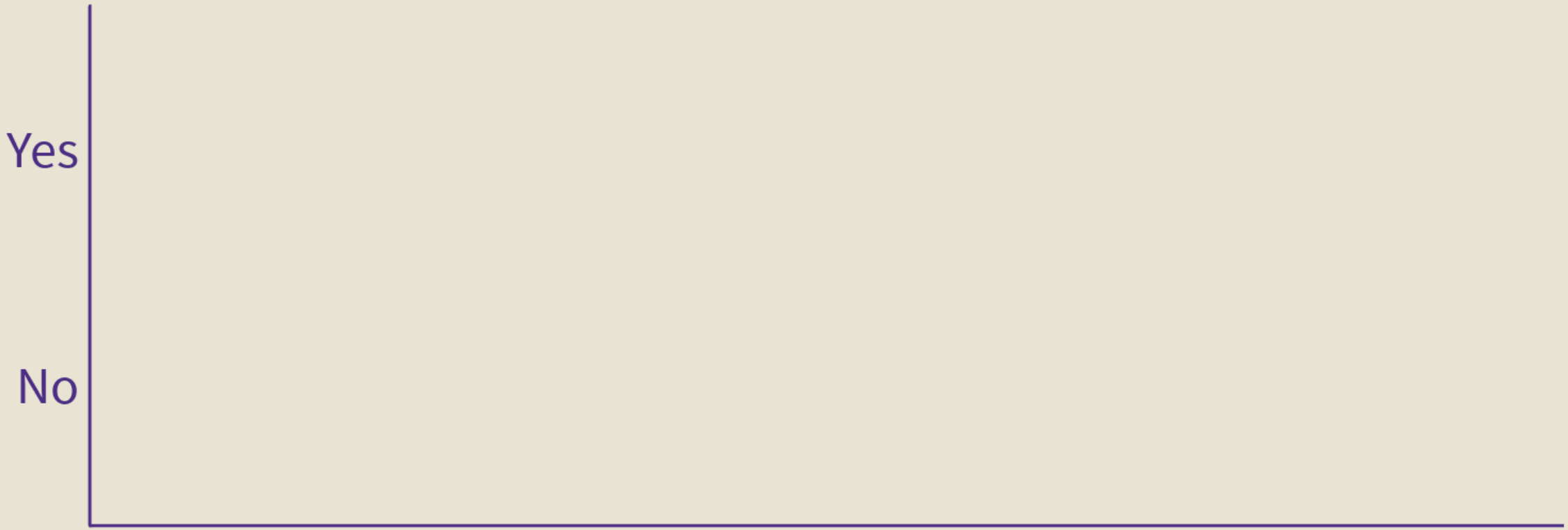
## Let's get to know each other [30seconds intro]

- Name
- Some fun fact about yourself
- Do you work, and where?

# Are you full time employed at the moment?

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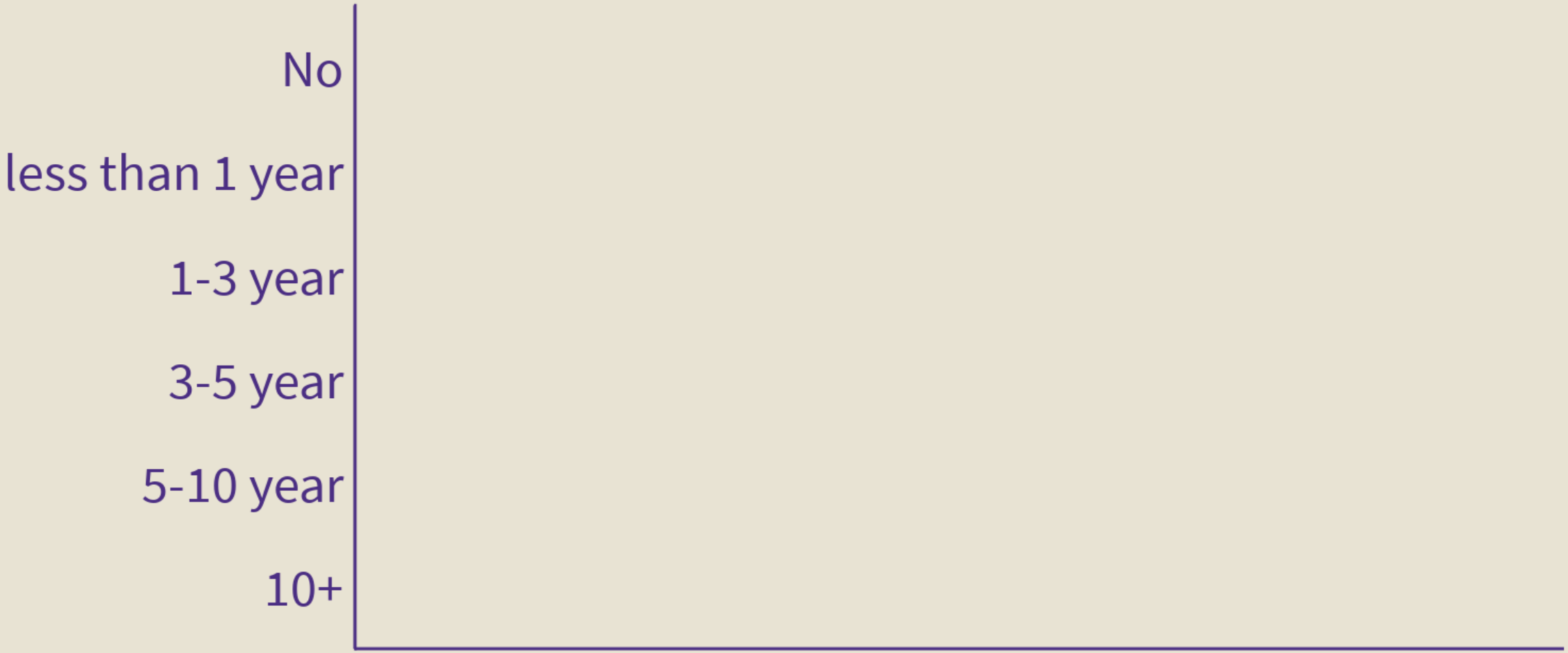
# Have you developed software? Experience in number of years

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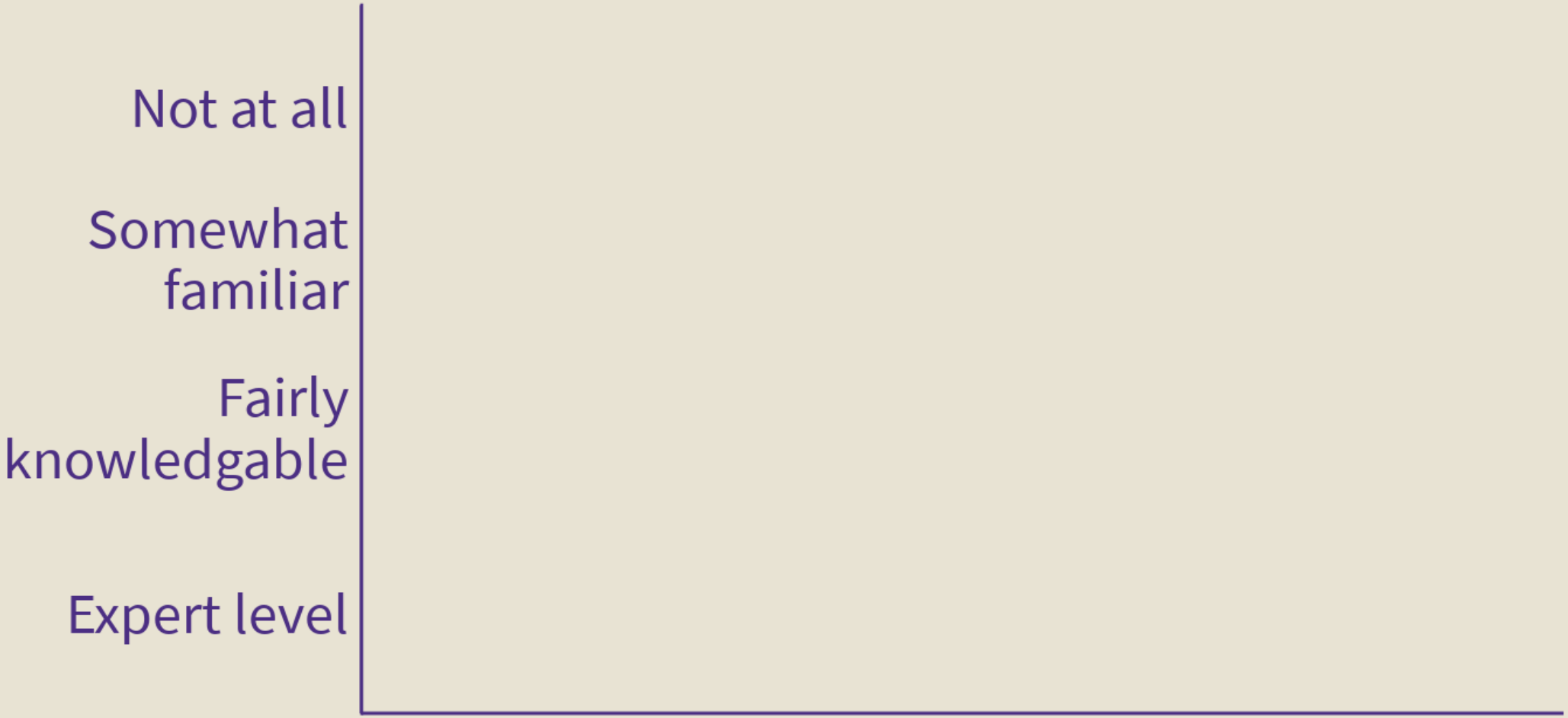
# How familiar are you with mobile computing?

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# Mobile Computing Architecture

## Course Description

Mobile networking enabled Internet-On-The-Go for social networking and over-the-top (OTT) audio and video applications with 3G and 4G technologies. The latest 5G technology combines cloud computing with mobile networking. 5G is designed to enable latency-centric applications like AR/VR, Critical IoT etc. over mobile devices. This course digs into the fundamental of Mobile Computing Architecture. Topics such as an overview of mobile computing stacks and standards; mobile devices hardware/software; Mobile Edge Computing (MEC); Software Defined Networking (SDN), etc. will be discussed. An introduction to how Network Functions Virtualization (NFV) and Software Defined Network (SDN) reduce the cost and time for mobile services operators. We will also deep-dive into both the non-Realtime and Realtime applications specially in the context of MEC. There will be a hands-on project to build a mobile software application

1. Introduction
2. Networking Basics
3. Evolution to 5G
4. 5G Networks Architecture
5. Mobile Network Protocol Stack – Control Plane
6. Mobile Network Protocol Stack – User Plane
7. Radio Spectrum and Cellular Architecture
8. MIDTERM 1
9. Software Defined Networking (SDN)
10. Network Functions Virtualization (NFV)
11. Mobile Edge Computing (MEC)
12. Mobile Devices Hardware and Software
13. Augmented Reality (AR over 5G)
14. MIDTERM 2
15. Voice Application (VoIP over 5G)
16. Over The Top Video (OTT Video)
17. Internet of Things (IoT over 5G)
18. Network Security
19. Mobile Devices - Projects presentation
20. Revision

# Course Governance

1. Integrity
2. Collaborate
3. Lectures
4. Quizzes and Assignments
5. Discussions
6. Communication with me
7. Midterms and Final
8. Grading
9. Project
    1. 4 or 5 groups [depending on total number] students) [Programmers in the course? Have a good mix]
    2. Simple Augmented Reality application on Mobile Device
        1. Client-Server architecture
        2. WoW Factor!
        3. Use any available SDK
        4. Compare performance over WiFI and 4G/5G

**Software Dev Project Timeline**

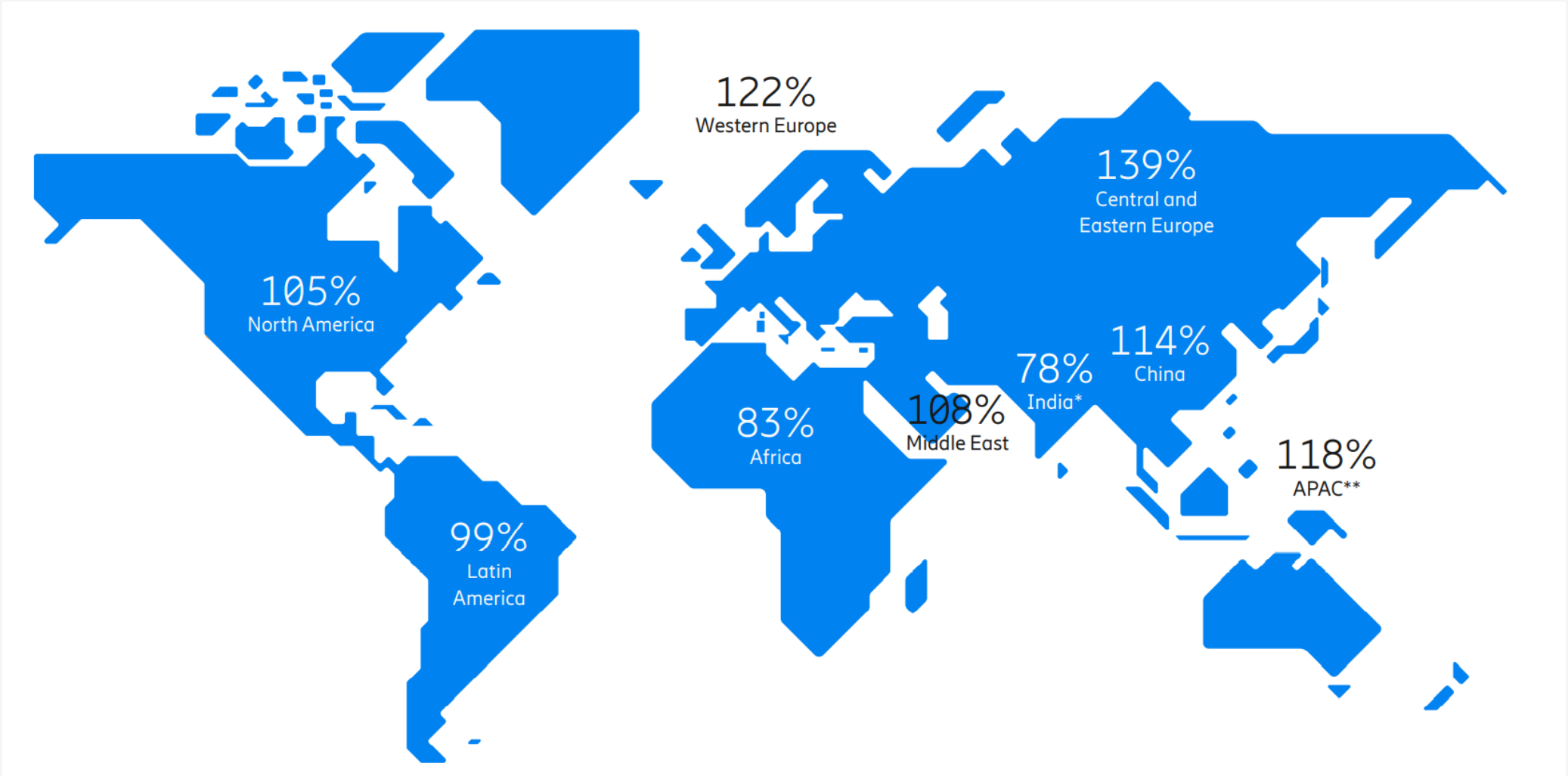
10/23 @11:159PM: Decide on the roles in the project team. Submit one slide per group

10/30 @11:59PM: What are you going to develop? Submit one slide per group: Name, Description, what each student will do? High level project plan

11/13 @11:59PM: Technical Design. 2-3 slides. Include Objectives, SDK, Operating system, Interfaces, Success Criteria, etc.

12/8: Group Presentation (30mnts) during lecture

# Mobile Communications



# Mobile Communications

In Q2 2020, the total number of mobile subscriptions was about 7.9 billion, with a net addition of 15 million subscriptions during the quarter.

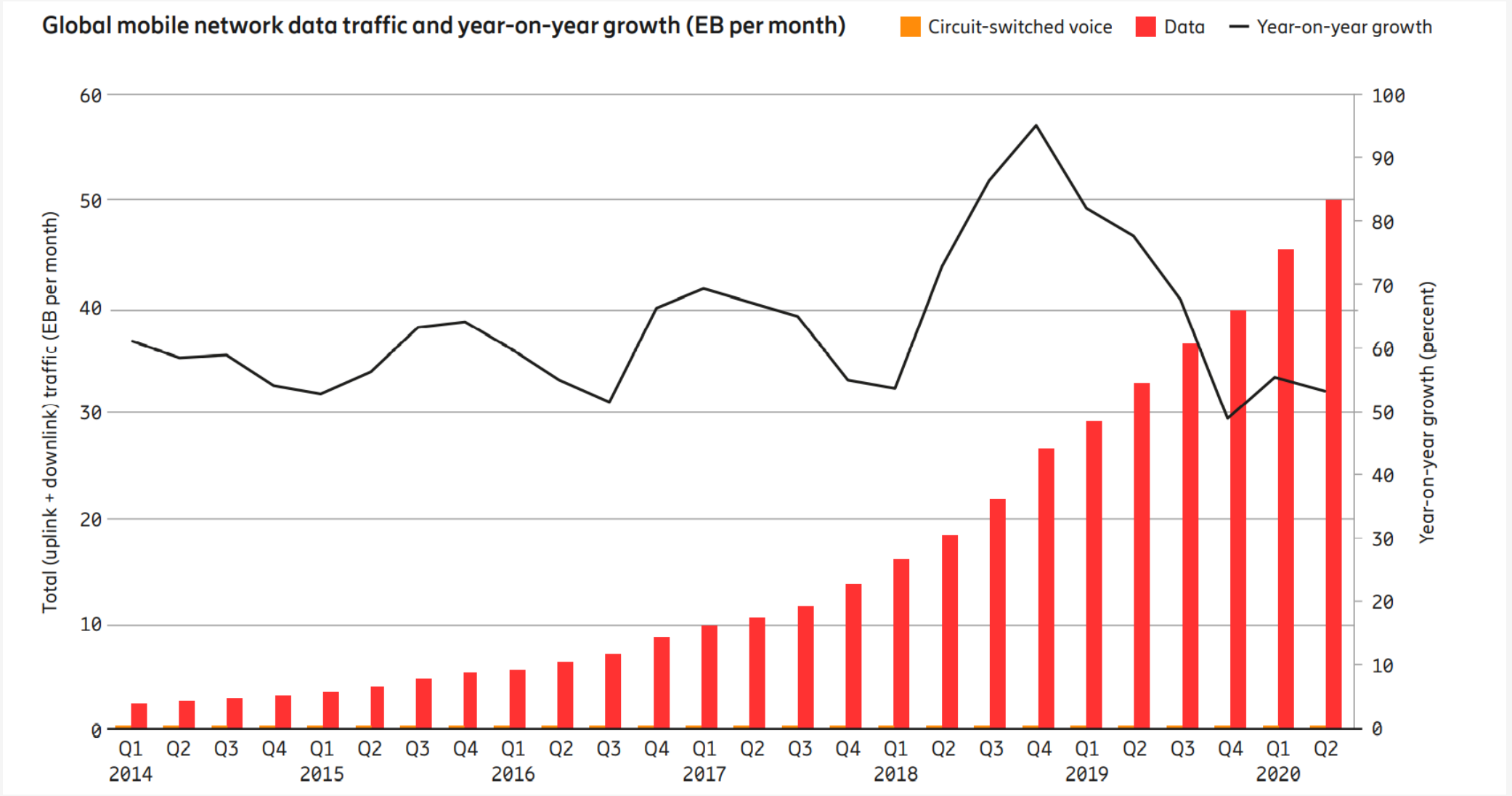
- The low net addition of mobile subscriptions during the quarter was most likely due to the coronavirus disease 2019 (COVID-19) pandemic and associated lockdown restrictions.
- The year-on-year growth of mobile subscriptions was about 2 percent.
- China had the most net additions during the quarter (+6 million), followed by Nigeria (+6 million) and South Africa (+1 million). In India, the number of subscriptions declined by 4 million, probably due to the removal of inactive subscriptions.
- Global mobile subscription penetration was 103 percent.

- The number of mobile broadband subscriptions grew by about 60 million in Q2 2020 to reach about 6.4 billion. This reflects a year-on-year increase of about 7 percent.
- 5G subscriptions with a 5G-capable device grew by around 50 million during the quarter to reach around 80 million.
- LTE subscriptions increased by approximately 120 million to reach a total of around 4.5 billion, equaling 57 percent of all mobile subscriptions, while WCDMA/HSPA subscriptions declined by around 50 million. Most 3G and 4G subscriptions include GSM/EDGE as a fallback.

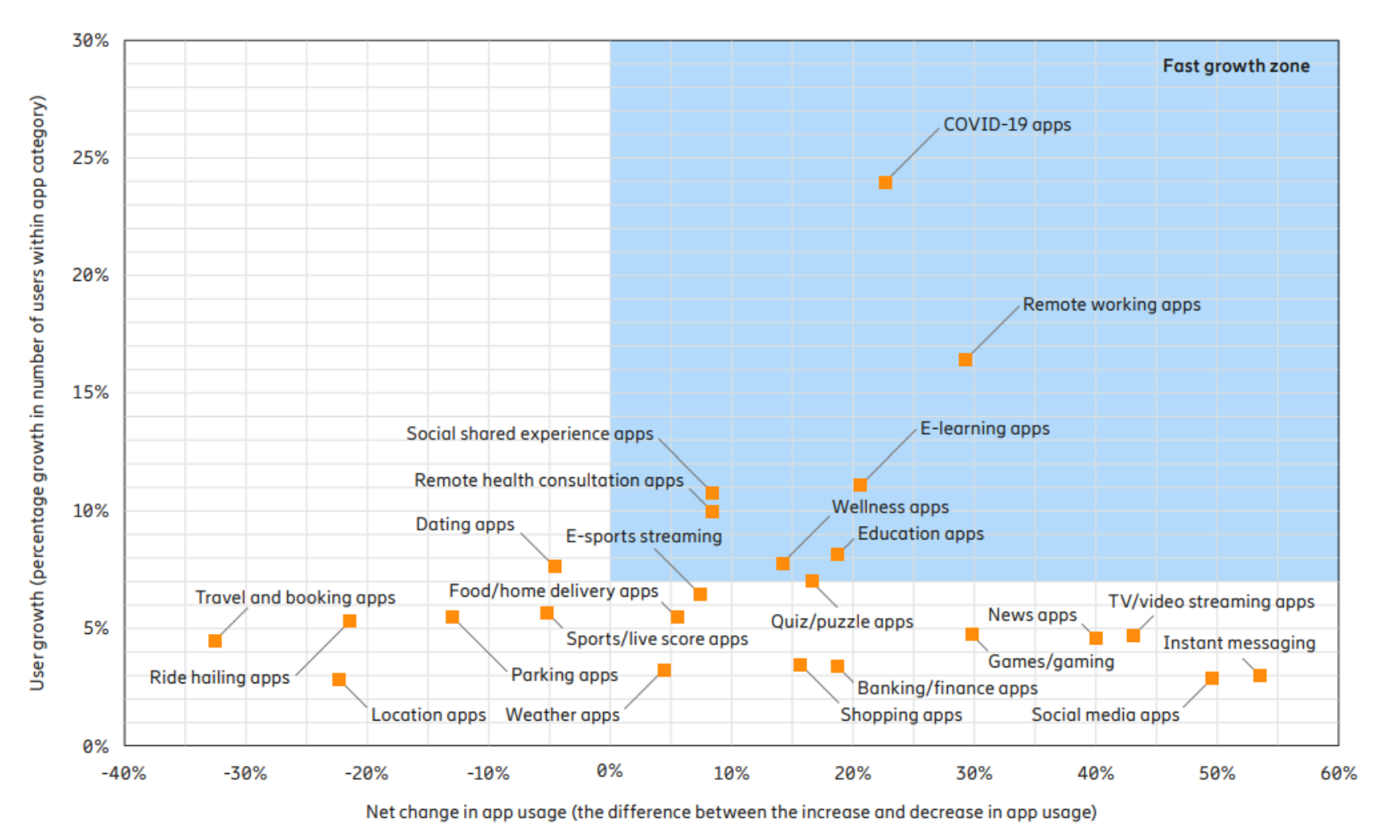
GSM/EDGE-only subscriptions declined by 110 million during the quarter, and other technologies[1] decreased by about 5 million.

- About 280 million smartphones were sold in Q2 2020. Seventy-four percent of all mobile phone subscriptions are now associated with smartphones.
- The number of unique mobile subscribers is about 6 billion. The difference between the number of subscriptions and the number of subscribers is due to inactive subscriptions, multiple device ownership and/or optimization of subscriptions for different types of calls.

# Mobile Communications



# Mobile Communications



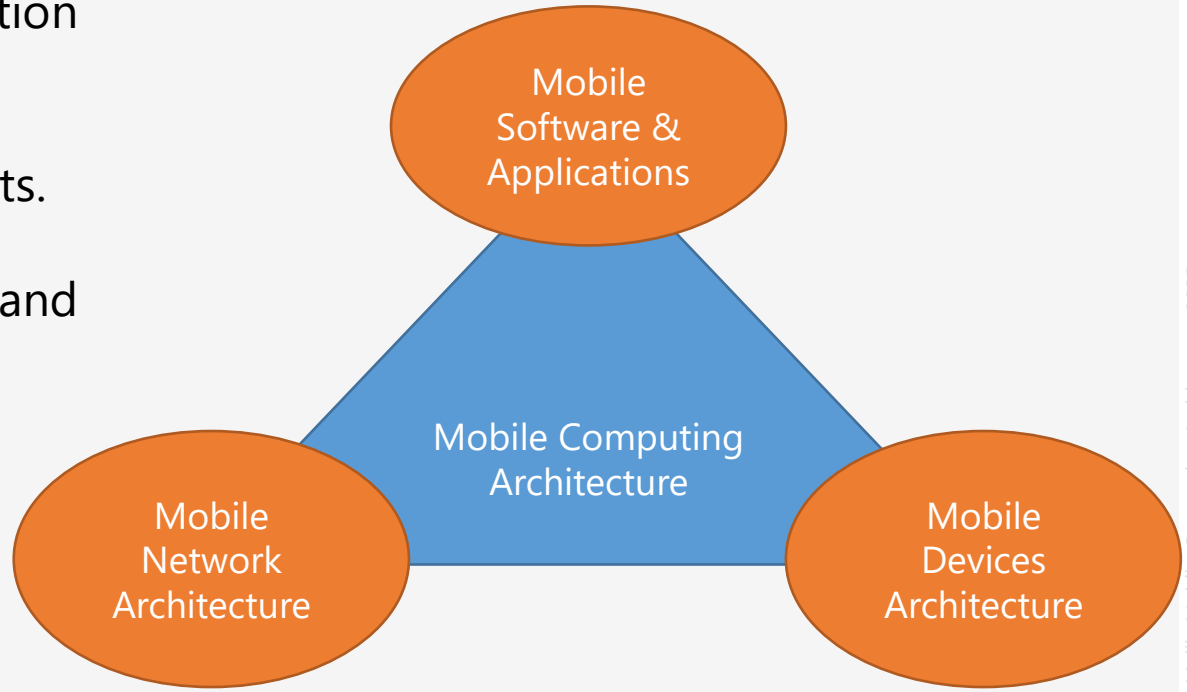
# Pillars of Mobile Communication

Mobile computing involves **mobile communication, mobile hardware, and mobile software**.

Communication is about mobile networks and infrastructure networks as well as communication properties, protocols, standards, etc.

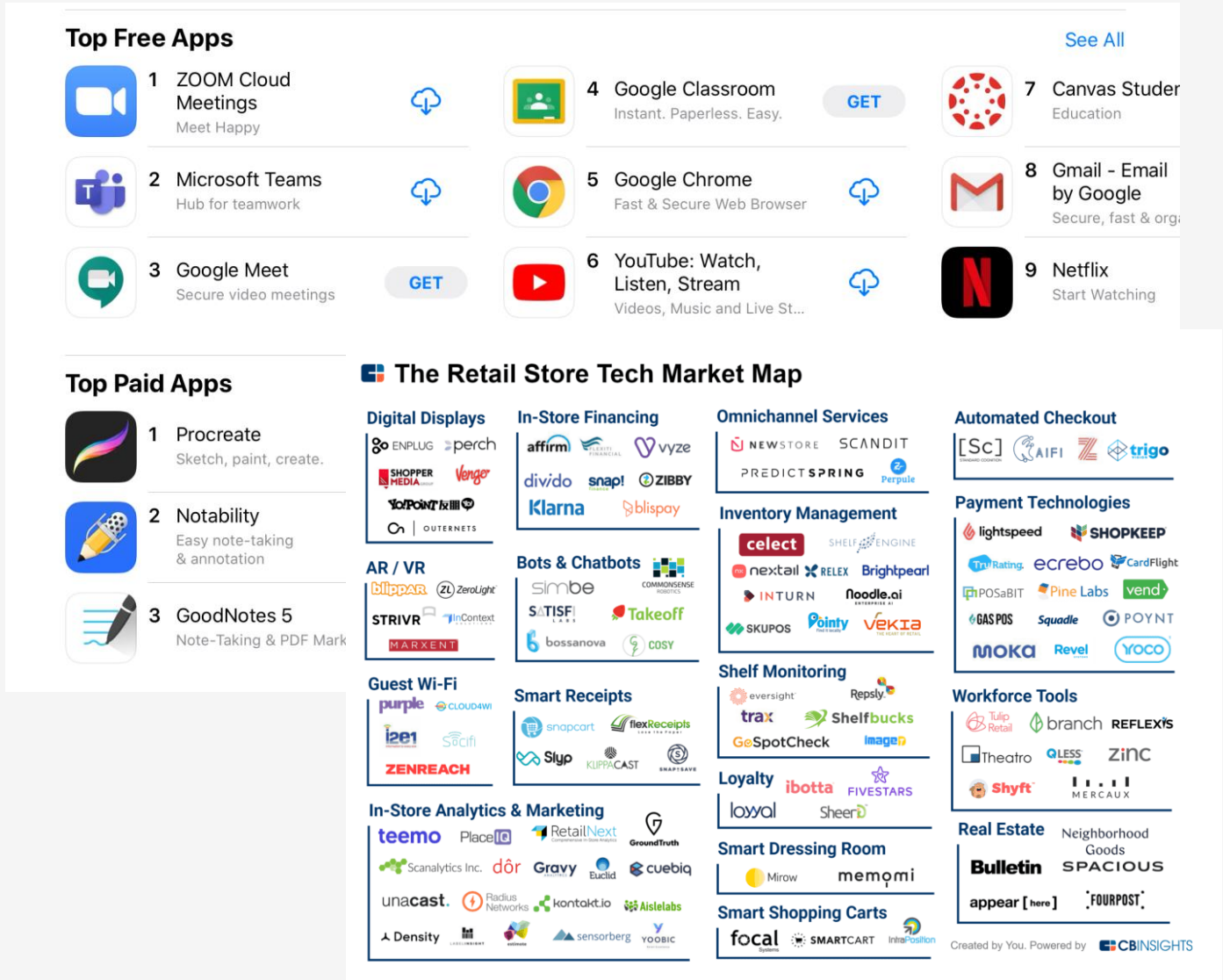
Hardware includes mobile devices or device components.

Mobile software deals with the characteristics and requirements of mobile applications.



# Mobile Computing – Mobile Applications

- Messaging
- Video Conferencing
- Streaming Video
- Social Media
- Work Productivity
- Photography/ Video Editing
- Games
- Cloud Storage, etc.



# Mobile Computing – Mobile Devices

- Apple
- Android
- Google
- Microsoft
- Facebook
- Qualcomm
- Samsung
- Sony, etc.



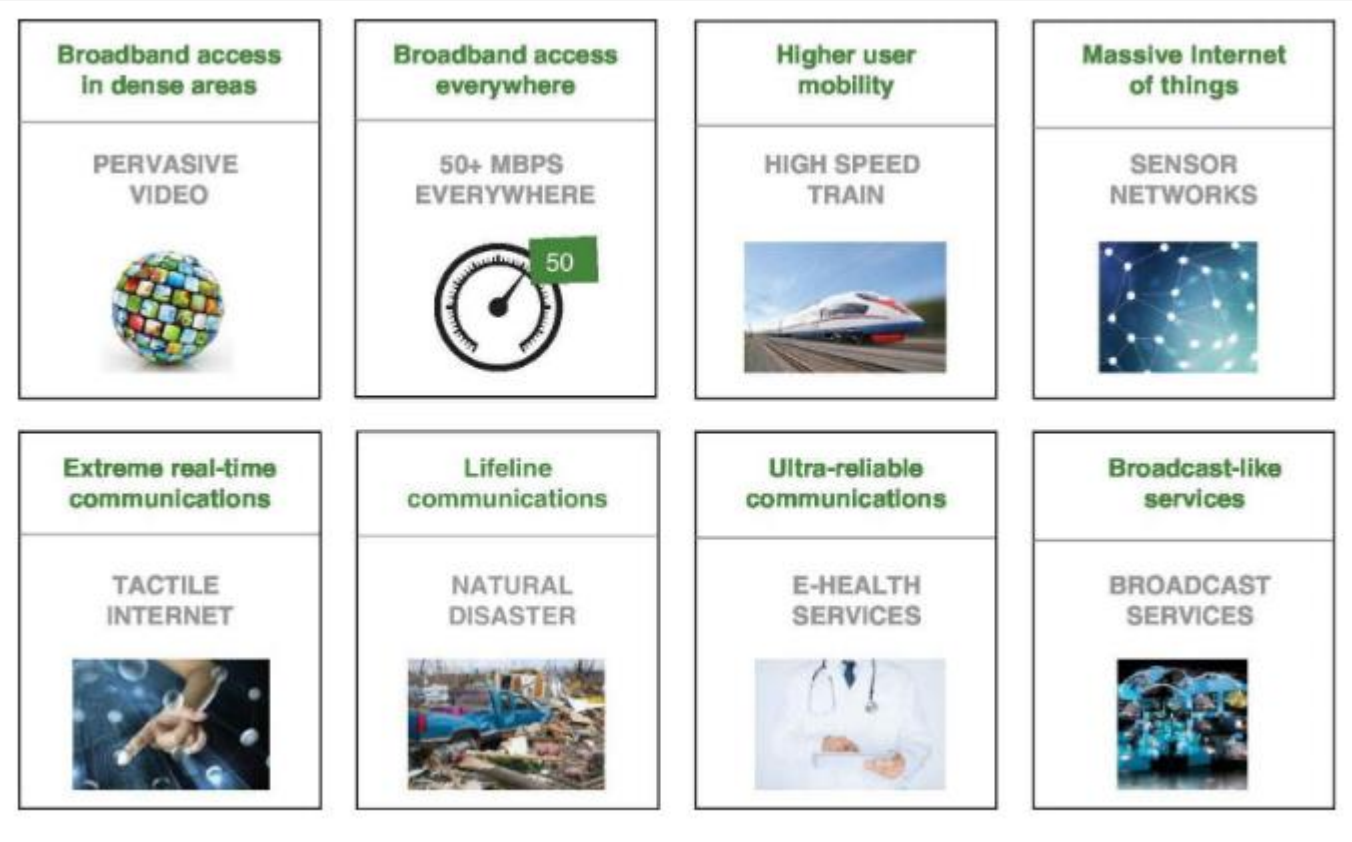
# Mobile Computing – Mobile Networks

- AT&T
- Charter
- DT
- T-Mobile
- US Cellular
- Orange
- Verizon
- Vodafone, etc.



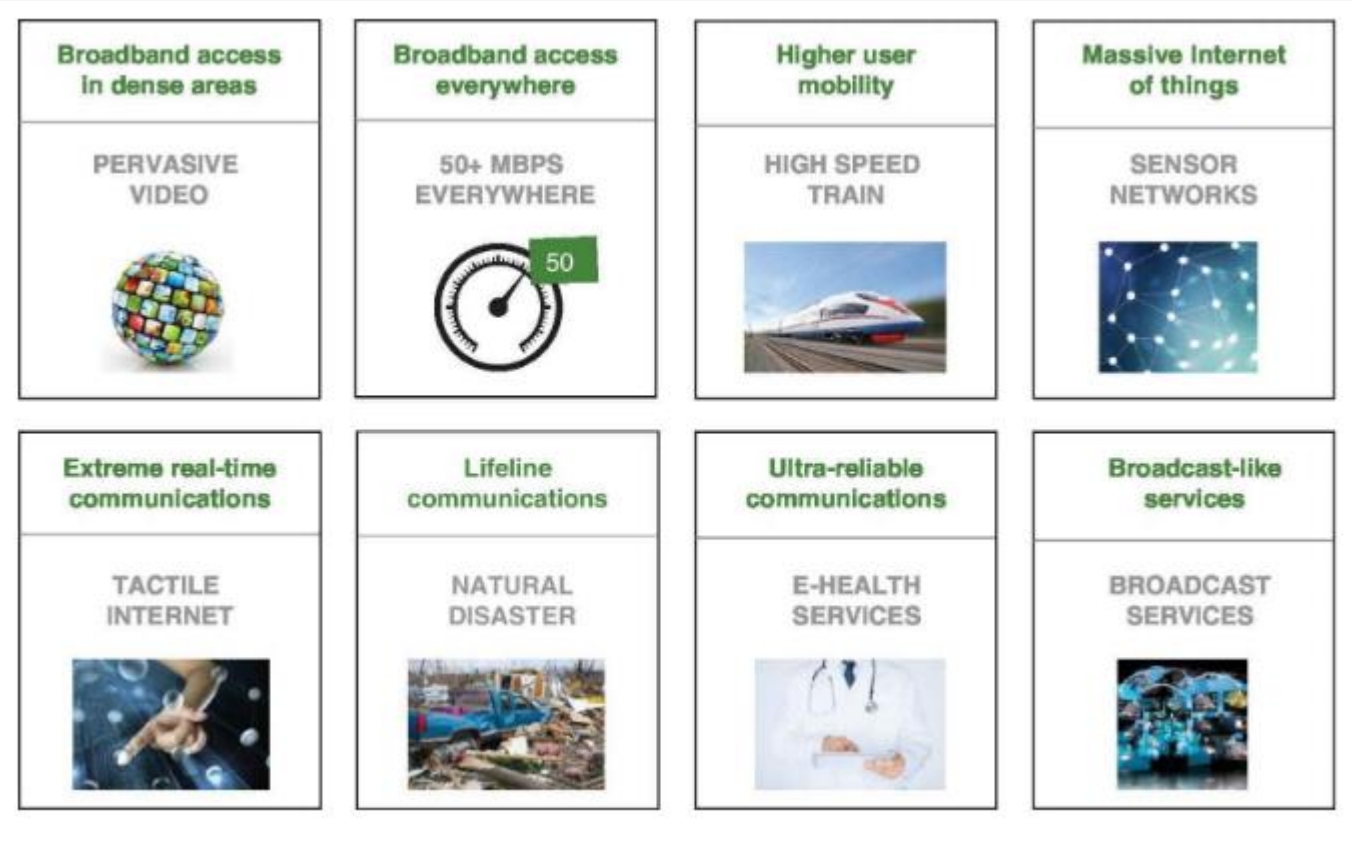

# 5G Impact on Industry & Society - I

- Media and Entertainment
  - Marketing and Ads
  - Games
  - Immersive Experience
- Automotive
  - Self-Driving Vehicles
  - Connected Vehicles
  - Road Safety and Traffic Services
  - Remote Driving
- eHealth
  - Remote Monitoring
  - Remote Surgery
  - Smart Medication
- Energy
  - Grid Access
  - Grid Backbone



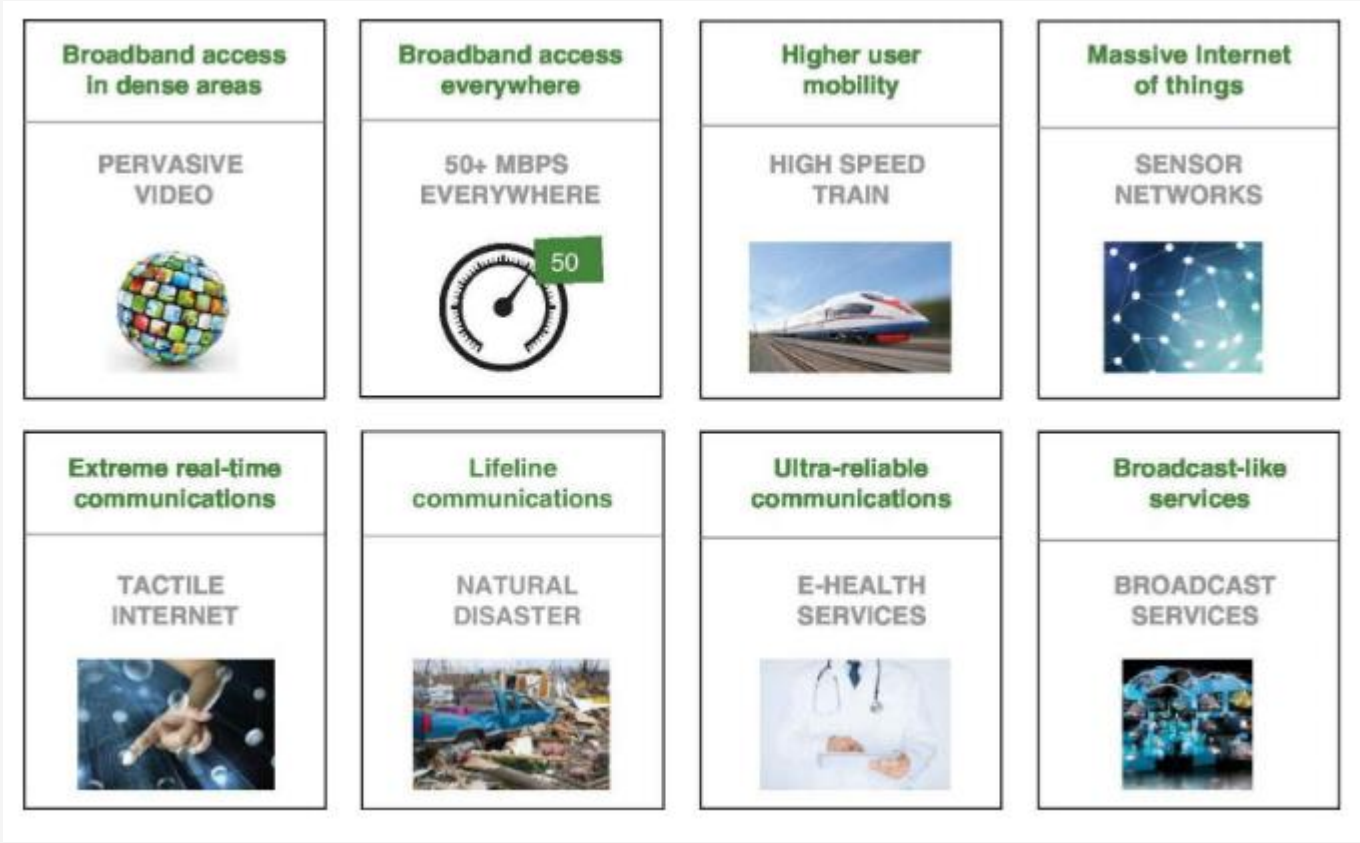
# 5G Impact on Society - II

- Smart Cities
  - Smart Utilities
  - eGovernment
  - Traffic Management
- Smart Buildings
  - Energy Management
  - Space Management
  - Security Management
  - Remote Maintenance
- Future Factories
  - Critical IoT
  - Wireless instead of wireline connec
  - Remote maintenance and operation
  - Asset management
  - Training, etc.
- Disaster Relief
  - Drones, etc.



# 5G Impact on Society - III

- Pervasive Video
  - Broadcast like services
  - Ultra High-Fidelity Media
  - Individual Content Providers
  - On-Site Live Experience
  - Co-operative and Collaborative Media production
- New Service Models
  - Everything as a Service
  - Network as a Service
  - Small Cells as a Service
  - Infrastructure as a Service
  - Platform as a Service



# Reading


june2020-ericsson-mobility-report (1).pdf

Optional: Reading Assignment: 5G Whitepaper 2 – NGMN Alliance LINK