Mobile Cloud Computing (MCC)

Mobile Computing

- Rapid progress of mobile computing have become a powerful trend in the development of many fields, including IT, commerce, industry, etc.

- Mobile devices have limited resources (e.g., battery life, storage, and bandwidth) and communications (e.g., mobility and security).

- The limited resources significantly handicap the quality of services offered by mobile computing.

Mobile + Cloud Computing

- Cloud Computing has been identified as the next generation's computing infrastructure.
- Cloud Computing allows access to infrastructure, platforms, and software provided by cloud providers at low cost, in an on-demand fashion.
- Mobile Cloud Computing is introduced as an integration of cloud computing into the mobile environment, to bring new types of services and facilities for mobile users.

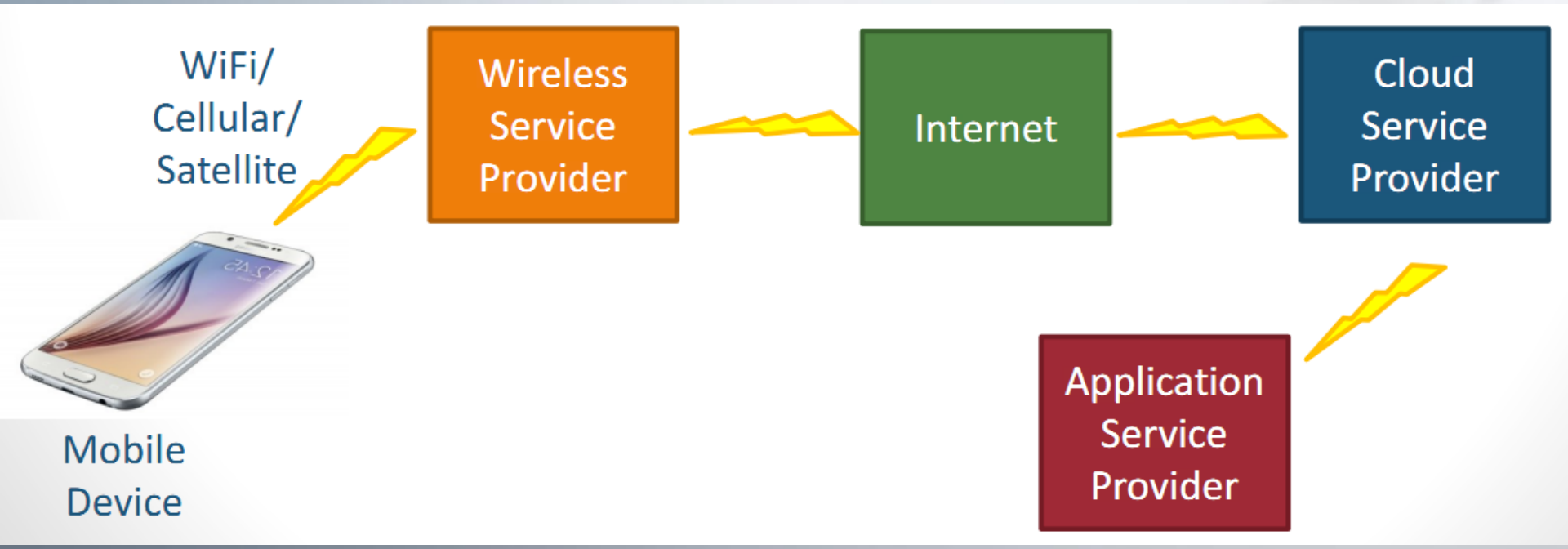
Mobile Cloud Computing -Definition

"Mobile Cloud Computing at its simplest refers to an infrastructure where both the data storage and the data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and in to the cloud, bringing applications and mobile computing to not just smart phone users but a much broader range of mobile subscribers".

- Mobile Cloud Computing Forum (MCC-forum, 2011)

How it Works?

- Data processing and storage are moved from the mobile device to powerful and centralized computing platforms located in clouds.
- They are accessed by mobile devices over a wireless connection using an app or a web browser.



Google’s Voice Search

- When you talk to Android's voice recognition software, the spectrogram of what you've said is chopped up and uploaded to Google's cloud servers.

- It's then processed, using the neural network models.

- There are a couple of layers in processing speech. First Google tries to understand the consonants and the vowels. That is the foundational layer. Next, it uses those to make intelligent guesses about the words. And then higher.

Advantages for Mobile Users?

Extended battery lifetime of mobile devices

- Using computation offloading techniques, large computations and complex processing is migrated from resource-limited mobile devices to resourceful cloud servers.
- This avoids taking a long application execution time on mobile devices, resulting in a significant reduction in power consumption.
- Large-scale numerical computations and shows that up to 45% of energy consumption can be reduced for large matrix calculations.
- Offloading a compiler optimization for image processing can reduce up to 41% for energy consumption of a mobile device.
- Migrating mobile game components to cloud servers can save 27% of energy consumption for computer games and 45% for chess games.

Advantages for Mobile Users?

Improving data storage capacity

- Storage capacity is also a constraint for mobile devices.
- Mobile cloud computing is developed to enable mobile users to store/access large amounts of data on the cloud through wireless networks.
- For instance, Google Photos allows users to upload unlimited photos and video to the clouds, even immediately after capturing. Users may access their images and videos from any connected device.
- Users can save considerable amount of energy and storage space on their mobile devices since all images are sent and processed on the clouds.

Advantages for Mobile Users?

Improved processing power

- Mobile cloud computing helps reducing the running cost for intensive applications that take long time and large amount of energy when performed on the limited-resource mobile devices.
- Cloud computing can efficiently support various tasks for data warehousing, managing and synchronizing multiple documents online.
- For instance, clouds can be used for transcoding, playing chess, or broadcasting multimedia services.
- In these cases, all the complex calculations for transcoding or offering an optimal chess move that take a long time when perform on mobile devices will be processed quickly on the cloud.

Advantages for Mobile Users?

Improved reliability

- Data and application are stored and backed up on a number of cloud servers.
- This reduces the chance of data and application lost on the mobile devices.
- Cloud can remotely provide security services such as virus scanning, malicious code detection, authentication, etc.

Advantages for Service Providers?

Dynamic provisioning

• Dynamic on-demand provisioning of resources.

Scalability

• Easily add and expand services without or with little constraint on there source usage.

Multi-tenancy

• Share resources and costs to support a variety of applications and large number of users.

Ease of Integration

• Multiple services from different service providers can be integrated easily.

Mobile Cloud Computing Applications?

- Mobile Learning
- Mobile Commerce
- Mobile Gaming
- Mobile Healthcare
- Searching
- And a lot more…

Cloud Computing for Mobile Users: Can offloading Computation save Energy?

- Saving Energy for Mobile Systems
- Offloading computation to save energy
- Energy Analysis for Computation offloading
- Sample Applications benefiting from offloading
- CHALLENGES AND POSSIBLE SOLUTIONS
  - Privacy and security
  - Reliability
  - Real-time data

Reference

Lecture 9.2 Mobile offloading for saving energy.pdf