



Enabling Innovation in Spectrum Management

Chi-Jen Wu
Chang Gung University

The Potential Problem of Telecom company

- Mobile Carrier (Mobile Network Operators)
 - To offer high quality services
 - Need to deploy more base stations
 - Increase capital expenditure
- \$275B on 4G reported by Morgan Stanley
- The capital spending of telecom companies
 - Very high and risky
 - May not gain significant returns on the investments*
 - Developing countries may not play this game

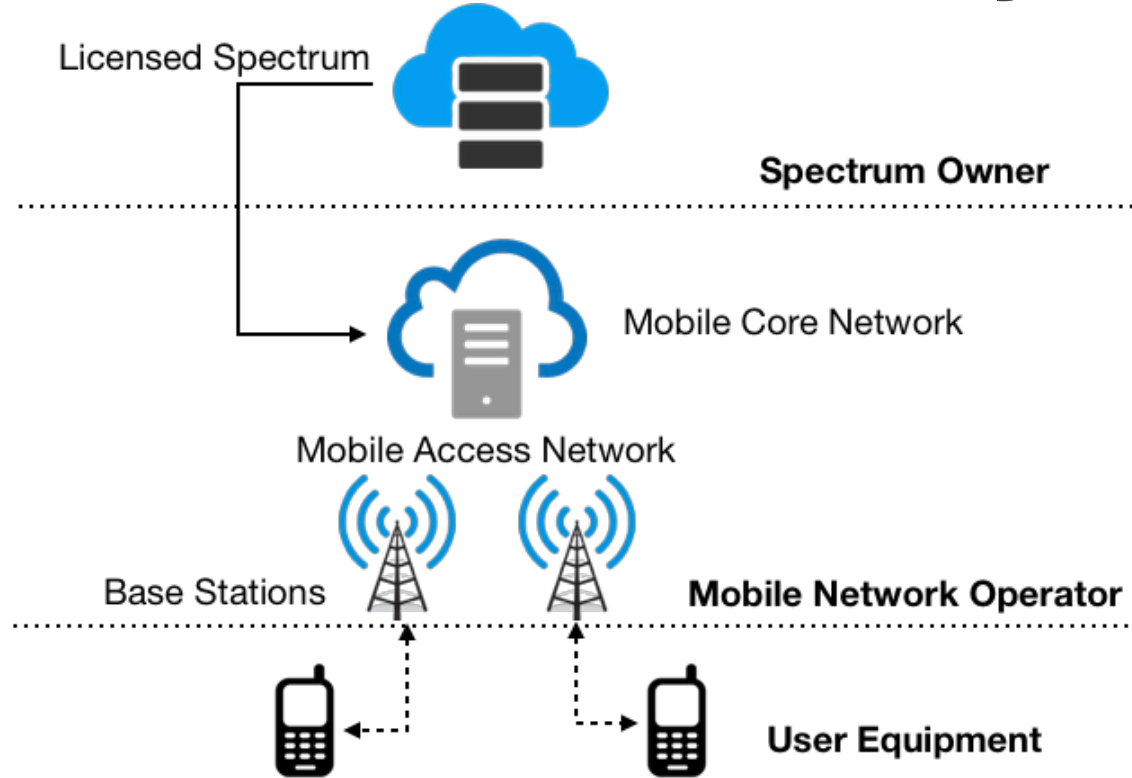
The CapEX breakdowns

- Infrastructure deployment
 - Radio access network and a core network
 - Operating costs
- Spectrum costs
 - Acquire more spectrum licenses for more spectrum capacity
 - US carriers spent \$95 billion on spectrum licenses for 5G*

Spectrum sharing

- Spectrum is a scarce resource for communication services
- Maximizing spectrum sharing matters
 - Dynamic Spectrum Sharing
 - 5G New Radio
 - Cloud-Radio Access Network (C-RAN)
 - Centralized/database-driven

Mobile Network Today



Intelligent Mobile Network

- Enable a fundamental change in
 - how to buy and sell the spectrum resources
- Three main ideas :
 - The new mobile network architecture
 - Spectrum recommendation
 - Real-time spectrum bidding market

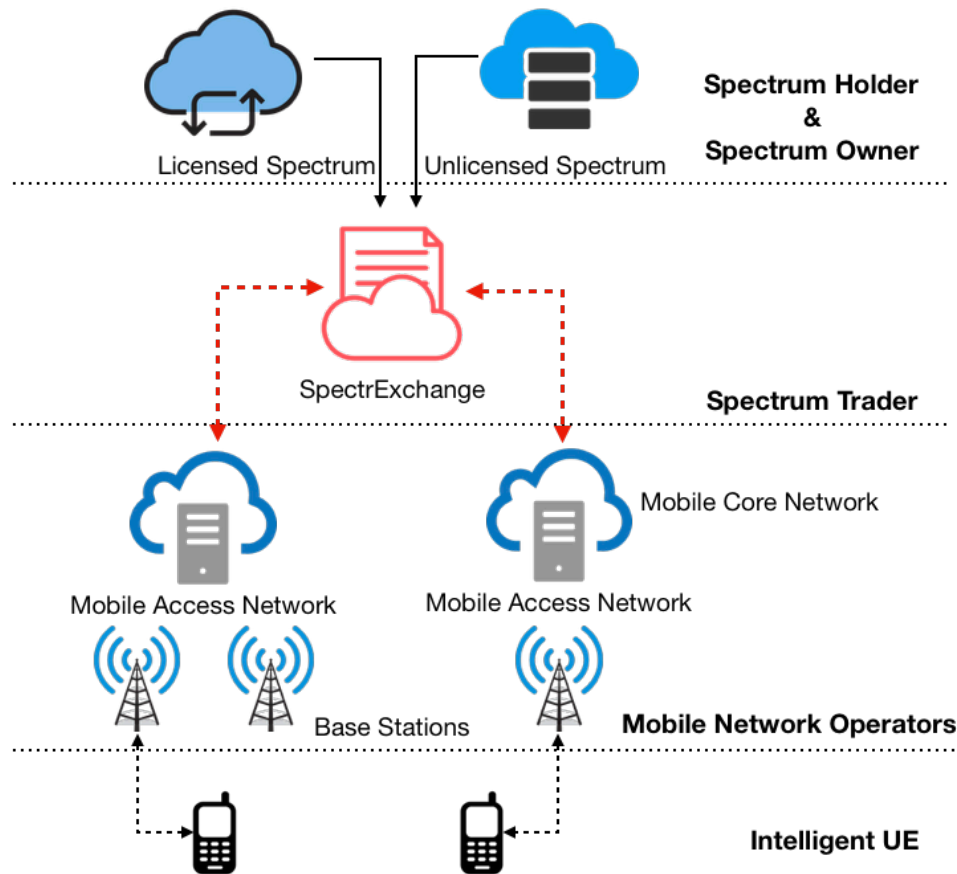
The Assumptions in Intelligent Mobile Network

- Spectrum owner
- Spectrum holder
- Spectrum trader (SpectrExchange)
- Mobile network operator (Carrier)
- Intelligent UE
- Spectrum Access Right Epoch (SAR Epoch)

Spectrum Access Right Epoch (SAR Epoch)

- A basic trading unit
 - The right to access spectrum in the epoch
- Divide each channel into small divisions
 - Frequency, geography and time
- Tuple (cell, channel, time, pricing)

The New Mobile Network Ecosystem



Spectrum recommendation

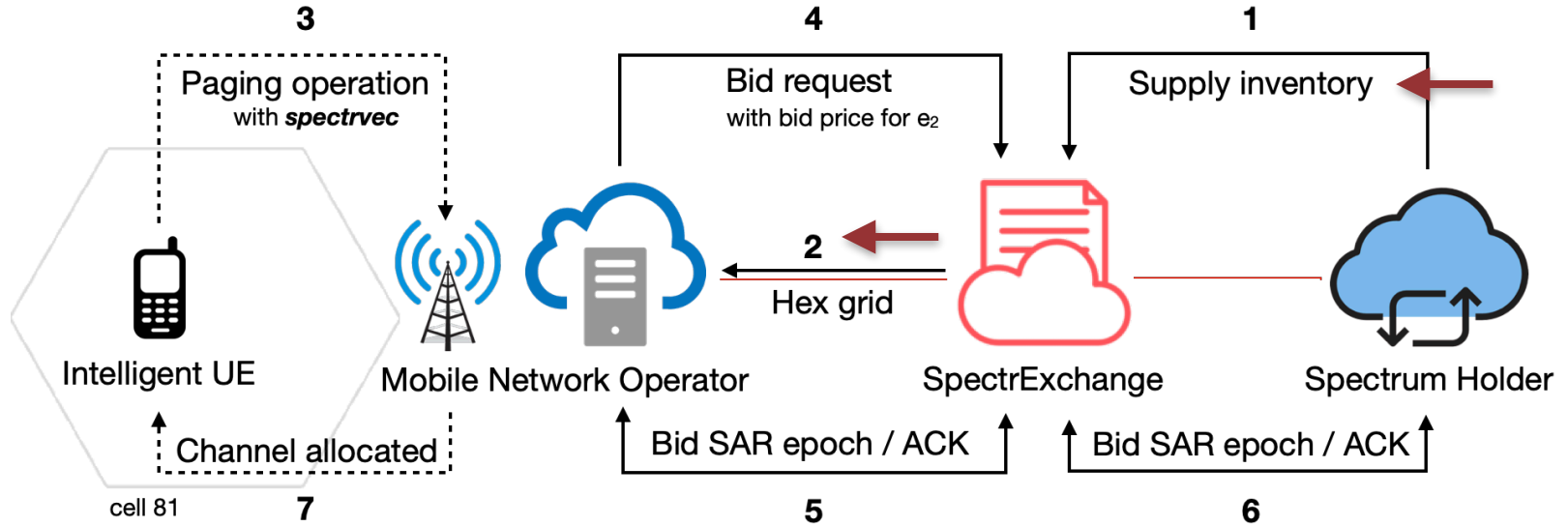
- Intelligent UE
 - Represent description of communication scenario into spectrum vector (spectrvec)
- Learn the association between
 - Spectrum allocation
 - Spectrum vector
- Turn the spectrum allocation problem to spectrum epoch recommendation

Real-Time Spectrum Bidding (RTSB)

- Leverage the concept of Real-Time Bidding
 - Popular using in Internet Ads industry
- Spectrum buyers bid on a SAR Epoch
 - Demand-side
 - MNOs
 - Supply-side
 - Spectrum stakeholders (owners & holders)
 - Trader
 - SpectrExchange

An Example of RTSB: Initial SAR Epoch Offering Process

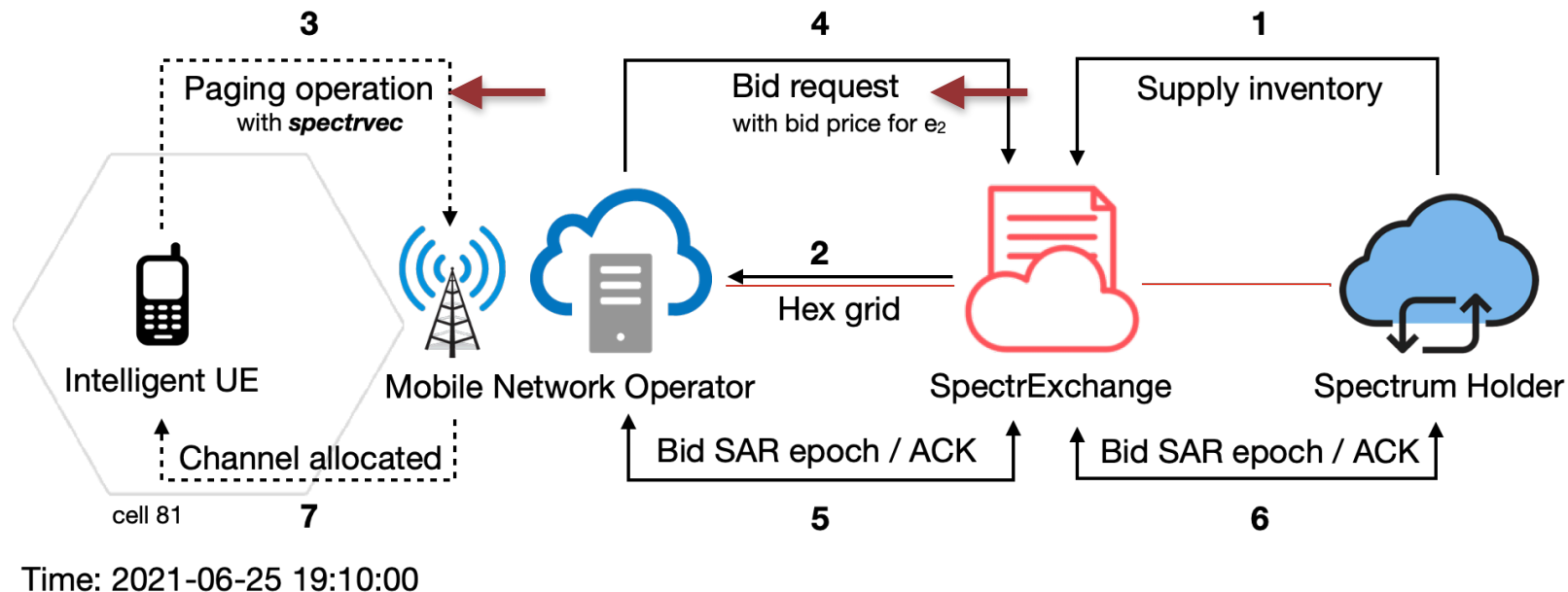
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An Example of RTSB: trigger a bidding in MNO

$t[e_1(\text{cell } 81, f_1, 2021-06-25 \text{ 19:10:00}+60s, \$0.1),$
 $e_2(\text{cell } 81, f_2, 2021-06-25 \text{ 19:10:00}+600s, \$0.8)]$



Future directions & Challenges

- The detail protocol-level design of the new architecture
- The design of real-time spectrum bidding market
- The spectrum recommendation models
- Incremental deployment
- Transparency
- Differentiated services

Conclusion

- A Novel Intelligent Mobile Network Architecture
 - Fundamental change in how to buy and sell the spectrum resources
- Base on the assumptions and ideas
 - A new architecture of cellular network
 - Spectrum recommendation
 - Real-time spectrum bidding market
- The sharing-economy thinking

Q&A

Thank you!

Thank you!

Looking research partners

Please drop us a line

CJ Wu

cjwu@mail.cgu.edu.tw

Mobile Network Today

- Wireless technologies achieved great improvements
- The high-level architecture of cellular networks
 - Spectrum Owner, ex., FCC
 - Mobile Network Operator (Carrier)
 - User Equipment (EU)
 - No changes over 30 years

An Example of Spectrum Recommendation

