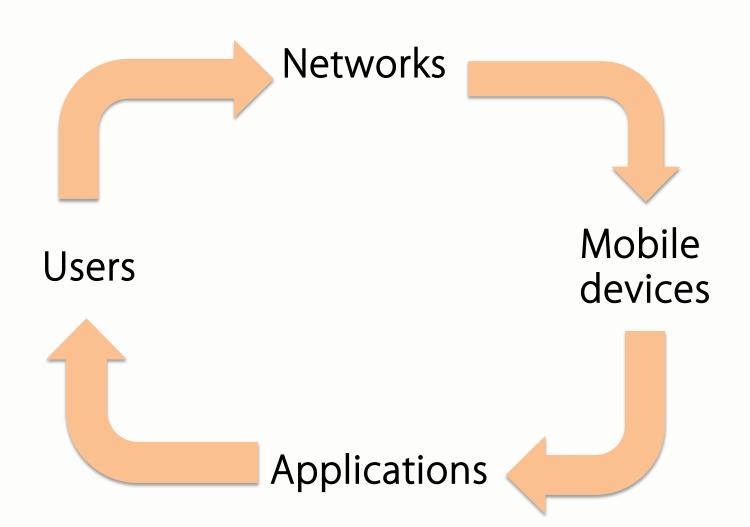
Openness in the Mobile Broadband Ecosystem

Mobile Broadband Working Group Jennifer Rexford Princeton University

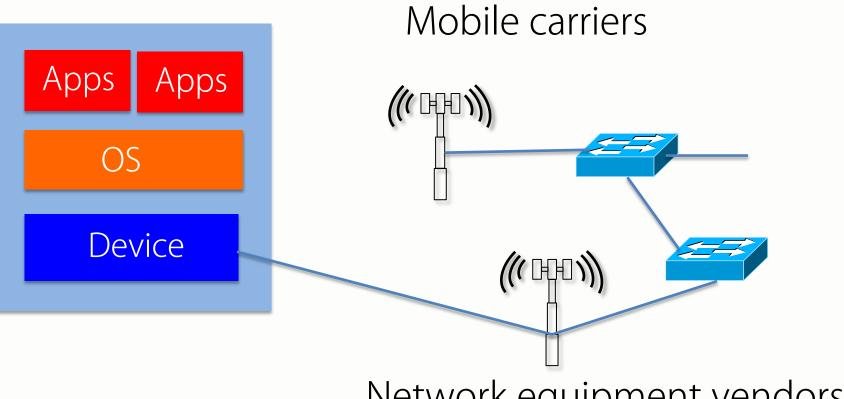
Broadening Our Scope

	AT&T/FaceTime Case Study	Ongoing Work
Who	Mobile network operators (carriers)	Mobile broadband ecosystem
Openness	Transparency, blocking, traffic discrimination	Incentivizing investment in mobile broadband
Time frame	Short term, single timely event	Long-term trends and principles

Virtuous Cycle

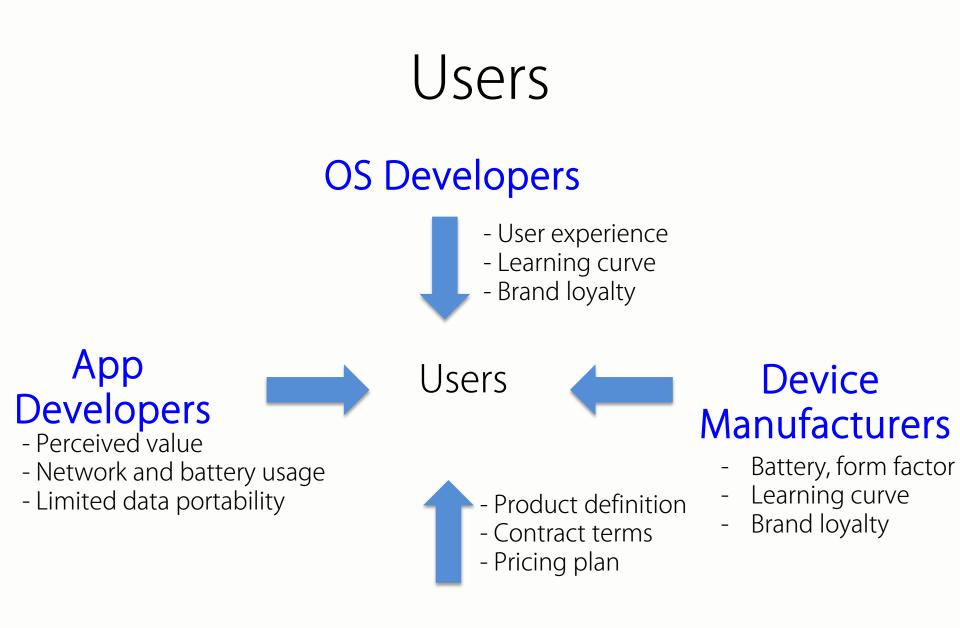


Complex Inter-relationships

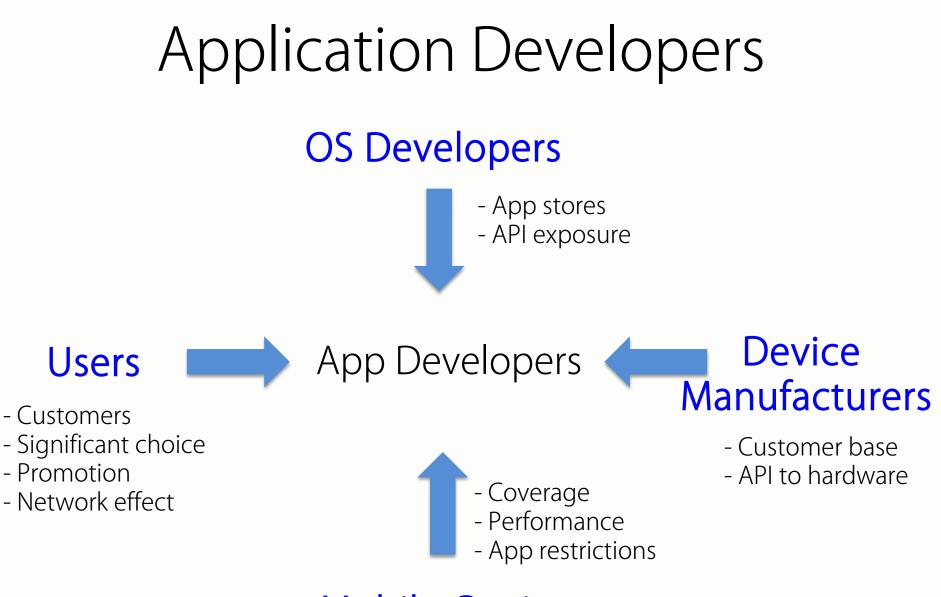


Small Number of Players in U.S.

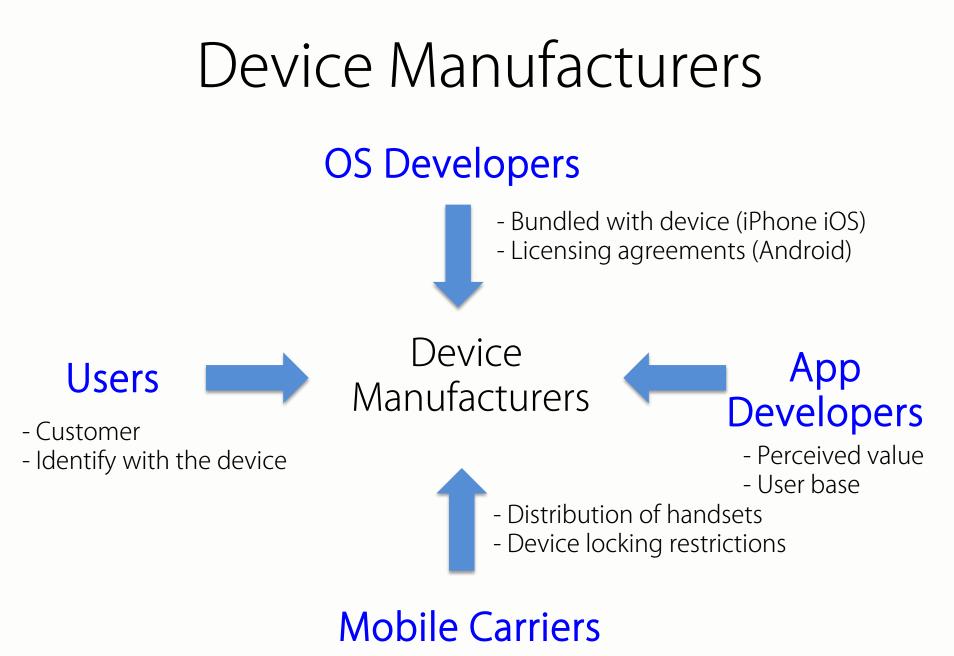
	Dominant Players
Device manufacturers	Apple (34.5%), Samsung (28.5%), and many smaller players (< 8% each)
Operating system developers	Google Android (60.5%), Apple iOS (34.5%)
Mobile carriers	Verizon (34%), AT&T (32%), Sprint (17%), T- Mobile (10%)
Network equipment vendors	Ericsson (34%), Huawei (22%), Nokia- Siemens (20%), Alcatel-Lucent (14%)
Application developers	Many, diverse, most make < \$500/month



Mobile Carriers

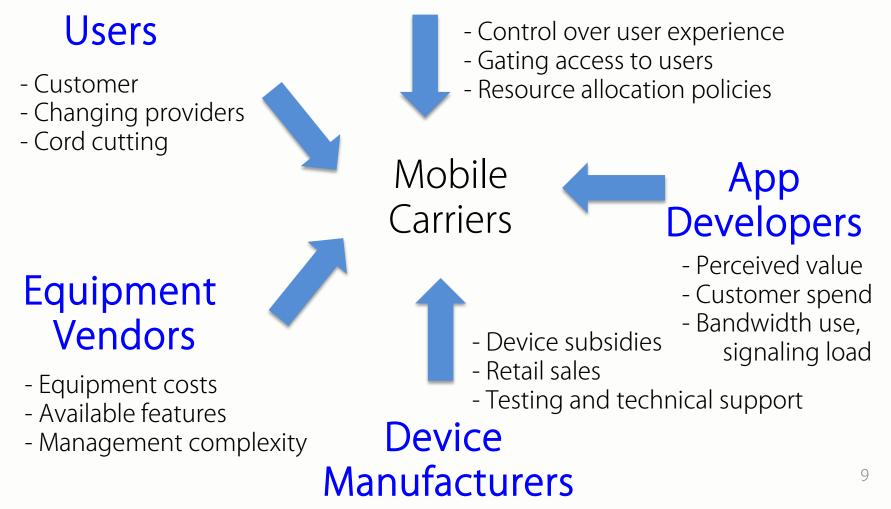


Mobile Carriers

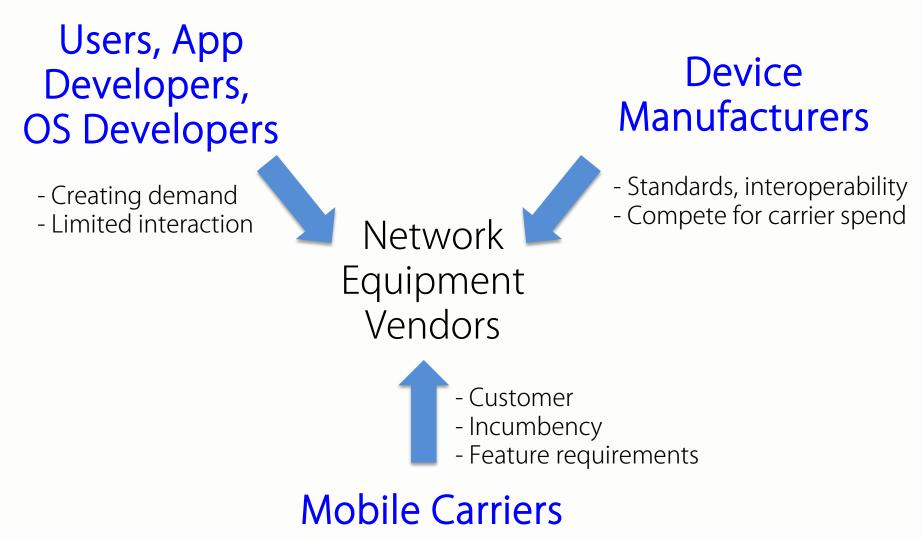


Mobile Carriers

OS Developers



Network Equipment Vendors



Case Studies

- App stores
- SDK and handset agreements
- Carrier service agreements
- Network-unfriendly applications
- WiFi offloading

Apps & OS: App Stores

- Mobile app distribution
 - Balancing trust, functionality, convenience
 - App review by platform provider
 - Semi-sandboxed execution environment
- Policies affecting openness
 - Installation mechanisms (app store required)
 - Screening policies (performance, security, ···)
 - Revenue-sharing agreements (e.g., 20-30%)
 - App store navigation (promotion, categories)
- Longer term: HTML5 and WebRTC

OS & Device: SDK/Handset Agreements

- Android
 - OS is free and open (unlike Apple iOS)
 - But the OS isn't the whole story
- Agreements with handset manufacturers
 - Early access to new versions of Android
 - Engineering and technical support
 - Access to Google Play (app store and search)
- Anti-fragmentation policy
 - Reduces app portability problems
 - Limits OS experimentation (e.g., search, navigation)

User & Carrier: Service Agreements

- Service agreements and pricing plans
 Customers: clarity and flexibility
 - Carriers: recoup costs and limit risk
 - Unlimited, usage cap, usage-based pricing
- Policies affecting openness
 - Device locking (and device subsidies)
 - Restrictions on tethering (and unlimited plans)
 - Application restrictions (e.g., FaceTime)
 - Zero-rating ("toll free") trend outside U.S.

App & Carrier: Net-Unfriendly Apps

- Misbehaving apps overload the network
 - Chatty: wasting signaling resources
 - Unfair: consuming excessive bandwidth
 Inefficient: poor caching wastes bandwidth
- Challenging to address
 - Large number of developers
 - Naiveté about app impact on the network
- Aligned incentives
 - Educate developers (e.g., AT&T ARO tool)
 - Benefit users (e.g., less bandwidth and battery)

Long-Term Trend: WiFi Offloading

- WiFi offloading
 - Unlicensed spectrum
 - Low-cost (free or cheap to users)
 - Carries 30-70% of mobile data traffic
- Multiple flavors
 - Home or office, offered by a business (e.g., Starbucks), commercial service (e.g., Boingo)
- Influencing the market structure
 - More options for consumers
 - Cellular for coverage, and WiFi for capacity
 - Seamless authentication and mobility support

Conclusions

- Complex ecosystem
 - Beyond consumers and carriers
 - Apps, OS, device, equipment vendors
 - Multiple parties affecting incentives to invest and innovate in mobile broadband
- Next steps
 - Complete the case studies
 - Identify principles (transparency, net-friendliness)
 - Identify possible areas to monitor further

Backup Slide: Market Share Data

- Q3 2012 MNO Subscriber Share: <u>http://www.statista.com/statistics/199359/market-share-of-wireless-carriers-in-the-us-by-subscriptions/, Chetan Sharma Consulting.</u>
- Q3 2012 Mobile OS Market Share: "North America Smartphone Vendor & OS Market Share by Country: Q3 2012," Strategy Analytics, (October 2012).
- Q3 2012 US Market Share Device Vendors: "North America Smartphone Vendor & OS Market Share by Country: Q3 2012," Strategy Analytics, (October 2012).
- Q3 2012 US Value Share Device Vendors: "Value Share: Global Handset Revenue, ASP and Profit in Q3 2012," Strategy Analytics, (November 2012).
- 2012 Revenue Distribution by Platform: "Developer Economics 2013" Vision Mobile, (January 2013), <u>http://www.visionmobile.com/product/developer-economics-2013-the-tools-report/?image3=1&utm_expid=1534519-18&utm_referrer=http%3A%2F%2Fwww.visionmobile.com%2Fproducts%2Fresearch%2F#download-form_
 </u>
- Q3 2012 US Market Share Network Equipment Vendors: <u>http://www.fiercewireless.com/story/nokia-siemens-market-share-jumps-18-20-</u> <u>q3-delloro-finds/2012-11-13</u>