

Communications Infrastructure

CSE 490c



Administrivia

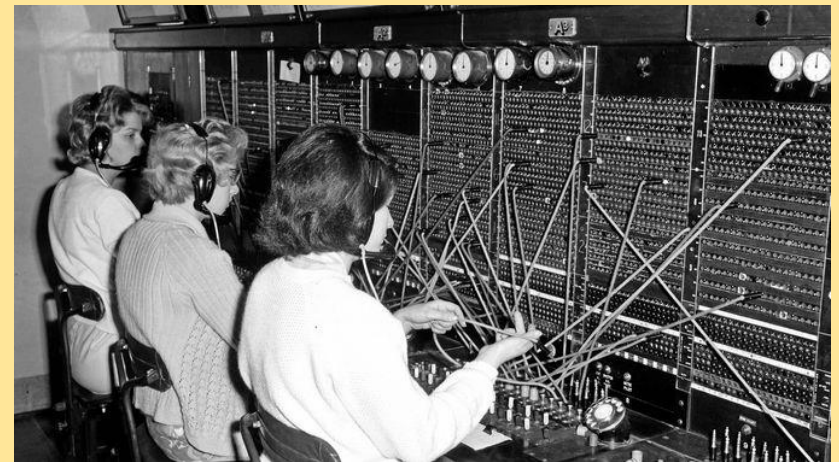
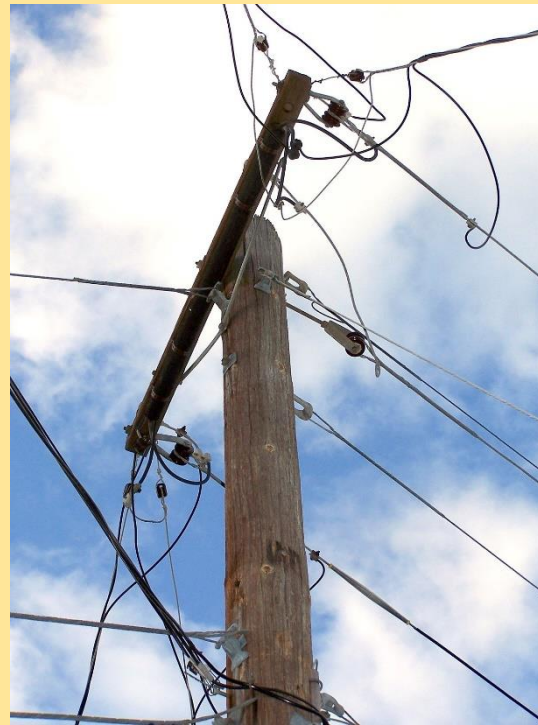
- Section 490 CB will meet in MGH 058
- Homework 2 Available
- Programming Assignment 1 Available
- Reading Assignment – Ken Banks, FrontlineSMS

Things to cover

- How it works – basics of cellular communication
- Call data records
- Cellular coverage
- Telcos – structure of telecommunication companies
- Cost models for telcos – how they make money
- Cell phone payment – how people cover costs

Phone Service

- Copper wire to house
- Phone connected to wire
- Physical exchange to connect calls
- Monopoly
- Development of standards to allow international calls
 - Technical
 - Billing



Cellular Service

- Cell Tower
 - Radio transceiver
 - Power source
 - Range: Up to 40 miles, limited by
 - Terrain
 - Technology
 - Capacity

- Aside
 - OpenBTS



Cellular Technology

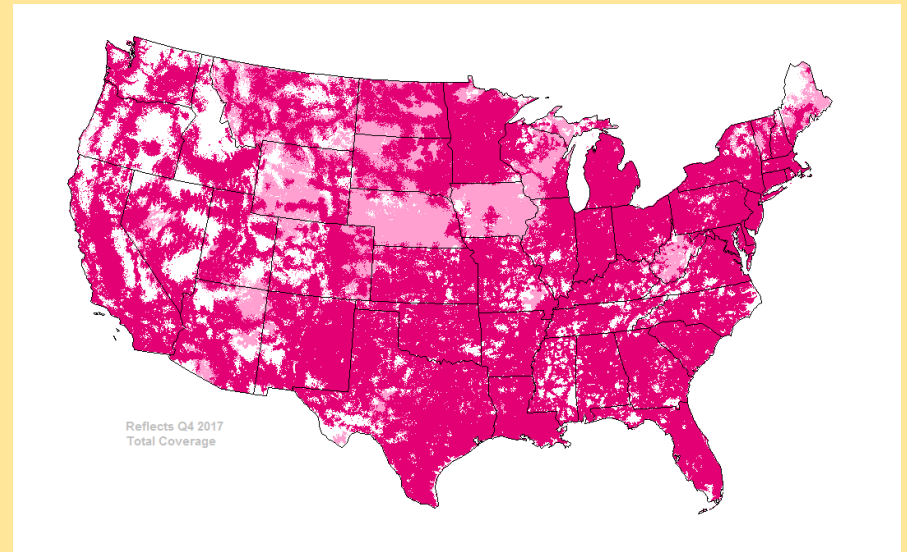
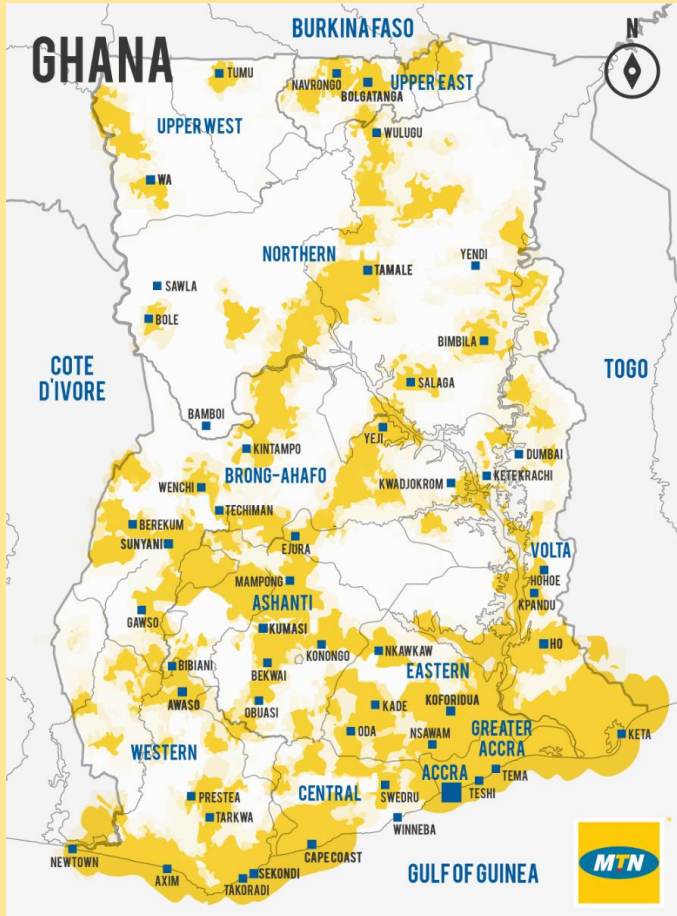
- Backhaul
 - Connecting base station to main network
 - Wired backhaul
 - Optical Fibre or Copper
 - Wireless
 - Microwave radio relay
 - High capacity radio



Cellular Connections

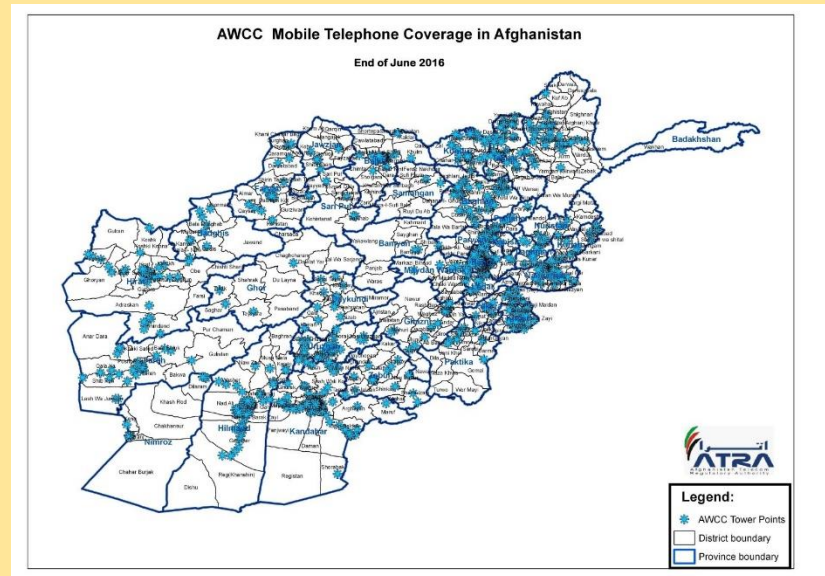
- Cell towers must connect to all phones in radius
 - Protocol for identifying phones
 - Needs to know to initiate action to a phone or from a phone
- Cell tower handoff
 - Mobile communication
- Connectivity info
 - Cell tower logs
 - TAC – type allocation code
 - Records all (turned on) phones
 - Not just making calls or on the network
- Call Data Records
 - Data for individual calls
 - Phone numbers, time, duration, cell tower ids

Global Cellular Coverage



Global Cellular Coverage

- Finding good cellular coverage maps is a challenge
- Areas with high population will be covered
- Low coverage in remote/mountainous areas
- Coverage between carriers is highly variable
- Often there are carriers focusing urban areas, and carriers with a rural focus
- Crowdsourced cellular data not that useful – need telco data



Telcos



- Big, global companies
- Most countries seem to have about three to five competing mobile operators
 - Possibly with some government ownership
 - A few countries have government monopolies
- List of top 15 mobile telecommunications company
 - Companies either focus on one large market or serve many countries
 - USA barely appears on this list
 - T-Mobile (Deutsche Telekom)
 - TracFone (America Movil)
 - US Based Telcos do not have a global presence
- Largest companies (by subscriptions)
 - China Mobile
 - Vodaphone Idea (India)
 - Airtel (India) [20 countries]
 - Vodaphone (UK) [26 countries]
 - China Unacom
 - China Telecom
 - America Movil (Mex) [22 countries] Claro
 - Telefonica (Sp) [20 countries] Movistar
 - Veon (Neth)[14 countries]
 - Reliance Jio (India)
 - MTN (SA) [20 countries]
 - Orange (France) [25 countries]
 - Telkomsel (Indonesia)
 - Telenor (Norway) [12 countries]
 - Deutsche Telekom (Ger) [16 countries] T-Mobile



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ington, Autumn 2018

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Charging for Calls and SMS

- Telcos want to maximize ARPU
 - High capital costs
 - Low cost per call
- Charging for service
 - Call cost
 - SMS cost
- Wide range of costs in different markets
 - Costs may be very high relative to income
- Charging for calls across networks
 - In-network vs. out of network
 - Charge incoming and out going
- Bundling of handset and services



Paying for calls and SMS

Prepaid vs Postpaid

- Utilities are often of poor quality in developing countries
- Cell phones are different with pre-paid models
 - Buy credit from vender
 - Buy scratch card from vendor
- Behavior when calls are very expensive (relative to income)

