Rural Telecommunications Radio Channel and Radio Frequency Spectrum Jun-ichi TAKADA Department of International Development Engineering Tokyo Institute of Technology

Technical Aspects of Rural Telecommunications

Connection

- Access technology
 - End user to network entry point
- Backhaul technology
 - Network entry point to core network
- P2P/Ad-Hoc technology

Networking

- TCP/IP
- (Classical) telephone

Hierarchical Network Architecture



Ad-Hoc Network Architecture



Access Technologies

- Radio and wireless
 - Leap frog effect
 - In developing countries, they skip the wired infrastructure and go directly to wireless
- Copper cable
 - Twist pair: Phone/DSL
 - Coax: CATV
 - Power line communications
- Optics

Wireless Channel

- Radiowave propagation
 - Natural phenomenon: impossible to control
- Antennas
 - Parts of radio system: possible to design
 - => continue to OOo slides

Why spectrum is important?

- Frequency is a tool to easily separate the signals.
- Finite resource to share
- To avoid interference
- Frequency is reused only if two stations are far apart.
- Different frequencies have different characteristics.

Bandwidth

Shannon's channel capacity

$$C = B \log_2\left(1 + \frac{S}{N}\right)$$

Obviously proportional to bandwidth



LF

- Radiobeacons for vessels and aircrafts
- Standard frequency and time signal
- Radio broadcasting
 (Only in North Asia and Europe)
- Remote controller (keyless entry)
- Stable propagation in long distance



MF

- Maritime communications
- Radio broadcasting (AM)
- Propagation in tens of km
- Simple receiver (AM)

HF



- Maritime and aeronautical communications
- International communications
- International radio broadcasting
- Amateur radio
- Historically used for international links



VHF

- FM broadcasting (incl. community radio)
- TV broadcasting
- Utility radio

disaster prevention, administrative, fire protection, railway

- Air traffic control
- Paging
- Amateur radio
- Cordless phone



Most important band nowadays.

- Cellular phone
- Trunked radio
- Utility radio
 taxi, disaster prevention, administrative, railway
- TV broadcasting
- Mobile satellite communications
- Radar
- Amateur radio
- Wireless LAN
- Cordless phone
- ISM (industry, science, and medical) equipment



Most important band in near future.

SHF (microwave)

- Wireless LAN
- Fixed microwave link
- Fixed wireless access
- Dedicated short range communications
- Broadcasting relay
- Satellite communications
- Satellite broadcasting
- Radar
- Radio astronomy
- 4G cellular phone

Characteristics of Radio Wave



- Diffraction dominant propagation
 - Long distance
- Narrower bandwidth
 Low data rate
- Cheaper equipment
- Bigger and less
 directive antennas



- Line-of-sight dominant propagation
 - Short distance
- Wider bandwidth
 - High data rate
- More expensive equipment
- Smaller and more directive antennas

Web Page

http://portal.uml.gsic.titech.ac.jp/moodle/cour se/view.php?id=3

• You can create your own account by yourself.