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Techniques: attennas and propagation, signal encoding, spreadspectrum, coding and error control

Specifications	Wired network	wireless network.
speed	high	low. except advanced wireless technologies.
BW	high	low.
cost	cheap ~~least little~~	expensive.
installation.	difficult	easy
Mobility	limited	not limited.
transmission medium	wires. cables Ethernet	EM waves / radio waves.
Network coverage extention.	hubs. switches	more areas due to wireless base stations
Application	LAN. MAN	WLAN. Infrared. Cellular WPAN.
Channel Interference	small	large.
QoS.	good	Poor.
Reliability	high	Low.

Licensed band is for specific athorization, registration, needed to purchase licenses.

Factor: signal power. carrier frequency. propagation distance. interference.

Outdoor: urban diffraction and scattering

Indoor: reflection, multipath.

Free Space Loss: $\frac{Pt}{Pr} = \frac{(cd)^2}{f^2 Ar At}$.

Free space: $L_{pB} = -20\log(f) + 20\log(d) - 10\log(AtAr) + 169.5\,dB$

Two-ray: $P_{rdBm} = P_{tdBm} + 10\log(Gh_t^2 h_r^2) - 40\log d$

Path Loss: $PL = P_{tdBm} - P_{rdBm} = 40\log(d) - 10\log(Gh_t^2 h_r^2)$.

Slow Fading: Over longer distances, change in the average received power level about which the rapid fluctuations occur;

Fade Margin = Received power - Receive sensitivity$|_{dBm}$.

Macrocell cost 231 WI: $L_{LOS}|_{dB} = 42.6 + 26\log_{10} d|_{km} + 20\log_{10} f|_{MHz}$

$L_{NLOS}|_{dB} = L_{FS} + L_{rts}(W_r, f, \Delta h_{mobile}, \phi) + L_{MSD}(\Delta h_{Base}, d, f, bs)$ (h_{Base})

$L_{rts}| = -8.8 + 10\log_{10}(f|_{MHz}) + 20\log_{10}(\Delta h_{mobile}[m]) - 10\log_{10}(w[m]) + L_{ori}$

$L_{MSD} = L_{bsh} + k_a + k_d\log_{10}(d[km]) + k_f\log_{10}(f|_{MHz}) - 9\log_{10}(b)$

Microcell: 2-ray model

Multipath: ① different phases add destructively, the signal level related to noise declines making signal detection at the receiver more difficult ② ISI.

Doppler Effect $fd = 2\cos\theta \cdot V_{rms}\frac{fc}{c}$ $fric(r) = \frac{r}{\sigma^2}e^{\frac{-(r^2+\alpha^2)}{2\sigma^2}} I_0(\frac{\alpha r}{\sigma^2})$ $r\geq 0\ \alpha\geq 0$

Rayleigh fading: none distinct dominant path ($\alpha = 0$)

Rician fading: with a dominant path.

Level crossing rate. $LCR = \sqrt{2\pi} f_d \rho e^{-\rho^2} fd$ Doppler shift: $\rho = \frac{R_{thresh}}{R_{rms}}$ average fading duration: $(e^{\rho^2}-1)/(\rho f_d\sqrt{2})$

BS: fixed location transceiver which provides network coverage.

Uplink: from a phone to the RBS Downlink: the other way. Cell: an area of land.

Local Area: limited number of cells.

Mobile switching center: MSC, the primary service delivery node for GSM/CDMA

VLR: database of the subscribers who have roamed into the jurisdiction of the MSC which it serves.

HLR: a central database that contains details of ~~to~~ to use the GSM core network.

Handoff: the procedure for changing the assignment of a mobile phone unit from one ~~to~~ as the mobile unit moves from one cell to another.

Location Management: deals with location registration and tracking of mobile terminals

2G VS 3G: cost: 3G > 2G data transmission: 3G >> 2G. function: 2G ~~via~~ info voice signals via video conferencing, MMS feature: 3G has mobile TV, video transfers, GPS system, etc. frequency: 2G broad range for both upper and lower bands. implication: 3G high security Making calls: no big difference. speed: 236k. 21M/s. /M

TDMA: transmission is in the form of a repetitive sequence of frames, each of which is divided into a number of time slots. Each slot position across the sequence of frames forms a separate logical channel.

CDMA: multiplexing technique. used with spread spectrum and a special coding scheme. (each transmitter assigned a code) ~~not~~

GGSN is responsible for the internetworking between the GPRS network and external packet switched networks.

SGSN: is responsible for the delivery of data packets from and to the mobile stations within its geographical service area.

MSC is responsible for routing voice calls, SMS and other services (such as conference calls)

GMSC a special kind of MSC that is used to route calls outside the mobile networks.

Standards IMT 2000 WCDMA ~~WiMax~~ Wimax TD-SCDMA. CDMA 2000

Key Features: 3G = 2Mbps. bandwidth 2GHz. carrier frequency. 5MHz. high ~~at~~ data rate transmission. high service flexibility, both FDD and TDD, support future enhancing tech.

all-IP wireless networks: ISB. is based on a combination of DiffServ and IntServ models appropriate for low-bandwidth 3G cellular networks with significant resource management capabilities. DSB. purely based on DiffServ model targeted for high-bandwidth wireless LANs with little resource management capabilities. AIP combines ISB and DSB architectures to facilitate the integration of wireless LAN and 3G cellular networks towards a uniform architecture for all-IP wireless networks

Phase-I: It simply extends the connection from the old AP to the new AP. to maintain the call connectivity

Phase-II: It may be invoked to setup an optimal path in certain situations. It involves determining the Location of crossover switch, replacing the old branch connection with the new branch, and updating the connection server about the status of the new existing route.

MCHO. the MS continuously monitors the signals of the surrounding BSs and initiates the handoff. prosess when some handoff criteria are met.

NCHO: the surrounding BSs measure the signal. from MS. and the network initiates the. handoff process when some handoff criteria are met.

MAHO: the network asks the MS to measure the signal from the surrounding BS. The network makes the handoff decision based on reports from the MS.

hard-hand-off: a mobile station communicates with only one base station.

soft hand-off: a mobile station communicate at the same time.

straight-line model: Once a movement direction is chosen, the node moves in a straight line until the direction changes.

Fluid Flow: If the ~~Gauss~~ Markov Model has strong memory, the velocity of mobile nodes at time slot t is same as its previous velocity.

Time-based: not dependant on Location Areas. Lower paging cost; only internal clock easy to manage; value of T could be set different for each users.

pros. useless cost the user is stationary. Location. uncertainty can't be bounded

~~not~~-based: pros: when user travels around the boundary, ~~there~~ unnecessary updates occur.

Location-based: paging cost is low when move less and move within specific distance.

Zone based: paging cost pros: unnecessary location updates if user crosses the boundary very frequently. When x moves from i to j, instead of updating all databases on the path from j through Loc(j,i) to i, only the databases up to a level m are updated.

A forwarding pointer: is set from node s to node t, where s is the ancestor of i at level m, and t is the ancestor of j at level m.

Permanent: Host your own File on FTP server. Host your own website or domain name server; use other servers or equipment; faster.

Mobile Nodes (MN): System (node) that can change the point of connection to the network without changing its IP address

Home Agent (HA) System in the home network of the MN, typically a router, Registration of the MN, tunnel IP datagrams to the COA

Foreign Agent: system in the current foreign networks of the MN, typically a router; Forwards the tunnelled datagrams to the MN, typically also the default router for the MN, provided the COA.

Care-of-Address: Address of the current tunnel endpoint for the MN; Actual location of the MN from an IP point of view.

In reverse tunneling: MN delievers the packets to FA using source address as its home address, FA encapsulates the datagrams and sends them to HA using reverse tunneling. HA delievers the packets to CN after decapsulating them.

Registration Phase: In this phase MN register its current COA with HA by sending the registration request message to HA, either via FA or directly using mobile node's CCOA. In response to this registration request message, HA sends a registration request message to MN again either via FA or directly to CoA. This registration must be authenticated for the successful delivery of packets to and from the MN as it moves around. The MN must register its current location before registration time expires. After the authenticated of MN, HA and FA update their caches and visitor list entry respectively.

distributed coordination function: A class of coordination function where the same coordination function logic is active in every station (STA) in the basic service set (BSS) whenever the network is operation.

Point coordination function: A class of possible coordination functions in which the coordination function logic is active in only one station (STA) in a basic service set (BSS) at any given time that the network is in operation.

IFS = The time interval between frames is called IFS. A STA shall determine that the medium is idle through the use of the CS function for the interval specified. Ten different IFSs are defined to provide priority levels for access to the wireless medium.

SIFS: the time from the end of last symbol, or signal extension if present, of the previous frame to the beginning of the 1st symbol of the preamble of the subsequent frame as seen on the WM.

PIFS: the PIFS is used to gain priority access to the medium.

DIFS: the DIFS shall be used by STAs operating under the DCF to transmit Data frame. (MPDUs) and Management frames (MMPDUs)

IEEE 802.11e-2005 or 802.11e is an approved amendment to the IEEE 802.11 standard that defines a set of quality of service (QoS) enhancements for wireless LAN applications through modification to the Media Access Control (MAC) layer.

Enhanced distributed channel access (EDCA): The prioritized carrier sense multiple access with collision avoidance access mechanism used by quality-of service (QoS) station (STAs) in a QoS basic service set (BSS) and STAs operates concurrently with hybrid cooperation function

(HCF) controlled access (HCCA).
hybrid coordination function (HCF) = A coordination function that combines and enhances ~~ment~~ aspects of the contention based and contention free access methods to provide quality-of-service (QoS) station (STAs) with prioritized and parameterized QoS access to the wireless medium (WM), while continuing to support non-QoS STAs for best-effort transfer.
Infrastructure Mode: Devices on the network all communicate through a single access point, which is generally the wireless router. For example, let's say you have two laptops sitting next to each other, each connected to the same wireless network. Even when sitting right next to each other, they're not communicating directly. Instead, they're communicating indirectly through the wireless access point. They send packets to the access point - probably a wireless router - and it sends the packets back to the other laptop. Infrastructure mode requires a central access point that all device connect to.
Ad-hoc mode: is also known as "peer-to-peer" mode. Ad-hoc networks don't require a centralized access point. Instead, devices on the wireless network to each other.
AP = STA MAC: data link layer PHY: physical layer.
The Logical Link Control (LLC) (IEEE-802.2): sublayer acts as an interface between the media access control (MAC) sublayer and network layer. The LLC sublayer is primarily concerned with multiplexing protocols transmitted over the. MAC layer (when transmitting) and decoding them (when receiving). In 802.11, flow control and error management is part of the CSMA/CA MAC protocol, and not part of the LLC layer.
802.11 Physical (PHY): layer is divided into 2 sublayers.
1. PLCP sublayer. The PLCP prepare the frame for tramssion by taking the frame from MAC sublayer & creating PLCP Protocol Data Unit
2. PMD sublayer. PMD sublayer then modulates and transmits the data as bits
However, in IEEE 802.11-2016 the PHY sublayer is never divided into 2 two parts.
The IR PHY uses near-visible light in the 850nm to 950nm range for signaling. Radio wireless networks use radio waves on a particular frequency for data transmission from device to ~~deride~~ device. IR: pro: cheap; con: range is limited, in an environment that has few or no reflecting surfaces, and where there is no line-of-sight, an IR PHY system may suffer a reduced range. RF: pro: range Con: expensive.
802.11 a/b/g/n/ac/ae/aa/ad/af/ai Priority: based on the priority part of MSDU
synchronization: many kinds, for OFDM symbol syn, carrier syn.
Software-Defined Networking (SDN): is an approach to computer networking that allows network administrators to programmatically intialize, control, change, and manage network behavoir dynamically via open interface and abstraction of lower-level functionality.
Characterizations of WiMAX: OFDM-based Physical Layer; Very High Peak Data Rates Support; Adaptive Modulation and Coding (AMC); Link-~~lay~~layer ~~Reco~~ Retransmissions; Support for TDD and FDD; WiMAX Uses OFDM; Flexible and Dynamic per User Resource Allocation; Support for Advanced Antenna Techniques; Quality-of-service Support; Robust Security; Support for Mobility; IP-based Architecture.
PHY: 10-66 GHz Frames duration: 0.5, 1 or 2 ms
The frame: divided in PHY slots for the purpose of ~~assi~~ bandwidth allocation and identification of PHY ~~transmis~~ transitions; One PHY slot is defined to be 4 QAM symbols.
TDD-PHY: UL sub-frame follows the DL sub-frame on the same carrier frequency.
FDD-PHY: UL and DL sub-frames are cincident in time but are carried on seperate frequencies
Space diversity: is achieved by observing the data from different paths in the space.