

Buku Ajar

**JARINGAN KOMUNIKASI
SELULAR**



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**UPT PERCETAKAN & PENERBITAN
UNIVERSITAS JEMBER**

JARINGAN KOMUNIKASI SELULAR

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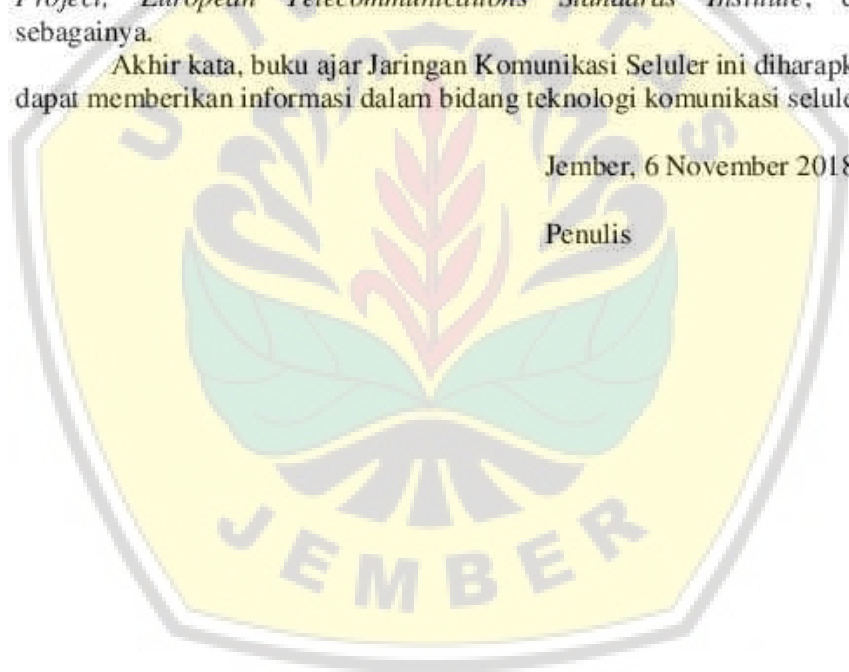
KATA PENGANTAR

Alhamdulillah Buku Ajar Jaringan Komunikasi Seluler ini dapat diselesaikan. Buku ini diharapkan dapat menjadi salah satu pengetahuan dalam bidang komunikasi seluler. Buku ini disusun berdasarkan perkembangan teknologi komunikasi yang berkembang diantaranya *Global System for Mobile Communiactions*, *General Packet Radio Service*, *Universal Mobile Telecommunications System*, dan *Long Term Evolution*. Pada pembahasannya didukung dengan *standard* sistem komunikasi. *Standard* sistem komunikasi yang digunakan diantaranya *International Telecommunication Union*, *Third Generation Partnership Project*, *European Telecommunicaitons Standards Institute*, dan sebagainya.

Akhir kata, buku ajar Jaringan Komunikasi Seluler ini diharapkan dapat memberikan informasi dalam bidang teknologi komunikasi seluler.

Jember, 6 November 2018

Penulis



PRAKATA

Dengan memanjatkan rasa syukur kehadiran Tuhan Yang Maha Esa atas selesainya penulisan dalam menyelesaikan pembuatan Buku Ajar dengan judul Jaringan Komunikasi Seluler. Buku ajar ini berisi tentang perkembangan teknologi komunikasi seluler diantaranya *Global System for Mobile Communiactions, General Packet Radio Service, Universal Mobile Telecommunications System, Long Term Evolution*, dan regulasi komunikasi. Tujuan dan manfaatnya merupakan salah satu buku yang dapat digunakan untuk penunjang pada pembelajaran. Pembuatan buku ajar ini dapat terlaksana atas kerjasama yang baik dari berbagai pihak. Untuk itu kami sampaikan terima kasih kepada yang terhormat :

1. Rektor Universitas Jember.
2. Dekan Fakultas Teknik Universitas Jember
3. LP3M Universitas Jember

Semoga buku ini dapat bermanfaat dalam memahami materi khususnya bidang komunikasi seluler.

Jember, 6 November 2018

Penulis

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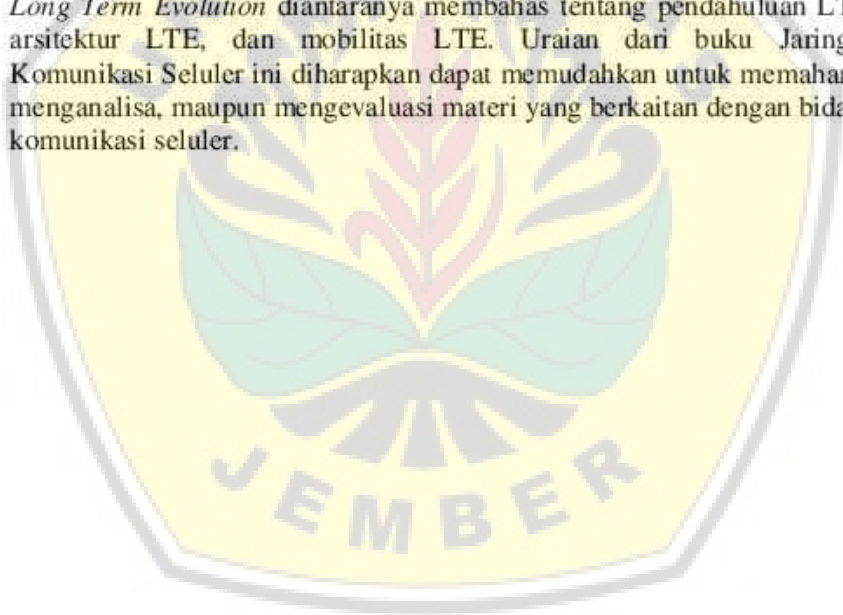
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TINJAUAN MATAKULIAH

Materi dalam buku Jaringan Komunikasi Seluler ini berisi tentang *Global System for Mobile Communiactions*, *General Packet Radio Service*, *Universal Mobile Telecommunications System*, *Long Term Evolution*, dan regulasi yang berhubungan dengan komunikasi seluler. Sub bahasan dari *Global System for Mobile Communications* diantaranya membahas tentang pendahuluan GSM, *Network Subsystem*, *Base Station Subsystem*, dan Mobilitas GSM. Sub bahasan dari *General Packet Radio Service* diantaranya membahas tentang pendahuan GPRS, elemen jaringan GPRS, dan mobilitas GPRS. Sub bahasan dari *Universal Mobile Telecommunications System* diantaranya membahas tentang pendahuluan UMTS, stuktur kanal UMTS, dan mobilitas UMTS. Sub bahasan dari *Long Term Evolution* diantaranya membahas tentang pendahuluan LTE, arsitektur LTE, dan mobilitas LTE. Uraian dari buku Jaringan Komunikasi Seluler ini diharapkan dapat memudahkan untuk memahami, menganalisa, maupun mengevaluasi materi yang berkaitan dengan bidang komunikasi seluler.



$$A_w(P) = \frac{0.0173 V_t(P) \gamma_w(f, P_{ref}, \rho_{v,ref}, t_{ref})}{\gamma_w(f_{ref}, P_{ref}, \rho_{v,ref}, t_{ref})} \text{ dB} \quad (5.56)$$

$$\rho_{v,ref} = \frac{V_t(P)}{4} \text{ (g/m}^3\text{)} \quad (5.57)$$

$$t_{ref} = 14 \ln \left(\frac{0.22 V_t(P)}{4} \right) + 3 \text{ (}^\circ\text{C)} \quad (5.58)$$

$V_t(P)$ merupakan hubungan *water vapour* pada persentase kebutuhan (kg/m^2 atau mm), diantaranya dapat diperoleh dari rekomendasi ITU-R P.836. Persamaan $\gamma_w(f, p, \rho, t)$ merupakan spesifikasi redaan berdasarkan fungsi pada frekuensi, tekanan, kerapatan *water-vapor* dan suhu [11].

5.6 Rangkuman

Level regulasi bidang telekomunikasi diantaranya level tingkat internasional dan nasional. Pada tingkat regulasi Internasional diantaranya *International Telecommunication Union (ITU)*, *Asia Pacific Telecommunity (APT)*, *ASEAN Telecommunication Regulatory Council (ATRC)*, dan Koordinasi bilateral antar negara. Pada regulasi tingkat Nasional terdapat perundang-undangan tingkat Nasional, peraturan Menteri Komunikasi dan Informatika, peraturan Direktorat Jenderal Sumber Daya dan Perangkat Pos dan Informatika (Dirjen SDPPI). Beberapa standar yang diantaranya *operating band*, *output power* dari *base transceiver station*, *output power* dari *mobile station*, frekuensi *carrier*, *channel coding* dan *multiplexing*, redaman atmosfer, dan sebagainya.

5.7 Bahan Diskusi

Regulasi dan standar Internasional untuk komunikasi seluler.

5.8 Daftar Pustaka

- [1] ..., *Alokasi Frekuensi Kebijakan dan Perencanaan Spektrum Indonesia*, Departemen Komunikasi dan Informatika Direktorat Jenderal Pos dan Telekomunikasi, 2010.
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- [13] ..., *Universal Mobile Telecommunications System (UMTS); FDD Base Station (BS) classification*, ETSI, 2016.
- [14] ..., *Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path*, ETSI, 2010.

5.9 Latihan Soal

1. Sebutkan beberapa standard komunikasi seluler pada ITU ?
2. Sebutkan beberapa Keputusan Menteri Komunikasi dan Informatika ?
3. Sebutkan beberapa peraturan yang ada pada Direktorat Jenderal Sumber Daya dan Perangkat Pos dan Informatika ?

4. Carilah standar output power pada Base Transceiver Station ?
5. Carilah standar output power pada Mobile station ?



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- [6] 3GPP, *3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; General Packet Service (GPRS); Mobile Station (MS) – Base Station System (BSS) interfacel; Radio Link Control/Medium Access Control (RLC/MAC) protocol*, 3GPP, 2005.
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- [17] 3GPP, *3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception*, 3GPP, 2009.
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- [21] ..., *Pengalokasian kanal pada pita frekuensi radio 800 MHz untuk penyelenggaraan jaringan tetap local tanpa kabel dengan mobilitas terbatas dan penyelenggaraan jaringan bergerak seluler*, Keputusan Menteri Komunikasi dan Informatika, Nomor: 181/KEP/M.KOMINFO/12/2006.
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- [26] ..., *Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path*, ETSI, 2010.

GLOSARIUM

INDEX

GSM

3GPP

AGCH

AICH

AMR

AMR-NB

AMR-WB

AoA

AoD

APN

APT

ARQ

AS

AS

ATCF

ATM

ATRC

AuC

AUTN

BCCH

BICN

BPR

BSC

BSS

BTS

CB

CC

CC SM

CCCH

CCE

CCES

INFORMATION*Global System for Mobile Communications**The 3rd Generation Partnership Project**Access Grant Channel**The Acquisition Indication Channel**Adaptive Multirate**AMR-Narrowband**AMR-Wideband**Angle of Arrival**Angle of Departure**Access Point Names**Asia Pacific Telecommunity**Automatic Repeat Request**Access Stratum**Application Server**Access Transfer Control Function**Asynchronous Transfer Mode**ASEAN Telecommunication Regulatory Council**Authentication Center**Authentication**The Broadcast Control Channel**Bearer-Independent Core Network**Branch Power Ratio**Base Station Controller**Base Station Subsystem**Base Transceiver Station**Coordination Beamforming**Call Control**Call Control, Session Management**The Common Control Channel**Control Channel Elements**Control Channel Elements*

INDEX

CDMA

CDR

CFU

CK

CM

CMAS

CoMP

CQI

CQI

C-RNTI

CSFB

CTCH

DCCH

DCCH

DCH

DCI

Dirjen SDPPI

DPDCH

DPS

D-RNC

DRX

DSP

DTAP

DTCH

DTCH

DTX

DVRBs

EARFCN

E-DCH

E-DPDCH

EFR

Eicic

EIRP

INFORMATION*Code Division Multiple Access**Call Detail Record**Call Forwarded Unreachable**Chipher Key**Connection Management**Commercial Mobile Alert System**Coordinated Multipoint Operation**Channel Quality Indeks**Channel Quality Indicator**Cell Radio Network Temporary Identity**Circuit Switched FallBack**The Common Traffic Channel**The Dedicated Control Channel**Dedicated Control Channel**The Dedicated Channel**Downlink Control Information**Direktorat Jenderal Sumber Daya dan Perangkat Pos dan Informatika**The Dedicated Physical Data Channel**Dynamic Point Selection**Drift Radio Network Controller**Discontinue Reception**Digital Signal Processing**Direct Transfer Application Part**The Dedicated Traffic Channel**Dedicated Traffic Channel**Detection Transmitted**Distributed Virtual Resource Blocks**Absolute Radio Frequency Channel Number**Enhanced Dedicated Channel**Enhanced Dedicated Physical Data Channel**Enhanced Full Rate**Enhanced ICIC**Equivament or Effective Isotropically Radiated Power*

INDEX

ETSI
 ETWS
 E-UTRA
 FACCH
 FACH
 FASFRI
 FDD
 FDMA
 FR
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 GGSN
 GMM
 GMSK
 GMSK
 GPRS
 GTP
 HARQ
 HLR
 HR
 HSDPA
 HSDPA
 HS-DPCCH
 HS-DSCH
 HSPA
 HS-PDSCH
 HSS
 HS-SCCH
 HSUPA
 HTML
 HTTP
 ICIC
 IFFT
 IMS
 IMSI

INFORMATION

European Telecommunications Standards Institute
Earthquake and Tsunami Warning System
Evolved Universal Terrestrial Radio Access
Fast Associated Control Channel
The Forward Access Channel
Tabel Alokasi Spektrum Frekuensi Radio Indonesia
Frequency Division Duplex
Frequency Division Multiple Access
Full Rate
Frequency and Time Division Multiple Access
The Gateway GPRS Support Node
GPRS Mobility Management
Gaussian Shift Keying Minimum
Gaussian Minimum Shift Keying
General Packet Radio Service
GPRS Tunneling Protocol
Hybrid Automatic Retransmission Request
Home Location Register
Half Rate
High Speed Download Packet Access
High Speed Downlink Packet Access
High Speed Dedicated Physical Control Channel
High Speed Downlink Shared Channel
High Speed Packet Access
High Speed Physical Downlink Shared Channel
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High Speed Shared Control Channel
High Speed Uplink Packet Address
Hyper Text Markup Language
Hyper Text Transfer Protocol
Inter Cell Interference Coordination
Inverse Fast Fourier Transformation
IP Multimedia Subsystem
International Mobile Subscriber Identity

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IN

INFORMATION*The Intelligent Network Subsystem*

IP

Internet Protocol

IP

Internet Protocol

IPV

Internet Protocol Version

IRAU

Inter Routing Area Update Procedure

I-SCSF

Interrogating - Call Control Session Function

ITU

International Telecommunication Union

ITU-RR

ITU Radio Regulation

JT

Joint Transmission

KAD

Kemampuan Akhir yang diharapkan

LAC

Location Area Register

LAI

Local Area Identity

LLC

Logical Link Control

LTE

Long Term Evolution

LVRBs

Localized Virtual Resource Blocks

MAC

Medium Access Control

MAP

Mobile Application Part

MCS

Modulation and Coding Scheme

MGW

Media Gateway

MGW

Media Gateway

MIB

Master Information Block

MIME

Multipurpose Internet Mail Extension

MIMO

Multiple Input Multiple Output

MM

Mobility nagement

MM

Mobility Management

MME

Mobility Management Entity

MMS

Multimedia Messaging Service

MNC

Mobile Network Code

MNC

Mobile Network Code

MPR

Maximum Power Reduction

MSC

Mobile Switching Center

MSC-S

MSC-Server

MSC-S

MSC - Server

MSC-S

MSC - Server

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MSISDN

MSISDN

MSRN

MTC

NACK

NAS

NAT

NSS

OFDM

OFDMA

OMA

PACCH

PBCH

PBX

PCCH

P-CCPCH

PCFICH

PCH

PCH

PCI

PCM

PCU

PDCCH

PDCP

PDN-GW

PDP

PDSCH

PDSCH

PDTCH

PHICH

PLMN

PMI

PRACH

PRACH

INFORMATION*Mobile Station International Subscriber Directory Number**Mobile Subscriber Integrated Services Digital Network**Mobile Station Roaming Number**Machine Type Communications**Negative Acknowledgement**Non Access Stratum**Network Address Translation**Network Subsystem**Orthogonal Frequency Division Multiplexing**Orthogonal Frequency Division Multiplexing Access**Open Mobile Alliance**Packet Associated Control Channel**Physical Broadcast Channel**Private Branch Exchange**The Paging Control Channel**The Primary Common Control Physical Channel**Physical Control Format Indicator Channel**Paging Channel**The Paging Channel**Physic Cell Identity**Pulse Code Modulation**The Control Unit Packet**Phsical Downlink Control Channel**Packet Data Convergence Protocol**Packet Data Network Gateway**Packet Data Protocol**Physical Downlink Shared Channel**Phsical Downlink Shared Channel**Packet Data Traffic Channel**Physical Hybrid - ARQ Indicator Channel**Public Land Mobile Network**Precoding Matrix Indicator**The Physical Random Access Channel**Physic Random Access Channel*

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PSS

PTCCH

PUCCH

PUSCH

QAM

QOS

QPSK

RAB

RACH

RACH

RANAP

RAT

RAU

RB

REG

RFC

RI

RISC

RLC

RNC

RoHC

RRC

RRH

RRHs

RSCP

RSRP

RSRQ

RSSI

RSSI

RTD

RTP

RV

S1-CP

S1-UP

INFORMATION*Primary Synchronization Signal**Packet Timing Advance Common Control Channel**Physical Uplink Control Channel**Physical Uplink Shared Channel**Quadrature Amplitude Modulation**Quality of Service**Quadrature Phase Shift Keying**Radio Access Bearer**Random Access Channel**The Random Access Channel**Radio Access Network Application Part**Radio Access Technology**Routing Area Update**Resource Block**Resource Element Group**Request for Comments**Rank Indicator**Reduced Instruction Set**Radio Link Control**Radio Network Controller**Robust Header Compression**Radio Resource Control**Remote Radio Head**Remote Radio Heads**Received Signal Code Power**The Reference Signal Receive Power**Reference Signal Receive Quality**Received Signal Strength Indication**The Receiver Strength Signal Indication**Repetition Time Diversity**Real Time Transport Protocol**Redundancy Version**S1 Control Plane**S1 User Plane*

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 SCC - AS
 SCCP
 S-CCPCH
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 SIM
 SIP
 SM
 SON
 SRB
 S-RNC
 SRS
 SR-VCC
 SSS
 TAC
 TCH
 TCP
 TDD
 TD-LTE
 TDMA
 TEID
 TFCI
 TMSI
 TPC
 TRAU
 UA

INFORMATION

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Service Centrallization and Continuity Application Server
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The Secondary Common Control Physical Channel
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Synchronization Channel
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The Temporary Mobile Subscriber Identity
Transmit Power Control
Transcoder Rate Adaptation Unit
User Agen

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UDP

UDP

UE

UICC

UM DRB

UMTS

UMTS CS

UMTS PS

URA-PCH

USB

USSD

UTRAN

UTRAN

VDSL

VLR

VoIP

VoLTE

WBMP

WSP

WTP

XRES

INFORMATION*User Datagram Protocol**User Datagram Protocol**User Equipment**Universal Integrated Circuit Card**Unacknowledged Mode Data Radio Bearer**Universal Mobile Telecommunications System**UMTS Circuit Switched**UMTS Packet Switched**UTRAN Registration Area Paging Channel**Universal Serial Bus**Unstructured Supplementary Service Data**UMTS Terrestrial Radio Access Network**The Universal Terrestrial Radio Access Network**Very High bitrate Digital Subscriber Line**Visitor Location Register**Voice Over Internet Protocol**Voice over LTE**Wireless Application Protocol Bitmap**Wireless Session Protocol**Wireless Transaction Protocol**Expected Response*

RINGKASAN BUKU & BIOGRAFI PENULIS**Ringkasan**

Perkembangan teknologi komunikasi seluler diantaranya ditunjukkan dari perkembangan dari generasi ke generasi, seperti GSM *Global System for Mobile Communications*, *General Packet Radio Service*, *Universal Mobile Telecommunications System*, *Long Term Evolution*, dan sebagainya. Pada buku ini menjelaskan perkembangan jaringan komunikasi seluler berdasarkan dari generasi ke generasi yaitu 1G hingga 4G, dan regulasi komunikasi seluler. Regulasi komunikasi merupakan peraturan maupun penelitian yang telah menjadi standar pada sistem komunikasi seluler. Pada bagian regulasi komunikasi disajikan beberapa hal yang berhubungan dengan peraturan level Nasional dan standar level Internasional tentang jaringan komunikasi seluler.

Biografi Penulis

Penulis merupakan pengajar di Universitas Jember. Penulis aktif kegiatan penelitian dalam bidang telekomunikasi.