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Komunikasi Data dan Komputer
Edisi 7

Bab 22

Distributed Applications

Electronic Mail

- Paling banyak digunakan di aplikasi pada beberapa jaringan
- Simple Mail Transfer Protocol (SMTP)
  - —TCP/IP
  - —Pengiriman pesan text yang sederhana
- Multi-purpose Internet Mail Extension (MIME)
  - —Pengiriman dari tipe-tipe data yang lain
  - —Suara, gambar/photo, video

SMTP

- RFC 821
- Tidak sesuai untuk format pesan/data
  - Covered in RFC 822 (see later)
- SMTP menggunakan info tertulis di envelope of mail
  - Message header
- Isinya tidak terlihat
  - Message body
- Kecuali:
  - Standard karakter message diset ke 7 bit ASCII
  - Menambah log info untuk memulai dari message
    - menampilkan path taken

Dasar Pengoperasian

- Mail diciptakan oleh user agen program (mail client)
  - —Pesan terdiri dari:
    - Header containing recipient's address and other info
    - Body containing user data
- Pesan diantrikan dan dikirimkan sebagai input ke SMTP sender program
  - —Typically a server process (daemon on UNIX)

Mail Message Contents

- Masing-masing pesan yang diantrikan memiliki:
  - —Text pesan
    - RFC 822 header with message envelope and list of recipients
    - Message body, composed by user
  - —Daftar tujuan pesan
    - Derived by user agent from header
    - Mungkin ditulis di header
    - May require expansion of mailing lists
    - May need replacement of mnemonic names with mailbox names
- jika BCCs diketahui, user agen perlu untuk menyiapkan format pesan yang benar

SMTP Sender

- Mengambil pesan dari antrian
- Dikirimkan ke tujuan host sendiri
  - Via SMTP transaction
  - Over one or more TCP connections to port 25
- Host memiliki bermacam-macam senders aktif
- Host should be able to create receivers on demand
- Ketika pengiriman selesai, sender menghapus tujuan dari daftar pesan
- Ketika semua tujuan telah diproses, pesan dihapus

Optimization

- Jika tujuan pesan untuk multiple users ditentukan host, pesan dikirim hanya sekali
  - —Pengiriman ke users ditangani pada host tujuan
- Jika berbagai pesan siap diberikan host, sebuah koneksi TCP dapat digunakan
  - —Saves overhead of setting up and dropping connection

Possible Errors

- Host unreachable
- Host out of operation
- Koneksi TCP gagal selama proses transfer
- Sender can re-queue mail
  - —Menyerah setelah beberapa saat
- Faulty destination address
  - —Kesalahan pengguna
  - —Target/yang dituju merubah alamat
  - —Redirect if possible
  - —Inform user if not

SMTP Protocol - Reliability

- Digunakan untuk mengirimkan pesan dari sender to receiver melalui koneksi TCP
- Berusaha untuk memberikan layanan yang dapat dipercaya
- Tidak menjamin untuk mendapatkan kembali pesan yang hilang
- No end to end acknowledgement to originator
- Tidak menjamin adanya indikasi kesalahan dalam proses pengiriman
- Umumnya dapat dipercaya

SMTP Receiver

- Menerima pesan yang datang
- Places in user mailbox or copies to outgoing queue for forwarding
- Receiver harus:
  - Verify local mail destinations
  - Deal with errors
    - Transmission
    - Lack of disk space
- Pengirim bertanggung jawab pada pesan sampai receiver memberitahukan proses transfer selesai
  - Mengetahui surat yang sudah tiba di host, bukan pemakai

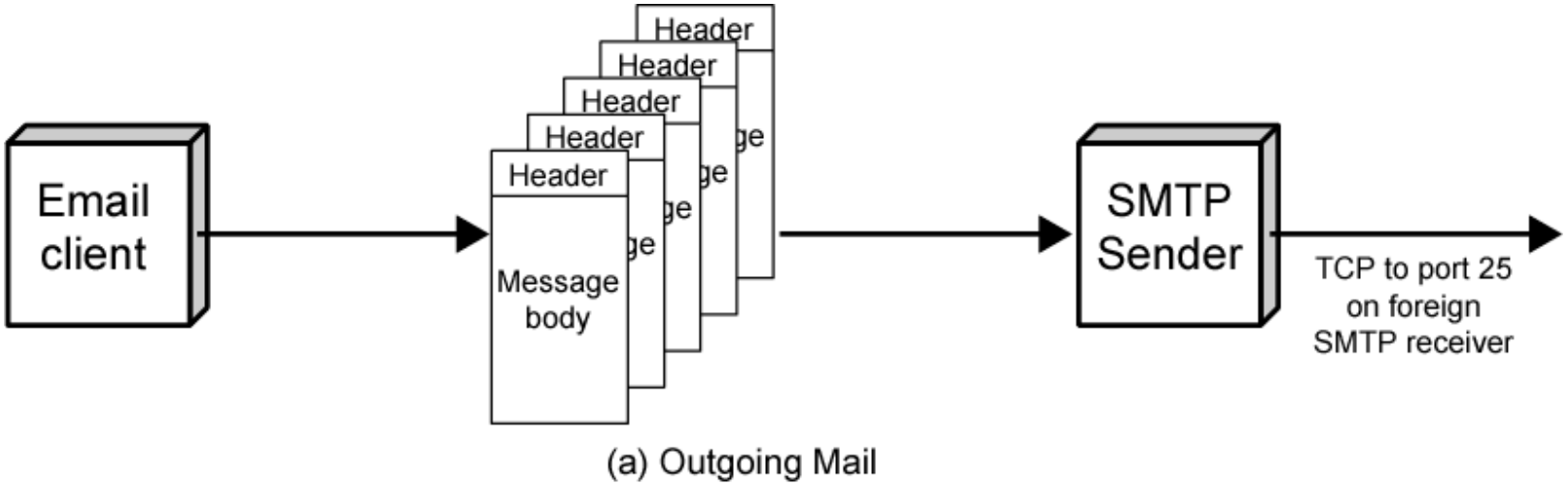
SMTP Forwarding

- Sering digunakan untuk transfer secara direct dari pengirim host ke receiver host
- May go through intermediate machine via forwarding capability
  - —Pengirim dapat menspesifikasi route
  - —Target user may have moved

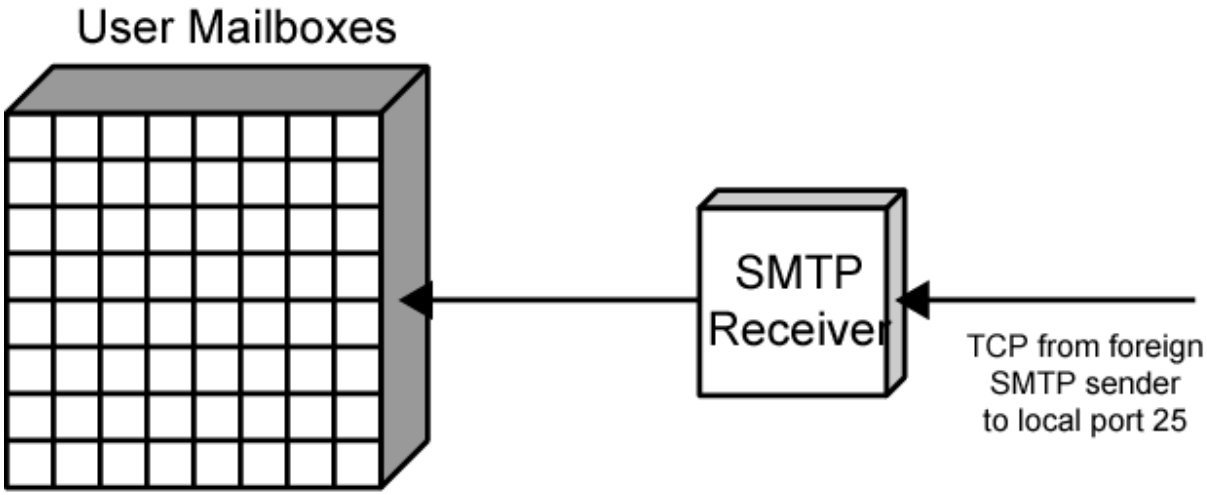
Conversation

- SMTP membatasi pembicaraan antara pengirim dan receiver
- Fungsi utama adalah untuk mengirimkan atau transfer pesan
- Berhenti menangani mail diluar lingkup SMTP
  - Mungkin berbeda antar sistem

SMTP Mail Flow



(a) Outgoing Mail



(b) Incoming Mail

SMTP System Overview

- Perintah and respon antara sender dan receiver
- Permulaan dengan sender
  - —melakukan koneksi TCP
- Sender mengirimkan perintah untuk receiver
- HELO<SP><domain><CRLF>
- Masing-masing perintah mengaktifkan satu balasan
- 250 requested mail action ok; completed

SMTP Replies

- Digit terdepan menandai kategori
  - Positive completion reply (2xx)
  - Positive intermediate reply (3xx)
  - Transient negative completion reply (4xx)
  - Permanent negative completion reply (5xx)

Operation Phases

- Setup koneksi
- Sentral command-response pairs
- Pembatasan koneksi

Connection Setup

- Pengrim membuka jalur koneksi TCP dengan receiver
- Sekali dikoneksikan, receiver mengidentifikasi dirinya sendiri
  - 220 <domain> service ready
- Sender mengidentifikasi dirinya sendiri
  - HELO
- Receiver menerima identidikasi dari sender's
  - 250 OK
- Jika servis mail tidak tersedia, langkah 2 diatas menjadi:
  - 421 service tidak tersedia

Mail Transfer

- Sender boleh mengirim satu pesan atau lebih ke receiver
- Perintah MAIL mengidentifikasi originator
  - Memberi alur kebalikan digunakan untuk error reporting
  - Receiver returns 250 OK or appropriate fail/error message
- Satu atau lebih perintah RCPT diidentifikasi penerima dari pesan
  - Memisahkan pesan untuk masing-masing penerima
- DATA command mentransfer text pesan
  - Akhir dari pesan ditandai oleh line yang hanya berisi period (.)

Closing Connection

- Dua langkah
- Sender mengirim QUIT dan menunggu jawaban
- Kemudian memerintahkan TCP menutup koneksi
- Receiver memerintahkan TCP menutup koneksi setelah mengirimkan balasan ke QUIT

Format for Text Messages RFC 882

- Message ditampilkan mempunyai amplop dan isi
- Amplop berisi informasi yang diperlukan untuk transmisi dan pengiriman message
- Message is sequence of lines of text
  - Uses general memo framework
  - Header biasanya kata kunci yang diikuti oleh tanda titik dua yang diikuti oleh argumentasi

Example Message

Date:Tue, 16 Jan 1996 10:37:17 (EST)

From: "William Stallings" <ws@host.com>

Subject:The syntax of RFC 822

To: Smith@otherhost.com

Cc: Jones@Yet-another_host.com

This is the main text, delimited from the header by a blank line.

Multipurpose Internet Mail Extension (MIME)

- Extension to RFC822
- SMTP tidak dapat transmit executables
  - Uuencode and other schemes are available
    - Not standardized
- Tidak dapat mengirimkan text termasuk karakter internasional (e.g. â, å, ä, è, é, ê, ë)
  - butuh 8 bit ASCII
- Servers bisa menolak mail jika melebihi ukuran standar/asli
- Terjemah dari ASCII dan EBCDIC tidak standar
- SMTP gateways ke X.400 tidak dapat menangani sama sekali data teks di X.400 messages
- Beberapa implemantasi SMTP tidak memenuhi standart
  - CRLF, truncate or wrap long lines, removal of white space, etc.

Overview of MIME

- Lima bentuk header pesan baru
  - —MIME version
  - —Content type
  - —Content transfer encoding
  - —Content Id
  - —Content Description
- Jumlah format dibatasi
- Transfer encoding dibatasi

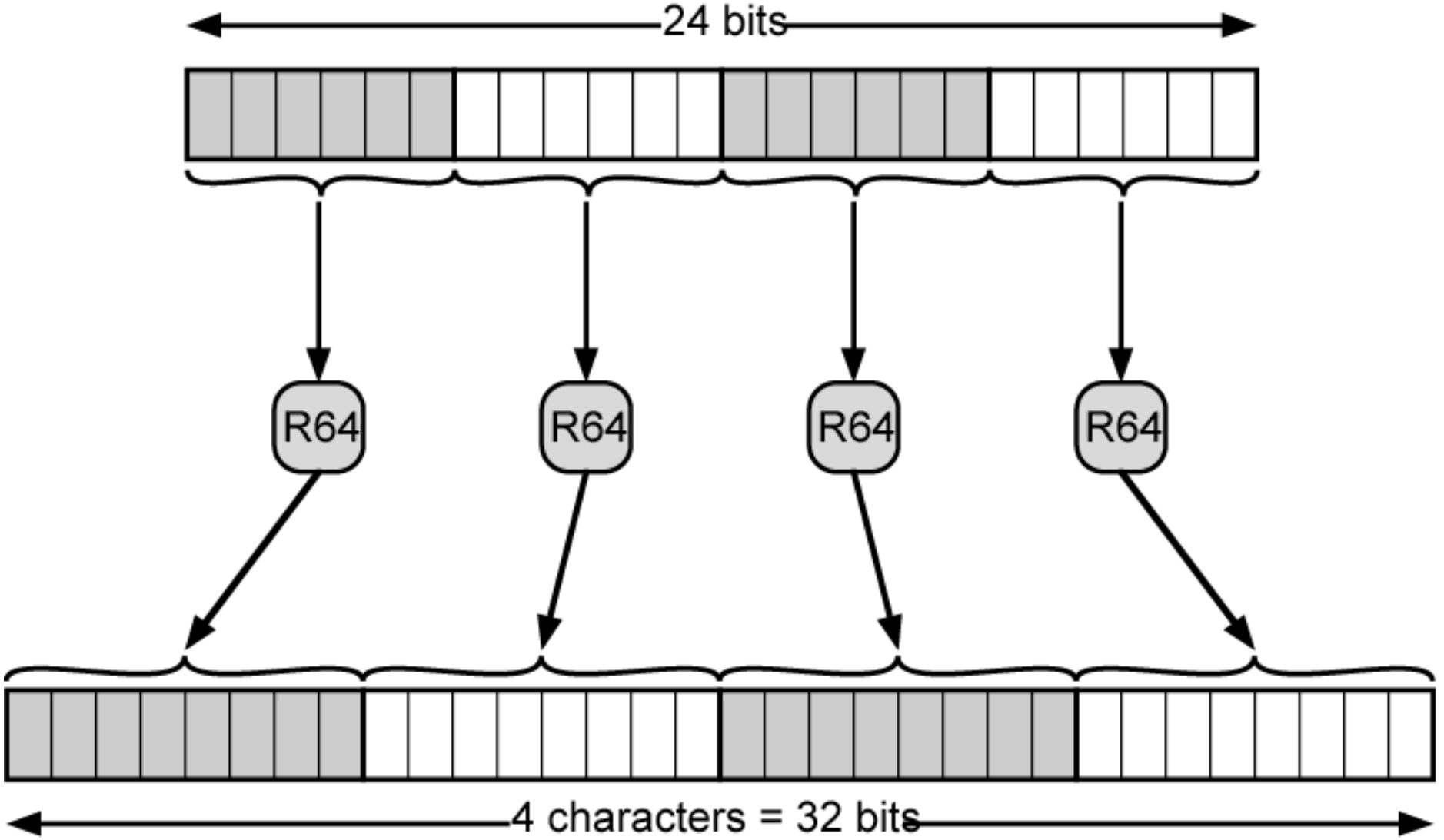
Content Types

- Text body
- Multipart
  - Mixed, Parallel, Alternative, Digest
- Message
  - RFC 822, Partial, External-body
- Image
  - jpeg, gif
- Video
  - mpeg
- Audio
  - Basic
- Application
  - Postscript
  - octet stream

MIME Transfer Encodings

- Reliable delivery across wide largest range of environments
- Isi transfer encoding field
  - Six values
  - Three (7bit, 8bit, binary) no encoding done
    - Provide info about nature of data
- Quoted-printable
  - Data largely printable ASCII characters
  - Non-printing characters represented by hex code
- Base64
  - Maps arbitrary binary input onto printable output
- X-token
  - Named nonstandard encoding

Radix-64 Encoding



Hypertext Transfer Protocol HTTP

- Underlying protocol of the World Wide Web
- Bukan protocol untuk pengiriman hypertext
  - For transmitting information with efficiency necessary for hypertext jumps
- Dapat mentransfer plain text, hypertext, audio, images, dan Informasi Akses Internet

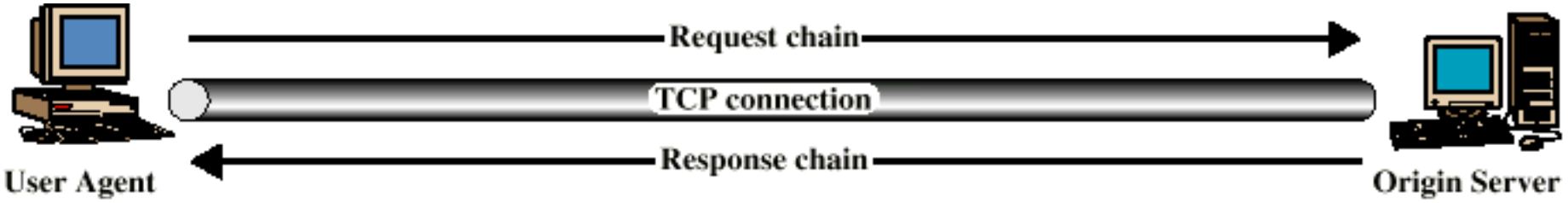
HTTP Overview

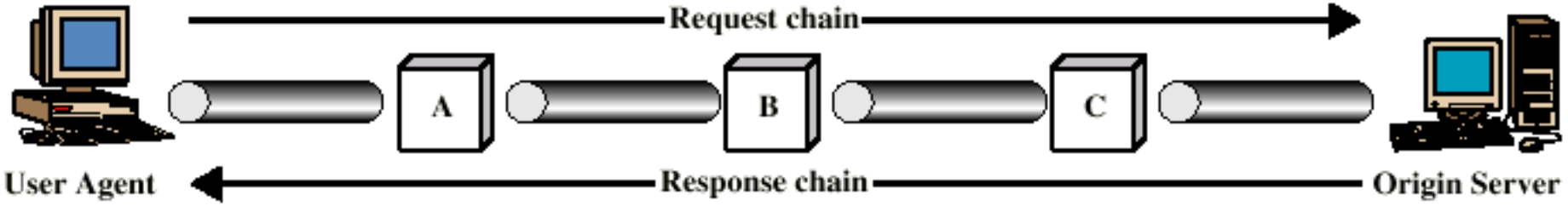
- Transaction oriented client/server protocol
- Biasanya antara Web browser (clinet) dan Web server
- Menggunakan koneksi TCP
- Stateless
  - Each transaction treated independently
  - Each new TCP connection for each transaction
  - Terminate connection when transaction complete

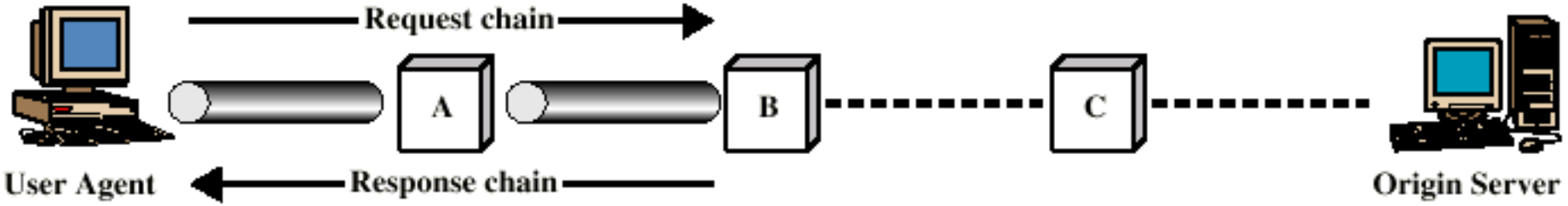
Key Terms

- Cache
- Client
- Connection
- Entity
- Gateway
- Message
- Origin server
- Proxy
- Resource
- Server
- Tunnel
- User agent

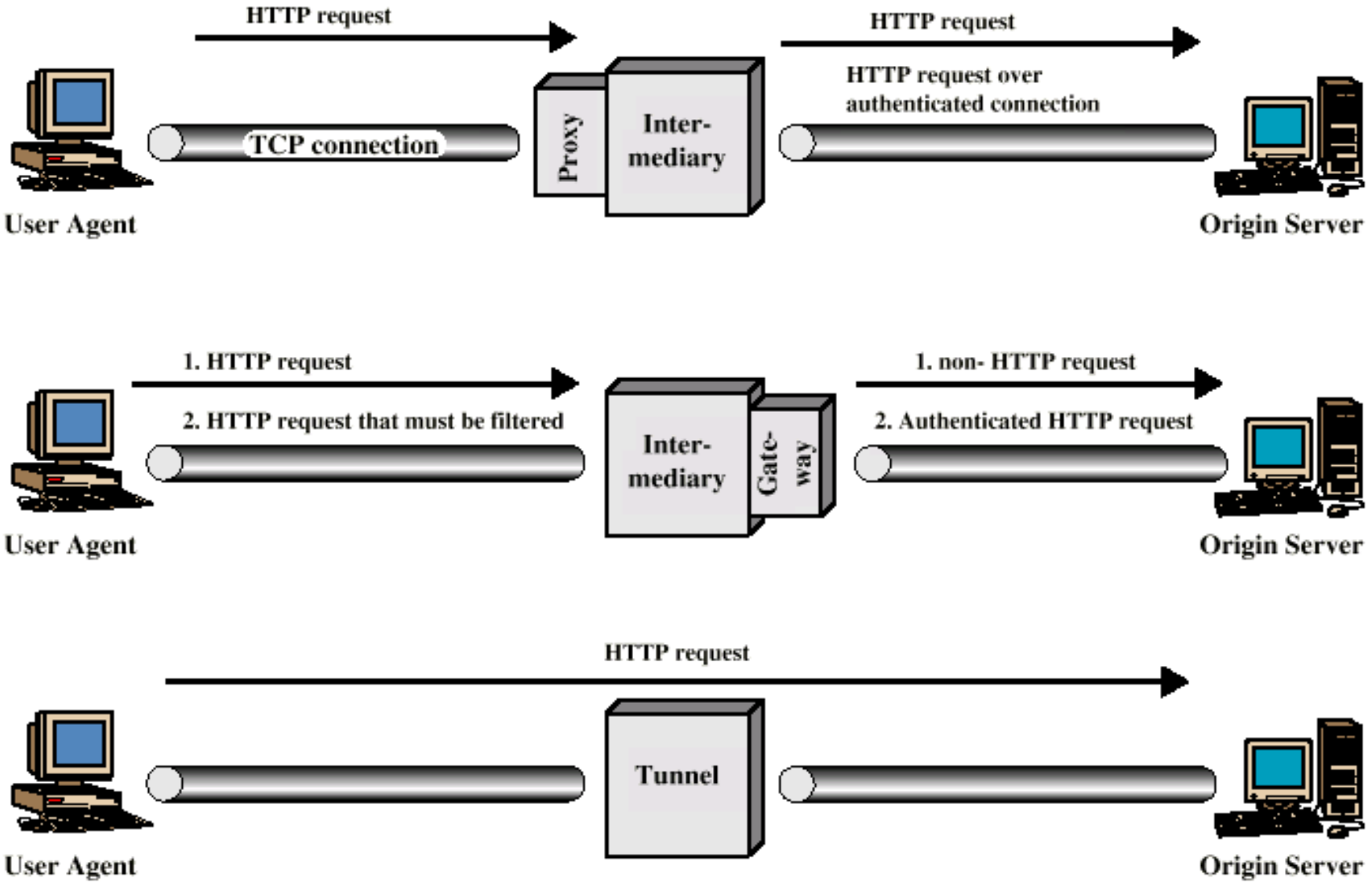
Examples of HTTP Operation







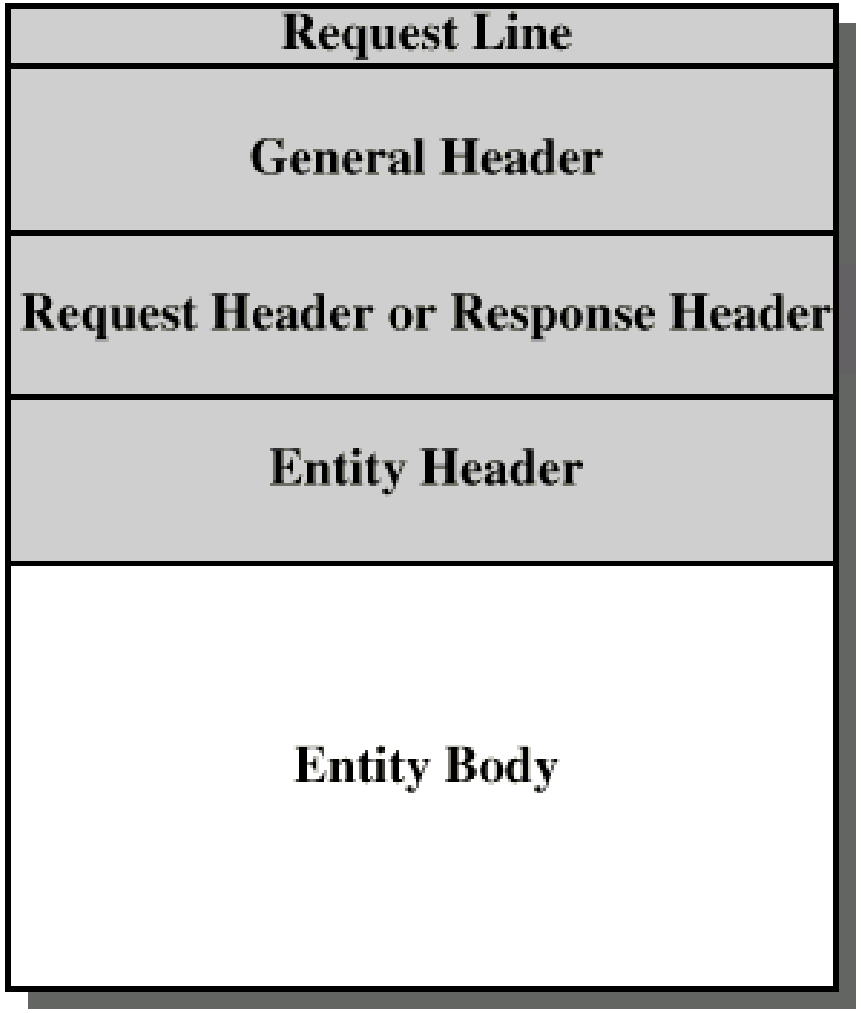
Intermediate HTTP Systems



HTTP Messages

- Requests
  - Client to server
- Responses
  - Server to client
- Request line
- Response line
- General header
- Request header
- Response header
- Entity header
- Entity body

HTTP Message Structure



General Header Fields

- Cache control
- Connection
- Data
- Forwarded
- Keep alive
- MIME version
- Pragma
- Upgrade

Request Methods

- Request-Line = Method <SP> Request_URL <SP> HTTP-Version <CRLF>
- Methods:
  - Options
  - Get
  - Head
  - Post
  - Put
  - Patch
  - Copy
  - Move
  - Delete
  - Link
  - Unlink
  - Trace
  - Wrapped
  - Extension-method

Request Header Field

- Accept
- Accept charset
- Accept encoding
- Accept language
- Authorization
- From
- Host
- If modified since
- Proxy authentication
- Range
- Referrer
- Unless
- User agent

Response Messages

- Status line followed by one or more general, response and entity headers, followed by optional entity body

- Status-Line = HTTP-Version <SP> Status-Code <SP> Reason-Phrase <CRLF>

Status Codes

- Informational
- Successful
- Redirection
- Kesalahan client
- Kesalahan server

Response Header Fields

- Location
- Proxy authentication
- Public
- Retry after
- Server
- WWW-Authenticate

Entity Header Fields

- Allow
- Content encoding
- Content language
- Content length
- Content MD5
- Content range
- Content type
- Content version
- Derived from
- Expires
- Last modified
- Link
- Title
- Transfer encoding
- URL header
- Extension header

Entity Body

- Arbitrary sequence of octets
- HTTP mengirimkan bermacam-macam tipe data seperti:
  - —text
  - —binary data
  - —audio
  - —images
  - —video
- Interpretation of data determined by header fields
  - —Content encoding, content type, transfer encoding

Network Management - SNMP

- Simple Network Management Protocol
- Networks menjadi sangat dibutuhkan
- Lebih komplek membuat kegagalan lebih mungkin
- Require automatic network management tools
- Standards required to allow multi-vendor networks
- Covering:
  - Services
  - Protocols
  - Management information base (MIB)

Network Management Systems

- Collection of tools for network management
- Single operator interface
- Kuat, mudah dalam pengesetan perintah
- Performing most or all management tasks
- Minimal amount of separate equipment
  - i.e. use existing equipment
- View entire network as unified architecture
- Active elements provide regular feedback

Key Elements

- Management station or manager
- Agent
- Management information base
- Network management protocol

Management Station

- System yang berdiri sendiri atau merupakan bagian dari shared system
- Interface for human network manager
- Set of management applications
  - Data analysis
  - Fault recovery
- Interface to monitor and control network
- Translate manager's requirements into monitoring and control of remote elements
- Data base of network management information extracted from managed entities

Management Agent

- Hosts, bridges, hubs, routers dilengkapi dengan agent software
- Allow them to be managed from management station
- Respond to requests for information
- Respond to requests for action
- Asynchronously supply unsolicited information

Management Information Base

- MIB
- Representation of network resources as objects
- Each object a variable representing one aspect of managed object
- MIB is collection of access points at agent for management of station
- Objects standardized across class of system
  - Bridge, router etc.

Network Management Protocol

- Menghubungkan antar management station dan agent
- TCP/IP menggunakan SNMP
- OSI menggunakan Common Management Information Protocol (CMIP)
- SNMPv2 (enhanced SNMP) untuk OSI and TCP/IP

Protocol Capabilities

- Get
- Set
- Notify

Management Layout

- Mungkin di pusatkan di simple network
- Mungkin didistribusikan di jaringan besar yang kompleks
  - —Multiple management servers
  - —Each manages pool of agents
  - —Management may be delegated to intermediate manager

Example of Distributed Network Management Configuration

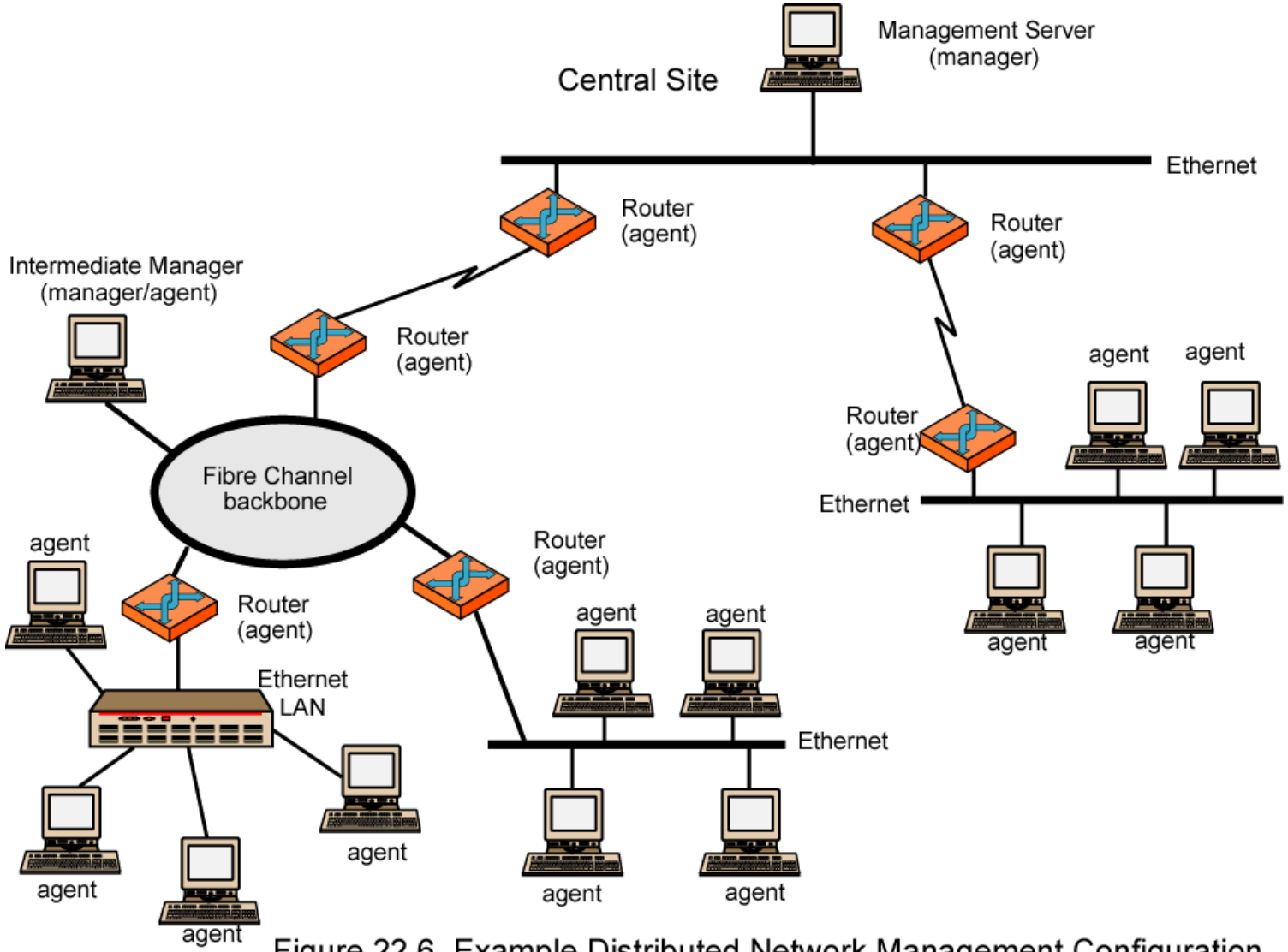
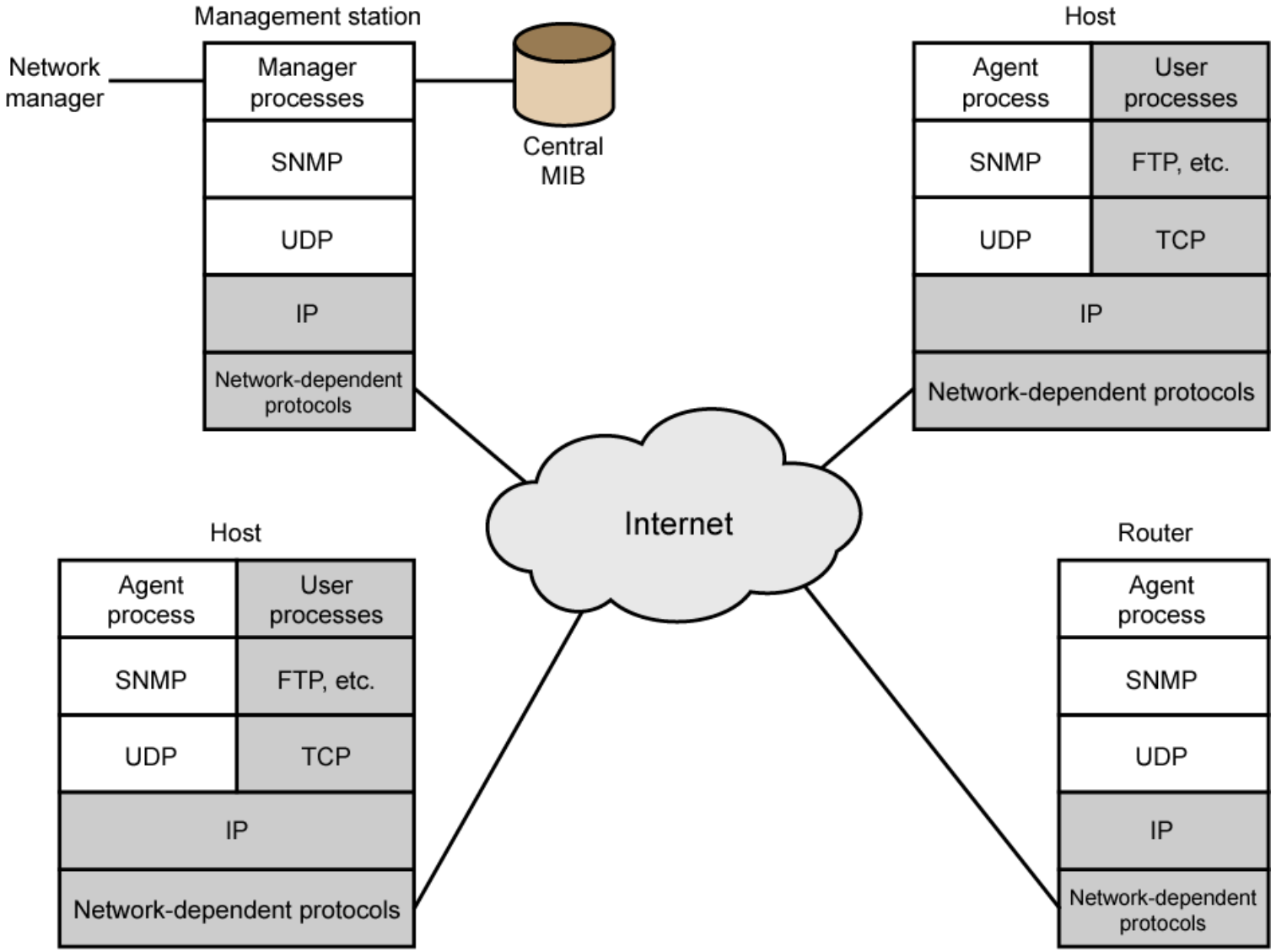


Figure 22.6 Example Distributed Network Management Configuration

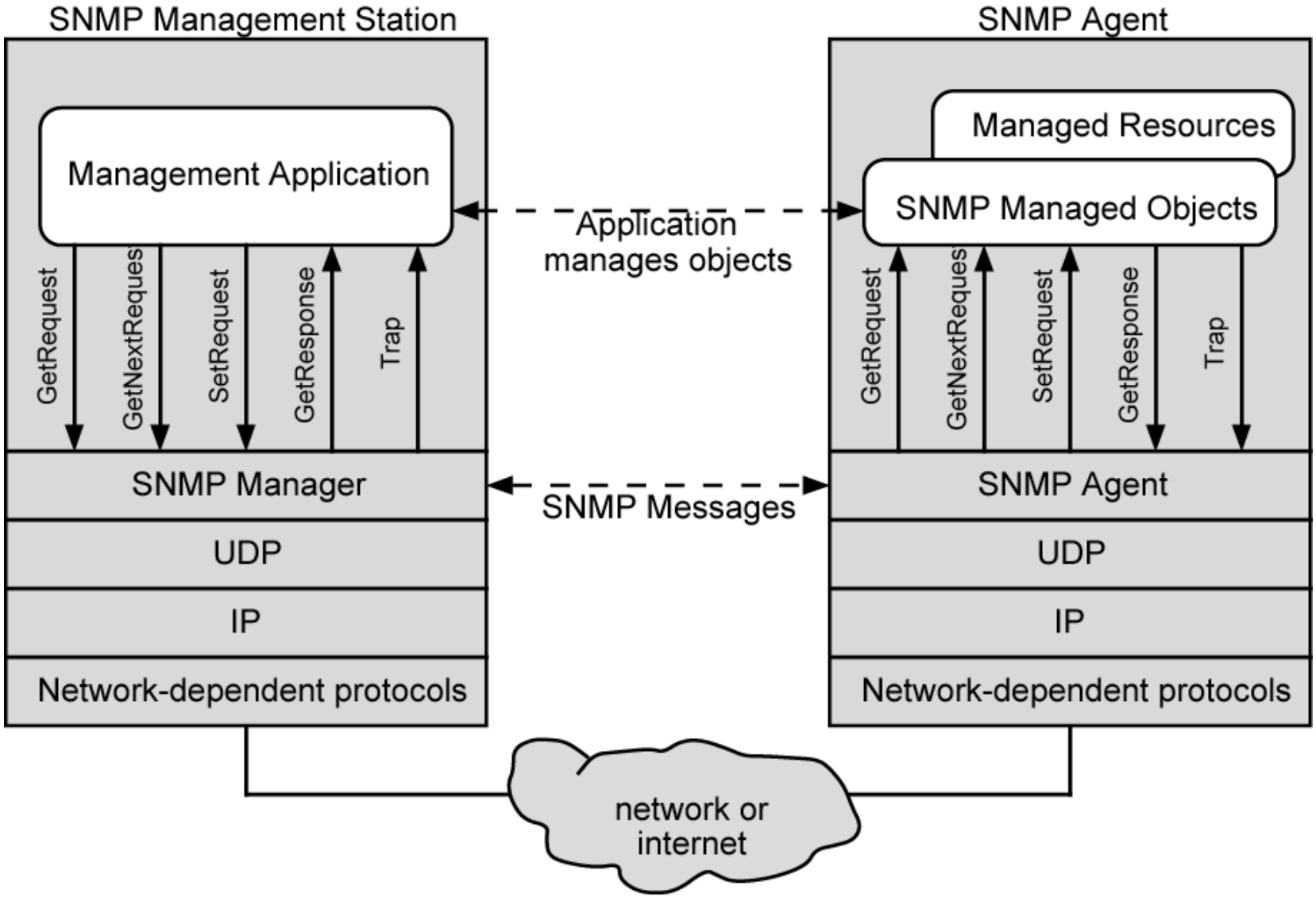
Network Management Protocol Architecture

- Application-level protocol
- Part of TCP/IP protocol suite
- Runs over UDP
- Dari management station, tiga tipe SNMP messages issued
  - GetRequest, GetNextRequest, and SetRequest
  - Port 161
- Agent replies with GetResponse
- Agent may issue trap message in response to event that affects MIB and underlying managed
  - Port 162

SNMPv1 Configuration



Role of SNMP v1



SNMP v1

- Spesifikasi SNMP dikeluarkan agustus 1988
- Stand alone management stations and bridges, routers workstations etc supplied with agents
- Defines limited, easily implemented MIB of scalar variables and two dimensional tables
- Protocol yang diefektifkan
- Kemampuan yang terbatas
- Ketiadaan keamanan
- SNMP v2 1993, ditinjau kembali 1996
  - RFC 1901-1908

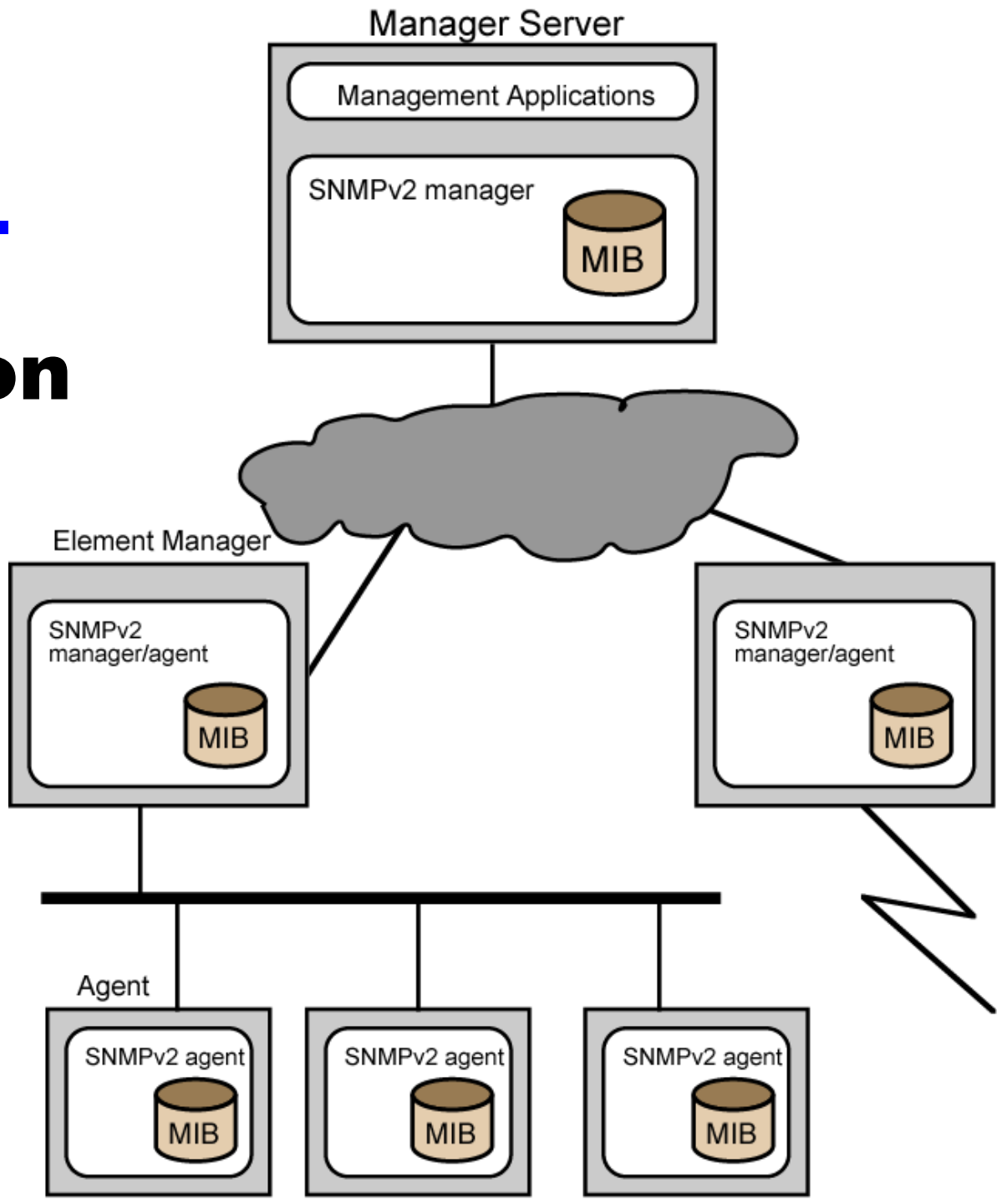
SNMP v2 (1)

- Framework on which network management applications can be built
  - —e.g fault management, performance monitoring, accounting
- Protocol digunakan untuk menukar management information
- Each player maintains local MIB
  - —Structure defined in standard
- Sedikitnya satu sistem yang bertanggung jawab untuk management
  - —Houses management applications

SNPM v2 (2)

- Support central atau distributed management
- Didalam sistem ditribusi, beberapa elements beroperasi seperti manager dan agent
- Pertukaran menggunakan SNMP v2 protocol
  - —Simple request/response protocol
  - —Typically uses UDP
    - Ongoing reliable connection not required
    - Reduces management overhead

SNMP v2 Managed Configuration



Structure of Management Information

- SMI
- Defines general framework with which MIB defined and constructed
- Mengidentifikasi tipe data
- How resources are represented and named
- Encourages simplicity and extensibility
- Scalars and two dimensional arrays of scalars (tables) only

Protocol Operation

- Pertukaran pesan
- Outer message header deals with security
- Tujuh jenis dari PDU

SNMP v2 PDU Formats

PDU type	request-id	0	0	variable-bindings

(a) GetRequest-PDU, GetNextRequest-PDU, SetRequest-PDU, SNMPv2-Trap-PDU, InformRequest-PDU

PDU type	request-id	error-status	error-index	variable-bindings

(b) Response-PDU

PDU type	request-id	non-repeaters	max-repetitions	variable-bindings

(c) GetBulkRequest-PDU

name1	value1	name2	value2	• • •	name*n*	value*n*

(d) variable-bindings

SNMP v3

- Addresses security issues of SNMP v1/2
- RFC 2570-2575
- Proposed standard January 1998
- Menggambarkan keseluruhan kemampuan keamanan dan arsitektur
- Untuk digunakan dengan SNMP v2

SNMP v3 Services

- Authentication
  - Part of User-Based Security (UBS)
  - Assures that message:
    - Datang dari identified source
    - belum diubah
    - belum delayed atau replayed
- Privacy
  - Encrypted messages using DES
- Access control
  - Dapat mengatur agen untuk menyediakan sejumlah tingkatan akses ke MIB
  - Access to information
  - Membatsi operations

Required Reading

- Stallings chapter 22
- WWW Consortium
- Loads of web sites on SNMP