

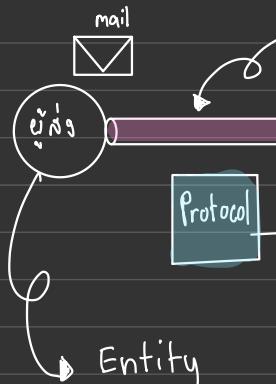
ICN



ICN Week1

Network គឺជាការសំនងការពាណិជ្ជកម្ម 2 ផ្លូវការណ៍ដំបូល

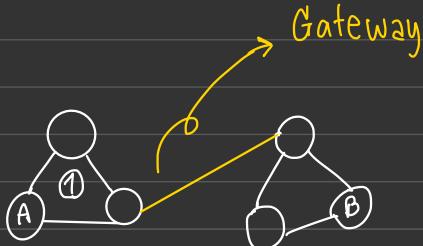
ទូទៅស្នើសារមួយ Network



medium (ពេះការទោះ)

- ផែអេខី (Light Optical)
- នឹងថាម (Wireless)

របៀបនៃការសំនងការ ចេញគុណភាពគុណភាពទូទៅ
(TCP/IP, HTTP, FTP, DNS)



រាយគុណភាពទូទៅ 2 network
តូចចាប់ InterNetworking

នគរបៀបរបៀបទូទៅ Network of Networks

Data

→ volunteered Data (ពេលវេលាដែលបានចូលរួមដោយខ្លួនគ្នា)

→ Observed Data (បានចូលរួមដោយខ្លួនគ្នា តាមការស្វែងរក និងការធ្វើឡើង)
ទៅលើការបង្កើតផលការងារ

→ Inferred Data (ទិន្នន័យត្រូវបង្កើតមានលទ្ធផល ជាការបង្កើតផលខ្លួន)

ទិន្នន័យត្រូវបង្កើតផល The Bit (គោរពតាតុ) → រួចរាល់ Binary



- electrical Signal → សាខាពាយໄល, សម្បាងໄដអី
- Light Signal → Fiber Optical (fact ពាន់ Fiber Optic នឹងការលើកឡើង)
ឈរនៃ Noise ដែលការ
- Wireless Signal → នាក់អី, គិតថាទាម

គឺនូវរាងការសែងក្រែង → រំភិបត់ គាមនឹង, Delay

ការរំភិ 10 mb/s

Bandwidth គឺជាគាមនឹងស្តីពីទំនាក់ទំនងការសែងក្រែង

Data	Bandwidth	throughput
2 mb	10 mb/s	2 mb/s
0 mb	10 mb/s	0 mb/s
20 mb	10 mb/s	10 mb/s

Throughput គឺជាគាមនឹងនៃការសែងក្រែងនៅលើម៉ាស៊ីន

សែងប្រើប្រាស់

Bandwidth = max throughput
(ឯករាជការបង្រី)

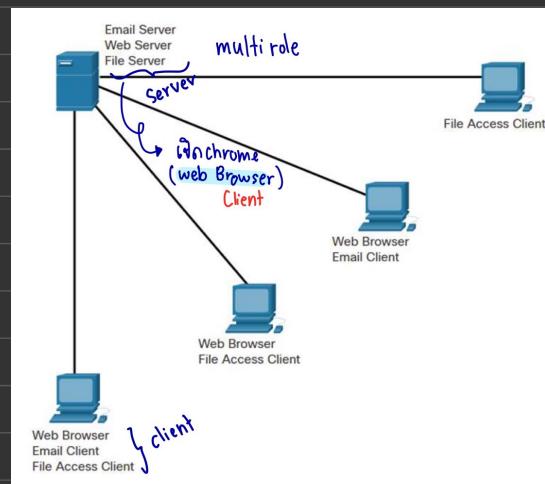
Clients n' Server

→ Host គឺ node នៃ Network ដែលមានការសារឡាតាំង Run App ។



Peer-to-Peer Network → តើមីនិត្តកិច្ច Client និង Server នឹងត្រូវដោយគ្នា

multi role



Infrastructure (ទេសចរណ៍)

→ End Device (ពេកផ្ទាល់ពេញចុះ)

→ Intermediate Device (អង្គភាពនៃ NW)
ex router, sw

→ Network Media (Access link)
(ផ្លូវការ, medium, ឥងការ)

LAN COMPONENT

→ Hosts (end device)

→ Peripheral (ພວກ ຂອງ, ສິ້ນພາ, Keyboard, ອຸປະກອດທີ່ໄດ້ມີການປະມານລົບ)

→ Network device (ພວກ router, sw.)

→ Network media (ຕາກລາງ, ຜາຍ, Access link)

ສ່ວນໃຈຮູບແບບຂອງ Network ທີ່ເຮັດວຽກ

Hosts running network app

Network edge → ສູດປາລະນວດ Network ຮ່ານໃຈງົດເປັນ end device

Network
Network Core → ໜຳເຫຼືອ → Packet Switching
ໂຕໂຫຼວດ ແຕ່ລະ ຈຳເປື້ອງກົດ

Access Network → ຕົກລາງ

(Infrared Port)

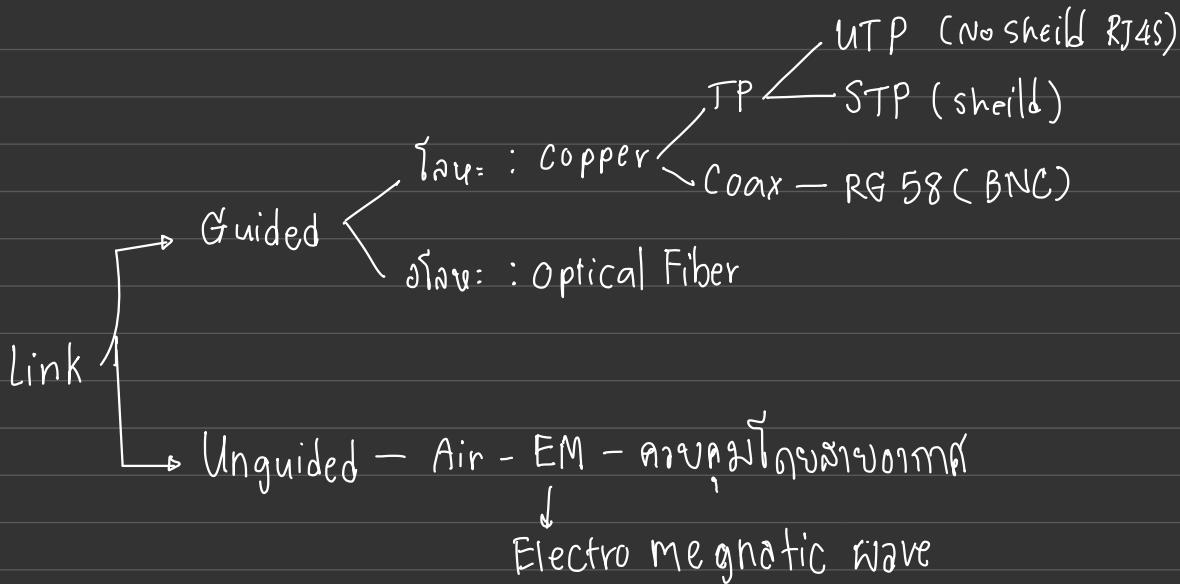
wire
LAN: Ethernet
WAN: xDSL, FTTx

wireless
LAN: WiFi, BT, NFC, IrDA
WAN: 3G, 5G, WiMax (802.16)

1) ວິທີ່ງານພາກທີ່ໃຫຍ່ໃນການ

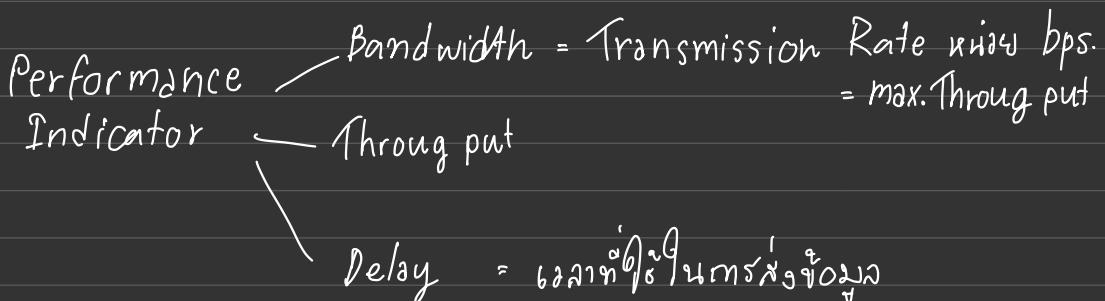
Data Over Cellular Network
gprs

2) Network Interface Module/Card



Half-Duplex សំខែរបស់ភ្លាមៗនៃបន្ទាន់

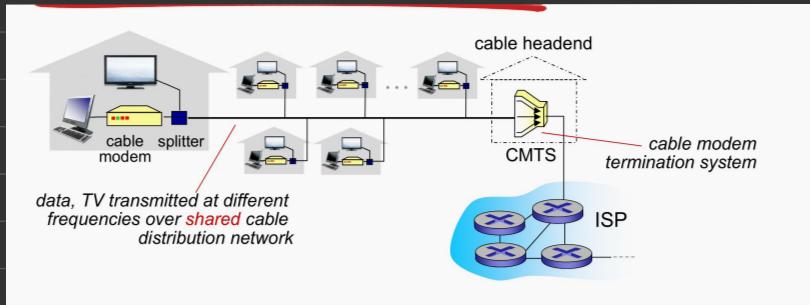
Full-Duplex សំខែរបស់ភ្លាមៗនៃភ្លាមៗ



Access Network

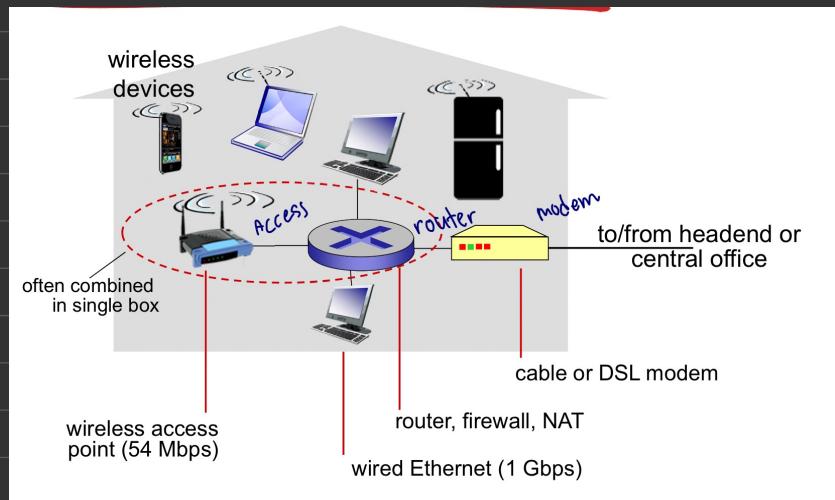
នៅលើប្រព័ន្ធ Share , dedicated

Share គឺជាគេវយោង Access ទៀតនេះក៏ដែរ



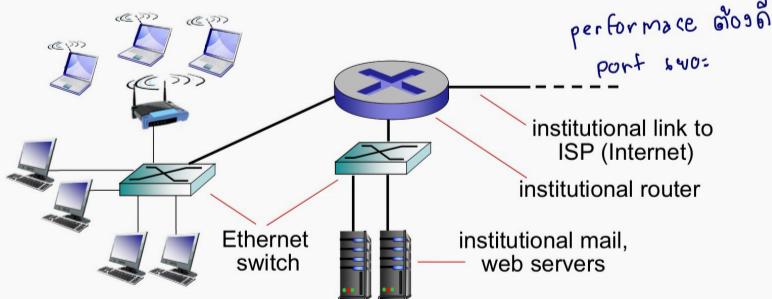
Dedicated គឺជាគេវយោងមិនចាប់ផ្តើមពីមុនពេលទៅសម្រាប់ bandwidth ពេញចូល

ទីផ្សាន Home



ອົບອົບ Enterprise

Enterprise access networks (Ethernet)



- typically used in companies, universities, etc.
- 10 Mbps, 100Mbps, 1 Gbps, 10Gbps transmission rates
- today, end systems typically connect into Ethernet switch

ອິນເວັບ Wireless

wireless LANs:

- within building (100 ft.)
- 802.11b/g/n (WiFi): 11, 54, 450 Mbps transmission rate



ຂອງນີ້ ລົມລົມກຳຕົ້ນ
(Mobilities)

wide-area wireless access

- provided by telco (cellular) operator, 10's km
- between 1 and 10 Mbps
- 3G, 4G: LTE

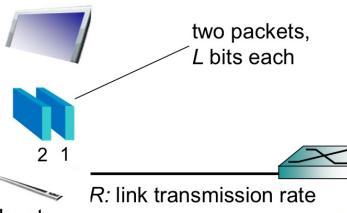


การส่ง Data ผ่านระบบ Access และ การคำนวณของ delay

host sending function:

- takes application message
- breaks into smaller chunks, known as **packets**, of length L bits
- transmits packet into access network at **transmission rate R (bandwidth)**
- link transmission rate, aka link **capacity**, aka **link bandwidth**

เวลาที่ต้อง clear เอก鞍客ต์ Host



ex) มีชิบ 10 ก้อน ใบบัว 1 ก้อน/ร
7 ร่อง 10 sec

$$\text{packet transmission delay} = \frac{\text{time needed to transmit } L\text{-bit packet into link}}{R \text{ (bits/sec)}} = \frac{L \text{ (bits)}}{R \text{ (bits/sec)}}$$

Introduction 1-19

Physical media

Guided media (ก้านมดก)

- Copper, fiber, coax

Unguided media (ไม่ก้านมดก)

- radio (อากาศ)

Copper twisted pair (TP)

- สายตรง, สาย Cross
- เรียงลําสື່
- ຈົບເສັ່ນ
- ອາຈນີກຽບການສ້າງຢູ່ອານຸ
- ຈົບຕັ້ງພັ້ນສາຍມົວງາງ
- Sheild กับ NO-Sheild

Coax Cable

- ลາງເຮດຕັ້ງພິບເປົ້ນ Bus
- ມີSheild

Fiber Optic

- ຈົບເສັ່ນ : ເຊິ່ງກ່າໄຟຝ້າ, ຄວາມໂກລ
ການສ້າງຢູ່ອານຸໄຟ່ຕ້ອງຄື
ໜູ້ກ່າວສ້າງຢູ່ອານຸກົບໄຟຝ້າ
- ຈົບເສັ່ນ : ພົມງ່າຍ, ແລ້ວ
ຈະເລີ່ມສ້າງຢູ່ອານຸໄຊ Absolution loss

▷ radio

ຈົດຕື່ອ Mobility

ຫົວເລີ່ມ

- ການສະກັບພາຍໃຕ້ໃນເກີດການແນກຮັດລົງຖານ (Multi Path) ▷ reflection
- ຫຼຸກກຶ່າງຈາກ ▷ ໂຄງຄາມຍາວຄລືນສັ້ນ ຈຶ່ງໄດ້ກຶ່າງຈາກເງິ່ນ
- ການຄູກຮບການເນື່ອນຂອງໂກລົງ (Interference)

ຝຶລາງປະເທດ

▷ terrestrial microwave

▷ LAN (WiFi) → 54 Mbps

▷ wide-area (cellular)

▷ satellite

Leo ອິກສ່ (ຕິດຕາວສອງ Day night)

meo ນິກາງ

geo ອິກາວ (ຕາວເກີ່ມດ້າວພໍາ)

Network Core > ពាក Router Connected

Packet-Switching : store-and-forward

> បញ្ចប់ message into packets នៅក្នុងបណ្តុះបណ្តុះ គ្រាមទំនាក់ទំនាក់
(full link capacity)

Path នីមួយៗ Links (Hops)

> ស្ថារតាំងវាតិំ នៅ Hops

ដែលត្រូវបាន
រាយរបា
Protocol



> ឧបនឹង queuing and loss : → ដែលត្រូវបាន (queuing delay)

: loss ក្នុង buffer (តីងកាតិំ) full

Key word : routing → ដំឡើងភាពរវាងប្រព័ន្ធបាន

forwarding → ផ្ទេរព័ត៌មានដោយព័ត៌មាន

Circuit-Switching : បញ្ចប់គ្រាមទំនាក់ទំនាក់ → ទីតាមតិំខ្លួនឯងចេរក្នុងបណ្តុះ

• FDM (Frequency) > បញ្ចប់តិំខ្លួនគ្រាមរបា (no share)



• TDM (Time) > បែងចែងពេលវេលា → ទីតាមពេលវេលាដែលបានបញ្ចប់



Binomial : link : 2 mb/s

User active when $\geq 133.33 \text{ kB/s}$

active 50 %

circuit switch $\frac{2000 \text{ kB/s}}{133.33 \text{ kB/s}} = 15 \text{ atm.}$

packet user 20 an սիմուլացիան վճարելու (overload)

$P_{CX} > 15 \text{ atm}$

$N = 20$

possibility = 0.5

$Prob = 0.005909$

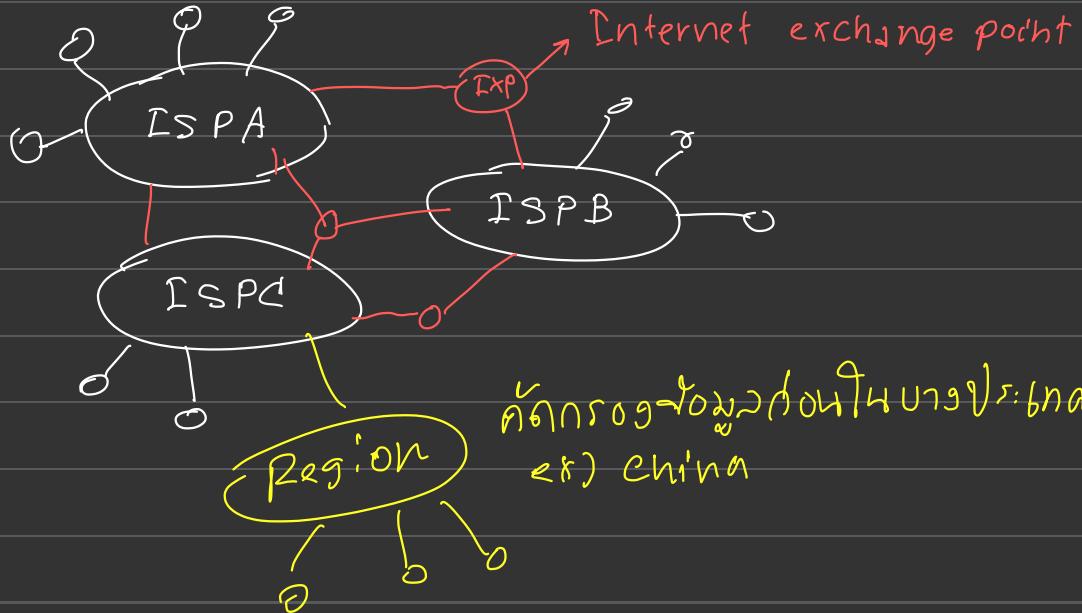
$X = 15$

$P_{CX} > 15 \rightarrow \{16, 17, 18, 19, 20\}$

$$\begin{aligned} P_{CX=16} &= Prob = 0.005 \\ P_{CX=17} &= Prob = 0.001 \\ P_{CX=18} &= Prob = 0.000 \\ P_{CX=19} &= Prob = 0.000 \\ P_{CX=20} &= Prob > 0.000 \end{aligned} \quad \left. \right\} \quad 0.006 \checkmark$$

Packet SW → មុនកំពូលការទាំងរប់ Data ទេសចរណ៍អាជវត្សន៍
→ ទៅ User តែមានការណា

end system → ទៅ Internet ឱ្យកិចចំដោយ [SPs]



Content Provider network → កម្រោង Server នៃការ
Tier 1 គឺ → កម្រោងកម្មវិធី Server

delay

$$d_{\text{nodal}} = d_{\text{proc}} + d_{\text{queue}} + d_{\text{trans}} + d_{\text{prop}}$$

เวลาที่ 1 Hops processing คิว ส่งไปยังบุคคล ขนส่ง

T_d = End to End

T_R กับ = Round trip

- delay, loss, throughput
- protocol layer, Service models
- security

Delay คือเวลาที่นิรบส์ต้องผ่าน (รวมๆ)

- ▷ nodal processing delay
 - กระบวนการพัฒนาต่อไป เช่น Check bit, Routing
- ▷ queuing delay
 - รอดำ
 - traffic intensity (รากศูนย์)
 - $\frac{La}{R} ; a$ คืออัตราการเข้ามาของ Packet
 - $\frac{La}{R} \sim 0$: เกิดการคิวไม่มีปัญหา (รากศูนย์)
 - $\frac{La}{R} \approx 1$: เกิดการคิวเฉลี่ยวจาก (รากศูนย์)
 - $\frac{La}{R} > 1$: เกิดอันดับ (ข้อมูลเข้ามามากกว่าที่มีช่องทาง) \rightarrow ไม่สามารถ Process ได้
(จะรอ 2) ∞
- ▷ transmission delay
 - $\frac{L}{R}$ packet length (bit)
Link Bandwidth (bit/sec)
- ▷ propagation delay
 - * ไม่สามารถแก้ไขได้
 - * ทำให้เสียเวลา!
 - เสลาในกราฟอาจไม่เท่า
 - $\frac{d}{S}$ (ระยะทาง)
(ความเร็ว)

* traceroute ▷ function ที่คุณสามารถ Host → Host มันเดินไปยังไง

Packet loss ▷ คือเมื่อสั้นเกิน Buffer และ Drop ที่

loss packet มันจะถูกส่งให้ไปยัง Host, node บนเส้นทาง
หรือ ซึ่งมันไม่สามารถรับได้

Through put រាជធានីក្រោង NW

Bandwidth រាជធានីក្រោងដែលមិនអាច fail (Max through put)

ផ្តល់ភាពទូរារសំខែង	វត្ថុការងារ	ការពិនិត្យការងារ	Delay	តាមរយៈ 10 mb/s
Bandwidth គឺ	ការងារដែលបានការសំខែង			
				នៃ Data Bandwidth throughput
				2 mb 10 mb/s 2 mb/s
				0 mb 10 mb/s 0 mb/s
Through put គឺ	ការងារដែលបានការសំខែងដែលជាដែនលេខ			20 mb 10 mb/s 10 mb/s សង 2 នៅ

ផ្សេងប្រើប្រាក់

Bandwidth = max throughput
(បញ្ហាការបញ្ជី)

បានរាជធានីមិនអាច fail

$R_s < R_c$ នៅក្នុង through put រឿង R_s



$R_s > R_c$ នៅក្នុង R_c



មិនអាចផ្តល់ភាពទូរារសំខែង ទៅនឹង avg. end-to-end through put

ប៉ុន្មាន Bottle neck (អំឡាតាំង)

Layering > បានចំណាំ នូវការប្រព័ន្ធ និងរំលែកការណ៍

OSI model

application > តារាងទំនួរ Message និង Message
Presentation > ការកុំពេញ (encryption), ការបង្កើតបន្លឺ (compression)
Session > Sync និង Async
protocol : FTP, SMTP, HTTP

transport > process to process data

គណនីការដែលមិនមែនសំខាន់សំខាន់ឡើង, How much data to send, How fast, Where to go

transport layer នឹងទំនួរ Message ជាសំណើ Segment

(រៀងការទិន្នន័យ = Header L4 មួយដំបូង (Protocol, Port ស៊ី, Port អូ)
ឯកសារ . Segmentation

protocol : TCP, UDP

network > ស្រាវជ្រើសរើសពេលវេលានៃការប្រើប្រាស់ IP , ARP
ជាបន្ទាត់

ឱ្យ Segments នៃ transport មានលក្ខណៈ Header L3 (IP ស៊ី, IP អូ)

ឱ្យផ្តល់ទៅក្នុងថាមរយៈ Packet

មក Router , L3 SW និងប្រាក់បន្ទាត់ L3 ដើម្បី

protocol : IP

Link > នឹងការប្រើប្រាស់ node នៃការប្រើប្រាស់
គុណលេខា Mac address

ឱ្យ Packet មានលក្ខណៈ Header L2 (Mac ស៊ី, Mac អូ)

ក្នុងថាមរយៈ Frame ដែល SW, Hub និងប្រាក់បន្ទាត់

physical > ឲ្យធ្វើ, និង តម្លៃ (Bits, Bytes)

message	Application
segment	trans
datagram/packet	network
frame	link
bit	physical

message = [M]

[m] H_b port number (qú server kāo ex. SMTP Port25 HTTP Port21,80)

[m] H_b H_n IP address/domain name

[m] H_b H_n H_l MAC Address ຕົນ/ຢັນ node ໃກລົກທີ່ສົດ
ສຳເນົາ Bit ໃປງາ physical

Application layer

- network program 1) ເຮັດວຽກຂອງຮູບແບບ end-system
- 2) ອຸນຫ້ອນ network

Clients - Server

Server

- always-on host ຕົ້ນເຈົ້າຄົນ ດັວນ
- ຜົນສົ່ງ ສົ່ງອຸນດາເຄື່ອງແນ່ດີຍ!

Client

- ຕັ້ງໄປຖຸຍກົງ Server
- ດັວນ

P2P . no always-on server

. ພົມ 2 ດົດຖິ່ນໄຟຟ້າສົ່ງ - ຮັບ



- Self scalability ກໍ່ຄົນກໍ່ໃນເພຣະຖຸກຄນເປັນຜົນສົ່ງໄດ້ເນື້ອມື່ອຈຳນົດ

Processes communicating

process → ໂປຣແກຣມທີ່ກໍາລັງທຳການອຸ່ນໆ (Program Running)

Client, Server

Clients → Process ແພ້່ຂອງບັນຫຼວດ
(ເດືອນເຈົ້າ 7-11)

P2P

ເປັນຖື່ນິດແຕ່ມູນ໌ອໍານວຍຈົງ!

Server → Process ຊອກການຂອງບັນຫຼວດ
(7-11 ສະວັນດັກ)

P2P ແບປລາກົກ

ນີ້ File ພາ� F

ນີ້ Server 1 ຕ່ອງສ່ຽງໄໝ N peer ຂຶ້ວດຕາການກະຈາບເກົ່າໄຟ

ex) ນີ້ໄຟລົງນາດ $F = 10 \text{ MB}$ peer $\rightarrow N = 100$

ເລີດ ບັນໂນຮາງສິນ $U_s = 2 \text{ MB/S}$

ເລີດ download $d \approx 200 \text{ KB/S} = 0.2 \text{ MB/S}$

ເລີດ ລົງທະບຽນ User $U = 100 \text{ KB/S} = 0.1 \text{ MB/S}$

ໃຊ້ MAX

Client - Server time $\geq 500 \text{ sec}$

$$\left\{ \begin{array}{l} \frac{NF}{U_s} = \frac{100(10)}{2} = 500 \text{ sec} \rightarrow \text{ກົດປົກກົດໃຫ້ user } N \text{ ດົນ ດາວ } F \text{ mb} \\ \text{ກົດເລີດເກົ່າໄຟ ເນື້ອ ປັດທັນຕາ } U \\ \frac{F}{d} = \frac{10}{0.2} \approx 50 \text{ sec} \rightarrow \text{ເລີດໃນການ download } v \text{ user } \end{array} \right.$$

P2P time ≥ 83.33 sec

បោនក់ Server ដែលអាច

$$\left\{ \begin{array}{l} \frac{E}{U_s} = \frac{10}{2} = 5 \text{ sec} \end{array} \right.$$

បោនក់ Server ដែលអាច

$$\left. \begin{array}{l} \frac{E}{d} = \frac{10}{0.2} = 50 \text{ sec} \end{array} \right. \text{ បោនក់ user download file}$$

MAX

$$\left. \begin{array}{l} \frac{NF}{(U_i + \sum U_i)} = \frac{(100)(10)}{2 + 10} = \frac{1000}{12} = 83.33 \text{ sec} \end{array} \right. \checkmark$$

បោនក់ user ទៅ Server ដែលអាច
ដើរឡើង N នាទី (ដឹងមិន?)

$$\sum U_i = NU_i = (100)(0.1) = 10 \text{ MB/s}$$

ចំណាំថា user upload នៅលើ

Client - Server VS P2P

បោនក់ User អាចទូទាត់ Client - Server បានជាពាណ្យារាយ

ប៉ុន្មាន P2P មែនស្ថិតិយវិធី

Bit Torrent ត្រូវក្រោមសង្ឃ File

Tracker \rightarrow បានចូលរួម (បែង Client - Server)

Torrent \rightarrow ក្រុមសង្គម Peer នៃសំគាល់

Chunk \rightarrow ថាមពលការងារ

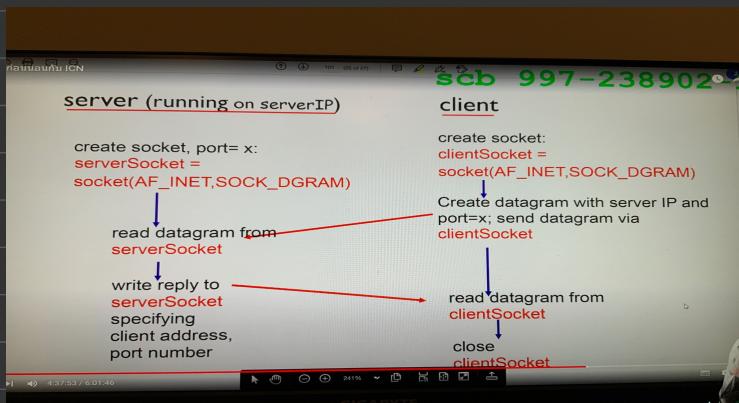
គ្រប់ Partner

Tit-for-tat \rightarrow ទៅកំណត់ Peer top 4 នៃភ័ព្យិក

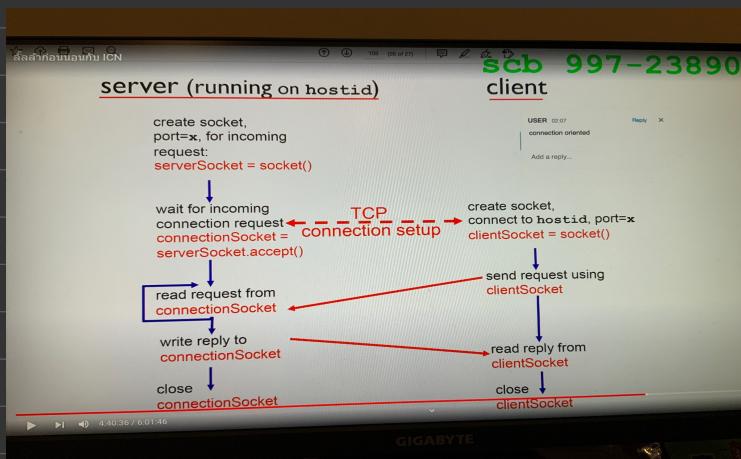
រាយការប្រើប្រាស់ថាមគម្រោង Quality នូវសាខាអំពី

Socket គឺជាឯករាយ process នៃ transport protocol

UDP



TCP

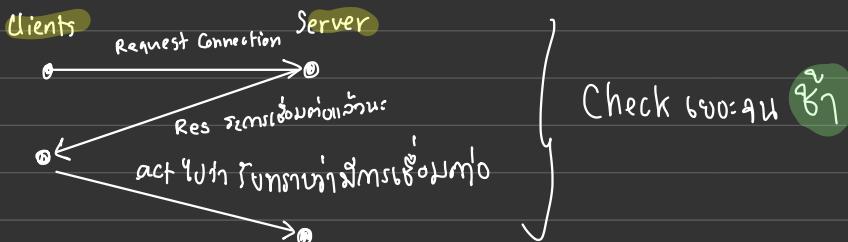


transport service app need

1. data integrity ความถูกต้องของข้อมูล track สถานะของ Data ว่าส่งไปยังมั้ย
2. throughput การส่งที่ดี
3. timing ความเร็ว
4. security ความปลอดภัย

TCP service

- reliable transport → ฝ่ายต่อฝ่ายชัดเจนและหน่วยการส่งตัวไปถึงมั้ย
- flow control → ควบคุมการโอน เผื่องไม่ให้ Buffer บันเต็ม (คงลักษณะ) (ระหว่าง Hop)
- Congestion → ควบคุมการโอน เพื่อยืดหัก NPM ณ จุดที่เกินไป (คับคั่ง)
- Connection-Oriented → Three way hand shake



UDP Service

- unreliable data transfer → ไม่สามารถ Check ให้ซ้อนกันได้ แม้ว่าจะส่งไปในลำดับเดียวกัน
- ไม่มี flow control, congestion control, timing ไม่มีเนี้ยบเรื่อยๆ ส่งมาเรื่อยๆ
- ข้อดี เฉพาะใน Check แบบไม่ตรวจสอบที่มีการสูญเสีย

- HTTP → stateless ບັນດາ
- Cookie ພາບທີ່ໃຫຍ່
- File ສໍາເລັດໃຫຍ່ Server
- ສິນໃຈ web Page
- ມັນຕີ
- recommend
- NO - Private

Web Caches → ເກັ່ງຈົບງຸນທີ່ເຫັນໄສບ່ອງກູມ Proxy Server (Server ຖໍ່ນຳ)
→ avg 100 kb
→ avg 15 Sec
→ avg data rate 1500 kb
→ RTT : 2 sec (ສົງໄລ - ສົງກົດ)
→ Net Speed : 1.54 mb

DNS → iterated query (ນີ້ຈະໃຫຍ່ໃນ Local Server ວິຊາ!

→ recursive query အသုတေသနပါရေးကြပ်များ ✓

hostname vs Domain name

it.kmit.ac.th

type A = name is host
value is IP

`type = CName = 16211119`

type: NS; name is domain
Value is hostname

f_type = MX ; Mail

Cyber Security សំខាន់!

Malware ➡ Program ធម្មាន

Virus ទេរាប់ចាយជាន់ នៅក្នុងកិច្ចការបង់បាន

Worm ឈរដាងលី ចំណាត់ការក្រោមគ្រប់គ្រង WTF

Spyware malware កែបច្ចុប្បន្ន

វិសាទ Server

Denial of Service (DoS) ➡ សេចក្តីណា Server fail (តាមរយៈមិនបាន)

Distributed DoS (DDoS) ➡ បានធ្វើឡើងនៅក្នុងមេរោគ

Com អ៊ូដីវិសាទ និង Botnet

Sniffing តាក់ស្ថិតប៉ឺមុនការងារ

IP Spoofing អ្នក IP

QUIZ

Technical term

1) 1.1 NW edge \triangleright end device ជាមួយប្រព័ន្ធនឹងមេរោគ
ដែលផ្តល់ទូទៅនូវព័ត៌មាននៃការផ្តល់ Data

1.2 NW core \triangleright Packet SW កំណត់ចំណាំនៃការផ្តល់ Data នៃ NW edge

1.3 Access NW \triangleright តំបន់និងការផ្តល់ Data

wire , wireless

1.4 Link media \triangleright ឧបករណ៍កំណត់ចំណាំនៃការផ្តល់ Data (សាយករណ៍)

2) ឬកវិធី Packet - switching \triangleright Core និង

ឯកសារនៃ node នៅម៉ោង bw 100 kb/s និងម៉ោង Active 10%

សំណង់: BW 75% និង 25%

2.1) $N = 10 \Rightarrow \text{loss} = 0 \% \text{ កំណត់}$

2.2) X : Random V von au. Active User

$$N = 11$$

$X \in \{0, 1, 2, 3, \dots, 11\} \rightarrow$ r.v. Binomial

$$P[X > 10 ; N=11, p=0.1]$$

$$\begin{aligned} P[X = k ; N, p] \\ \binom{N}{k} p^k (1-p)^{N-k} \\ \frac{N!}{k!(N-k)!} p^k (1-p)^{N-k} \end{aligned}$$

$$\begin{aligned} P[X > 10] &= P[X = 11] + P[X = 12] + \dots + P[X = 11] \\ &= \sum_{k=11}^{N} [X = k] \\ &\quad \begin{array}{c} 1 \\ \nearrow 1 \\ \cancel{\frac{11!}{11! \cdot 0!}} \end{array} \quad 0.1 \quad \begin{array}{c} 11 \\ \nearrow 1 \\ (1-0.1) \end{array} \quad = \quad 0.1^{11} \\ &= 10^{-11} \end{aligned}$$

$$= 10^{-9}$$

1. Consider distributing a file of $F = 15$ Gbits to N peers. The server has an upload rate of $u_s = 30$ Mbps, and each peer has a download rate of $d_i = 2$ Mbps and an upload rate of u_i . For $N = 10, 100$, and 1000 and $u = 300$ Kbps, 700 Kbps, and 2 Mbps, prepare a chart giving the minimum distribution time for each of the combination of N and u for both client/server distribution and P2P distribution.

ให้ประมาณว่า $1\text{K}=1000$ และ $1\text{M}=1,000,000$ และ $1\text{G}=1,000,000,000$

Distribution Scheme	$u=300\text{Kbps}$			$u=700\text{Kbps}$			$u=2\text{Mbps}$		
	$N=10$	$N=100$	$N=1000$	$N=10$	$N=100$	$N=1000$	$N=10$	$N=100$	$N=1000$
Client/Server	7500	50000	500,000	7500	500,000	500,000	7500	50,000	500,000
P2P	7500	25000	4545	7500	15,000	20000	7500	7500	7500

$$\frac{NP}{u_s + \sum u_i} = \frac{10(15000)}{30+7}, \frac{10(15000)}{230}, \frac{1000(15000)}{2030}$$

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$$F = 15 \text{ GB} = 15000 \text{ Mb}$$

$$u_s = 30 \text{ Mb}$$

$$d = 2 \text{ mb}$$

$$u = 0.3, 0.7, 2$$

$$N = 10, 100, 1000$$

$$\text{Client-S} \quad \frac{NF}{u_s} = \frac{10(15000)}{30} = 5000 \\ = 50,000 \\ = 500,000 \\ \frac{F}{d} = 7500$$

$$\text{P2P} \quad \frac{NF}{(u_s + \sum u_i)} = \frac{10(15000)}{30+7} = \frac{10(15000)}{37} = 49000 \\ = 490000 \\ \frac{F}{d} = 7500 \quad 100$$

$$\frac{F}{u_s} = 5000 \\ \frac{10(0.3)}{30} = 3 \\ 100(0.3) = 30 \\ 1000(0.3) = 300 \\ \frac{10(0.7)}{30} = 7 \\ 100(0.7) = 70 \\ 1000(0.7) = 700$$

ให้ตั้งค่าตอบลงในตารางนี้

Distribution Scheme	$u=300\text{Kbps}$			$u=700\text{Kbps}$			$u=2\text{Mbps}$		
	$N=10$	$N=100$	$N=1000$	$N=10$	$N=100$	$N=1000$	$N=10$	$N=100$	$N=1000$
Client/Server	7680	51200	512000	7680	51200	512000	7680	51200	512000
P2P	7680	25904	47559	7680	15616	21525	7680	7680	7680

20
200
2000

$$\frac{NF}{u_s + \sum u_i} = \frac{10(15000)}{30+7} = \frac{15000}{37} \quad \boxed{\sum u_i = 10(0.3) = 3, 100(0.3) = 30, 1000(0.3) = 300}$$

Open original