พัฒนาการและการประยุกต์ใช้เครือข่ายความเร็วสูงสมัยใหม่

รองศาสตราจารย์ สุรศักดิ์ สงวนพงษ์
ภาควิชาวิศวกรรมคอมพิวเตอร์
มหาวิทยาลัยเกษตรศาสตร์

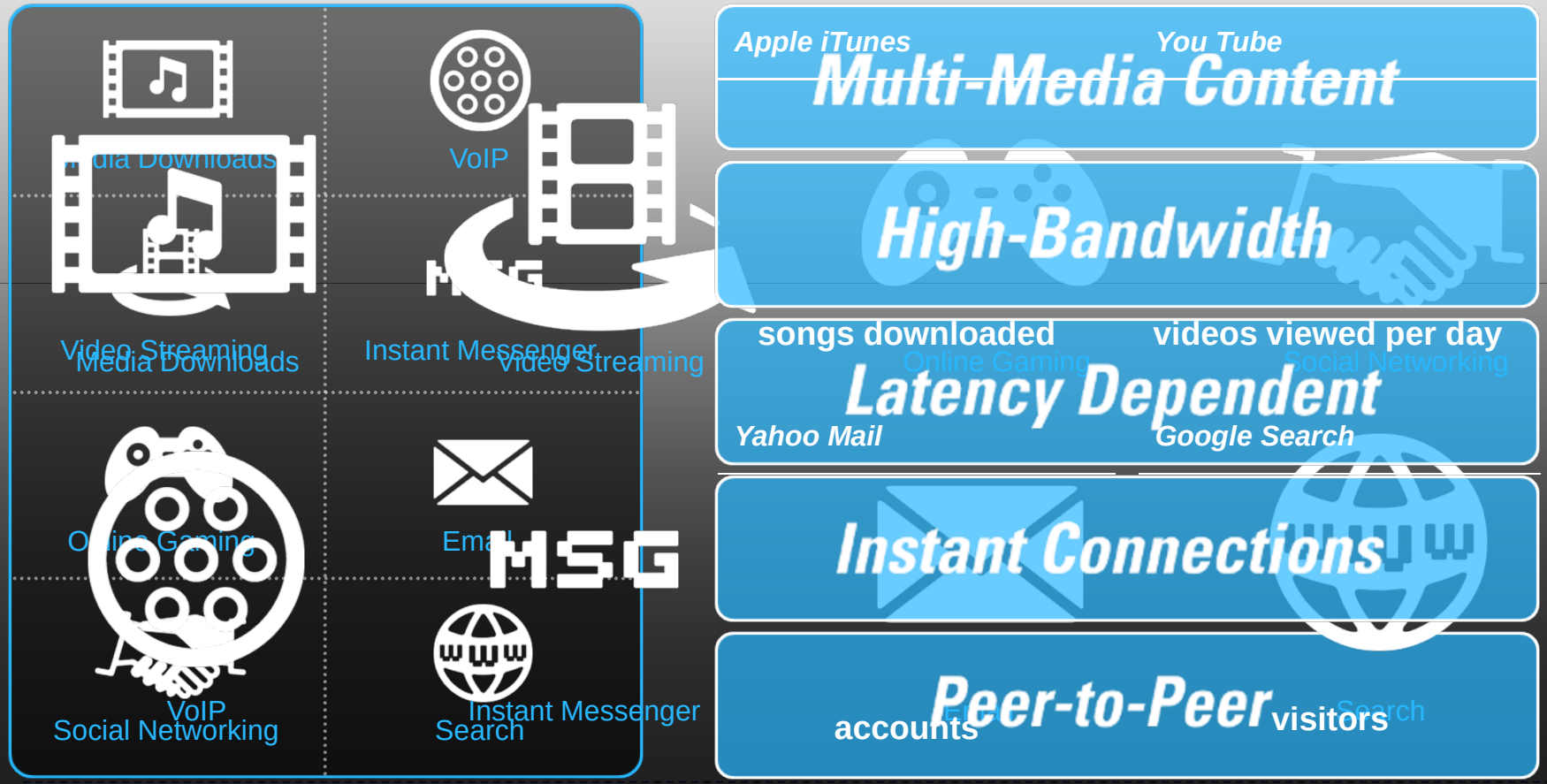
Surasak.S@ku.ac.th

หัวข้อ

- แรงผลักดันการใช้เครือข่ายความเร็วสูง
- เทคโนโลยีเครือข่ายความเร็วสูง
- การประยุกต์ใช้งาน
- โมโบล์บรอดแบนด์

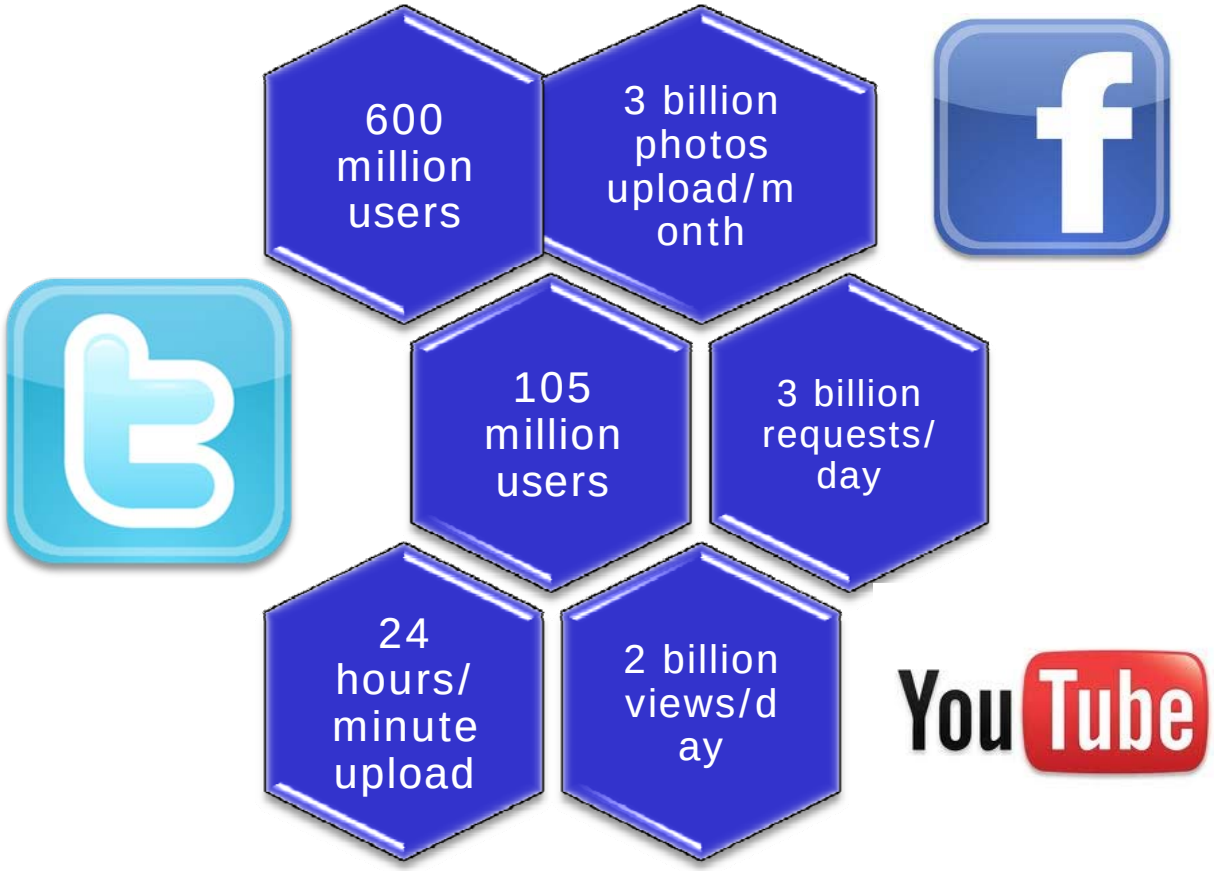
สังคมข่าวสารในยุคปัจจุบัน

บริการสื่อสารและแอพลิเคชันสมัยใหม่ที่มีอัตราการใช้เพิ่มขึ้นในปัจจุบัน



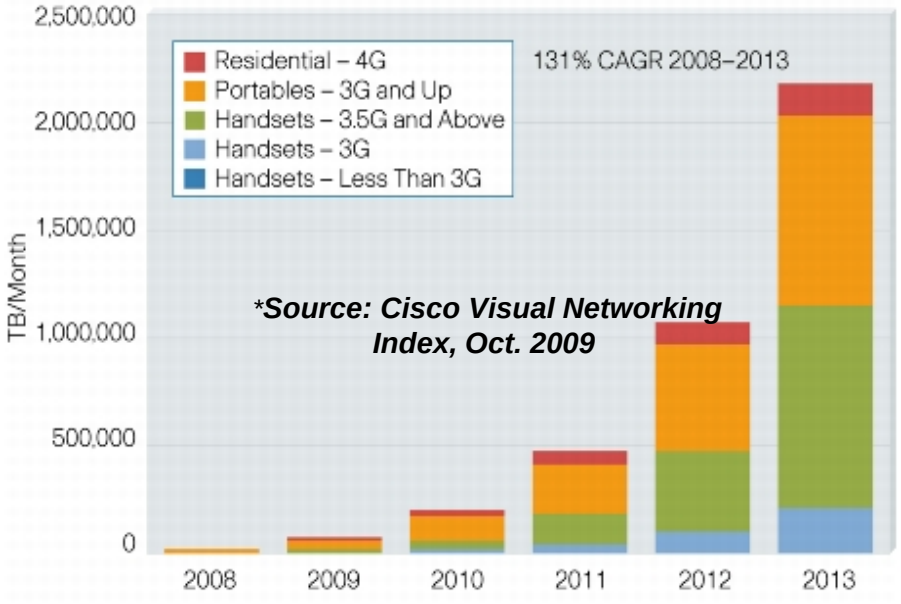
Source : How Do LTE and WiMAX Fit Into M2M?

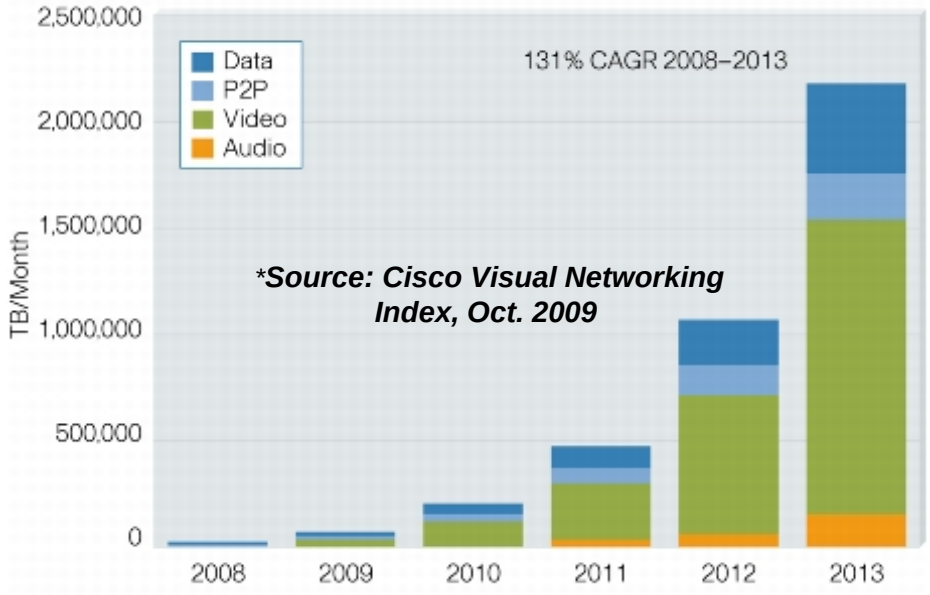
สถิติน่าสนใจ


600 million users
3 billion photos upload/month
105 million users
3 billion requests/ day
24 hours/ minute upload
2 billion views/day
YouTube

การขยายตัวของเทคโนโลยีและประเภทข้อมูล

- การเติบโตของการส่งข้อมูลผ่านโมไบล์จะขยายตัวขึ้น 66 เท่า จากปี 2008 ถึง 2013 (Source: Cisco*)
- วิดิโอและข้อมูลทั่วไปมีสัดส่วนสูงเมื่อเทียบกับข้อมูลอื่นๆ





แรงผลักดัน : Smart Phones

Apple totally sold 100M iPhones

http://mashable.com/2011/03/02/100-million-iphones

Android smart phone sales surged 888.8% in 2010

http://www.betanews.com/joewilcox/article/Gartner-Android-smartphone-sales-surged-8888-in-2010/1297309933

แรงผลักดัน : Tablet

iPad1 sold 15M units

http://www.apple.com/pr/library/2011/03/02ipad.html

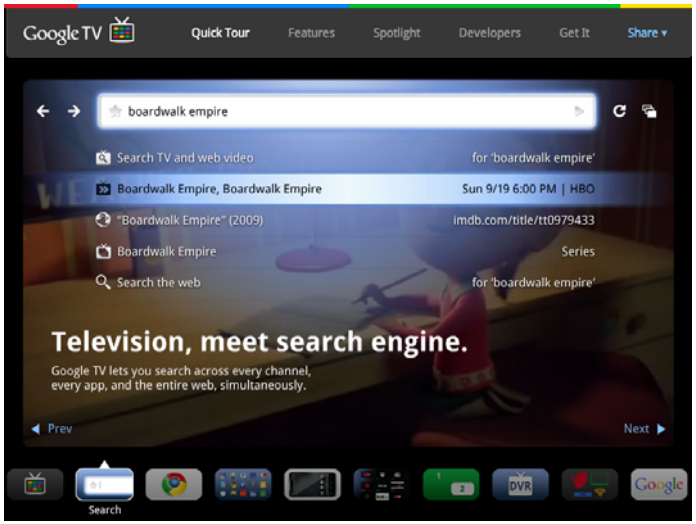
iPad 2 sales seen clearing 1 million units

http://www.reuters.com/article/2011/03/14/us-apple-research-idUSTRE72D30020110314

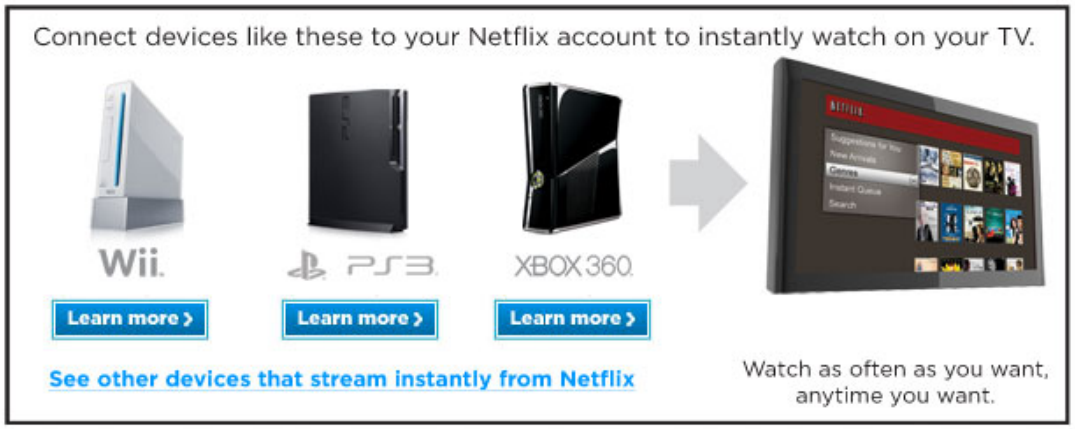
Over 100 tablets were unveiled at CES 2011

http://www.bgr.com/2011/01/24/over-100-tablets-were-unveiled-at-ces-2011-heres-a-list-of-all-of-them/

แรงผลักดัน : Internet TV



- **Google TV**
  - Watch and browse, simultaneously
  - Search your television
  - The web is now a channel
  - Your phone = remote control
  - Fling a video to your television



NetFlix

only $7.99 a month, instantly watch unlimited movies & TV episodes streaming over the Internet to your TV via an Xbox 360, PS3, Wii or any other device that streams from Netflix. You can also watch instantly on your computer too!

ก้าวเข้าสู่ยุค **100 Gbps**

GIGAOM

EVENTS GIGAOM.TV PRO RESEARCH

HOME APPLE BROADBAND CLEANTECH CLOUD COLLABORATION MOBILE VIDEO

BROADBAND sponsored by Qwest BUSINESS

Search

We Will Soon Live in a 100 Gbps World

By Stacey Higginbotham | Feb. 22, 2011, 8:21am PT | 13 Comments

Tweet 142 Like 131 people like this. Be the first of your friends.

Thanks to iPhones, tablets and Netflix, the demand for bandwidth is back, and that's drumming up interest in expanding and building out fiber networks. Today we think 1 Gbps fiber networks are enough, but soon we'll need 100 Gbps, and a host of infrastructure companies are gearing up to provide it. Unnoticed by Silicon Valley, telecom is on the move again.

Equipment and network companies such as Ciena and Adtran are reaping the rewards in their stock prices: Ciena's stock has risen more than $14.74, or 117 percent in the last six months, while Adtran's has risen by $14.46 — or 47 percent. Other industry players such as

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Like 10K

หัวข้อ

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- เทคโนโลยีเครือข่ายความเร็วสูง
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เครือข่ายความเร็ว 100 gb/s

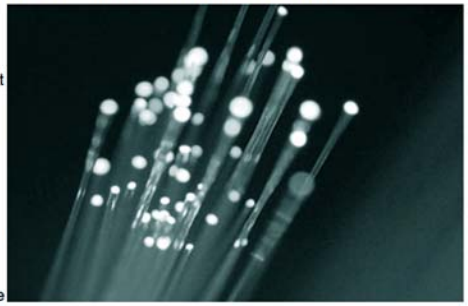
The World's First 100Gbps Network - BCNET Public Wiki - BCNET Wiki

https://wiki.bc.net/atl-conf/display/BCNETPUBLIC/200

100 gbps... | Traffic A... | http://m... | Google I... | National ... | Gartner's... | The Worl...

$62 Million to Develop the World's First 100 Gbps Network

Unprecedented data transfer to revolutionize scientific research



Right now in the scientific community, the data transfers needed to facilitate advanced research and collaboration are at the terabyte level and steadily increasing. As a result, ESnet, the US Department of Energy's high-performance networking facility, has been hired for $62 million to develop an Ethernet network capable of transferring data at an unprecedented 100 Gigabytes per second (Gbps). When it's finished, this will make history as the world's fastest computer network.

		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

BCNET Engineering- Hardening DNS with DNSSEC

Cybera and CANARIE National Summit

Is this high capacity network worth its $62 million price tag?

The Advanced Networking Initiative is being funded by the American Recovery and Reinvestment Act to ensure that the US stays at the forefront of scientific and technological innovation. The network's founders believe that data intensive research should be accommodated so that scientific advancement, discovery, and productivity aren't constrained by a lack of technological infrastructure.

AT&T completes 100-Gigabit Ethernet field trial using new Cisco gear, proves it does care

By Darren Murph posted Mar 11th 2010 5:28AM

Juniper intros world's first 100Gbps Ethernet interface

By Justin Mann, TechSpot.com
Published: June 9, 2009, 1:42 PM EST

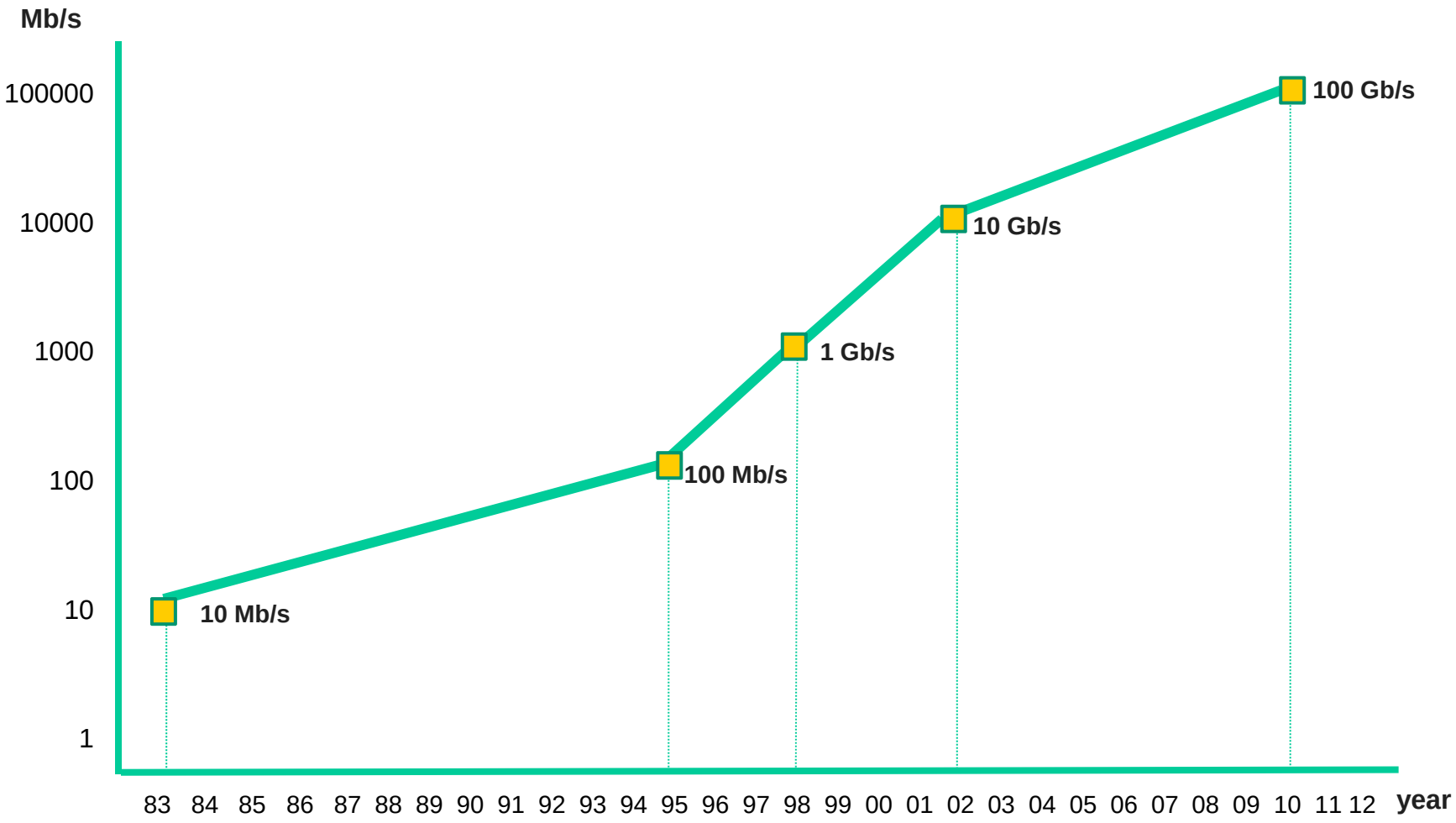
Most Ethernet devices used at home and offices today make do with the 100Mbps standard that has been used for many years. Gigabit options have also been available for a while, which largely satisfied many people's need for speed, and some businesses have even adopted the 10 Gigabit Ethernet standard. Compared to a traditional home LAN, that's a tremendous difference.

But what if even that immense speed isn't enough? Formerly, the answer would be to go beyond Ethernet and get into the world of fiber optics. However, Juniper Networks believes Ethernet is still the answer and has room to grow, announcing that they have introduced the industry's first 100Gbps Ethernet interface, aimed at telecom providers and other immensely high-capacity applications.

Infinera Demonstrates 100 Gigabit Ethernet With Optical Vendors

(Market Wire Via Acquire Media NewsEdge) SUNNYVALE, CA -- (MARKET WIRE) -- 03/22/10 -- Infinera (NASDAQ: INFN) has successfully demonstrated 100 Gigabit Ethernet (GigE) transmission using pluggable CFP optical transceiver modules from multiple vendors as it works towards developing commercial systems that can meet service provider and enterprise needs for 100 GigE services, which Infinera believes to be the next step in the evolution of Ethernet standards.

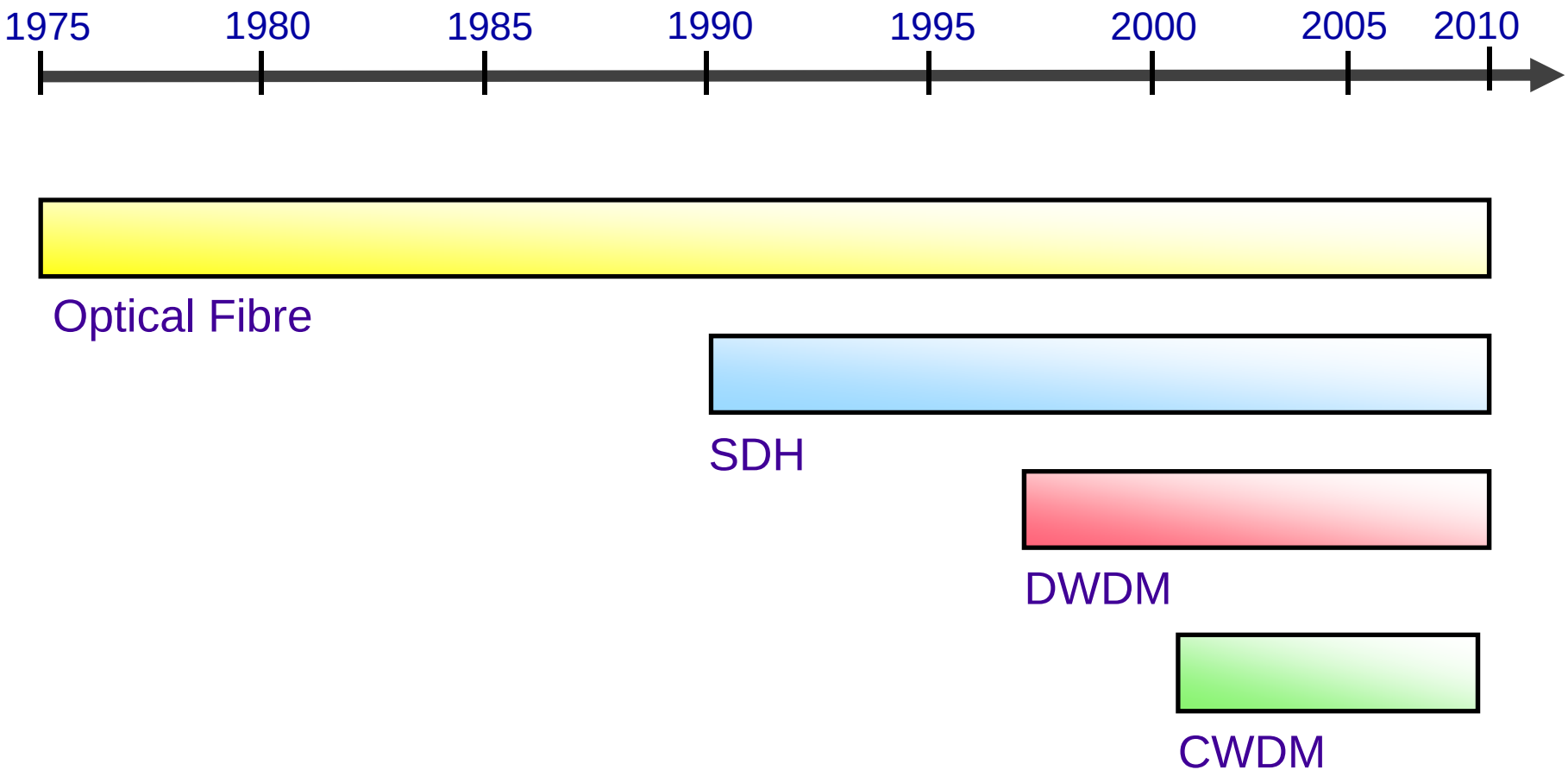
พัฒนาการอีเทอร์เน็ต



มาตรฐานเครือข่ายความเร็วสูง

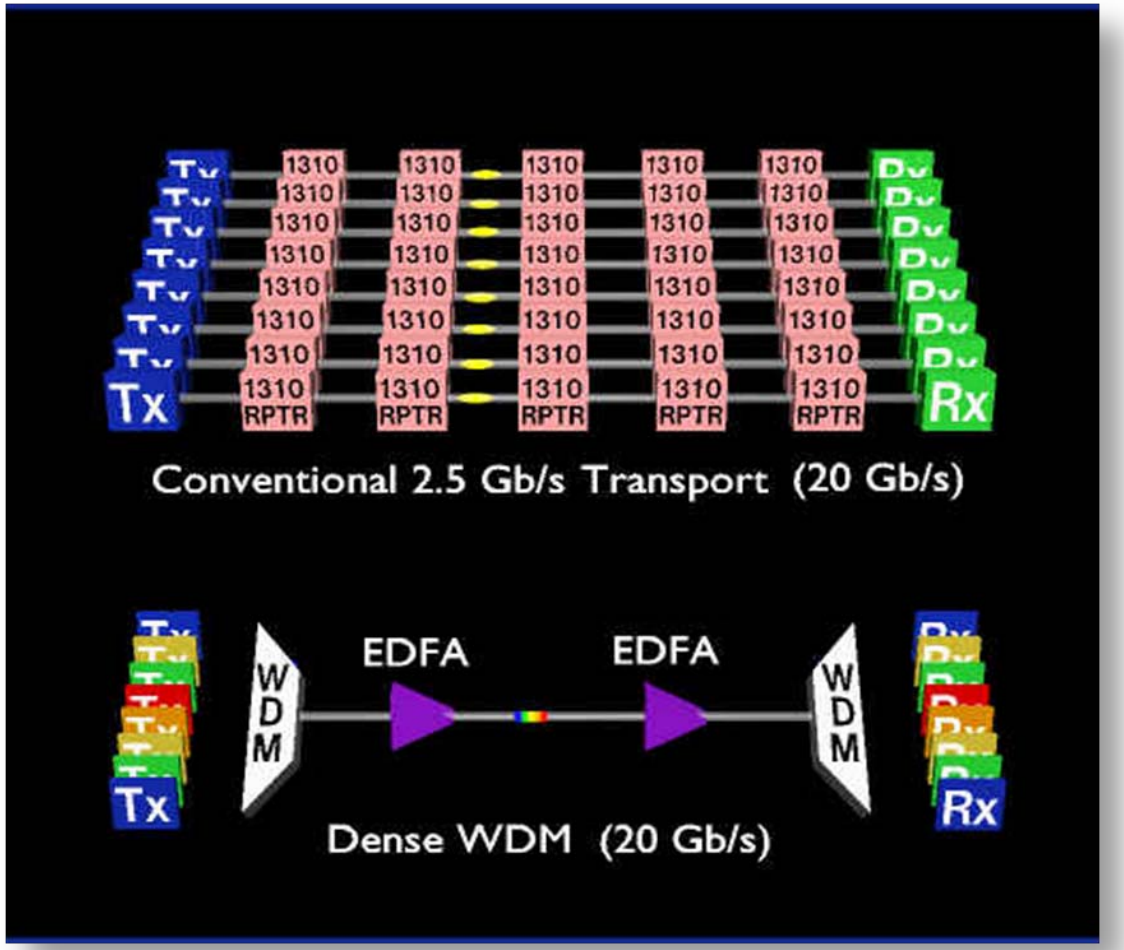
LANs	Wireless LANs	Wireless MANs
IEEE 802.3 Standards*	IEEE 802.11 Standards*	IEEE 802.16 Standards*
	802.11b (2.4 GHz) 802.11g (2.4 GHz) 802.11a (5 GHz) 802.11n (2.4, 5 GHz)	802.16e (Licensed <6 GHz) P802.16m (Licensed <6 GHz) *(under development)*
Current Peak: 100Gbps	Current Peak: 600Mbps	Current Peak: 300Mbps
	Target Peak IEEE P802.11ac (5GHz): >1 Gbps IEEE P802.11ad (60GHz):>1-3 Gbps	**Target Peak** >1 Gbps?

เทคโนโลยีการส่งข้อมูลด้วยแสง

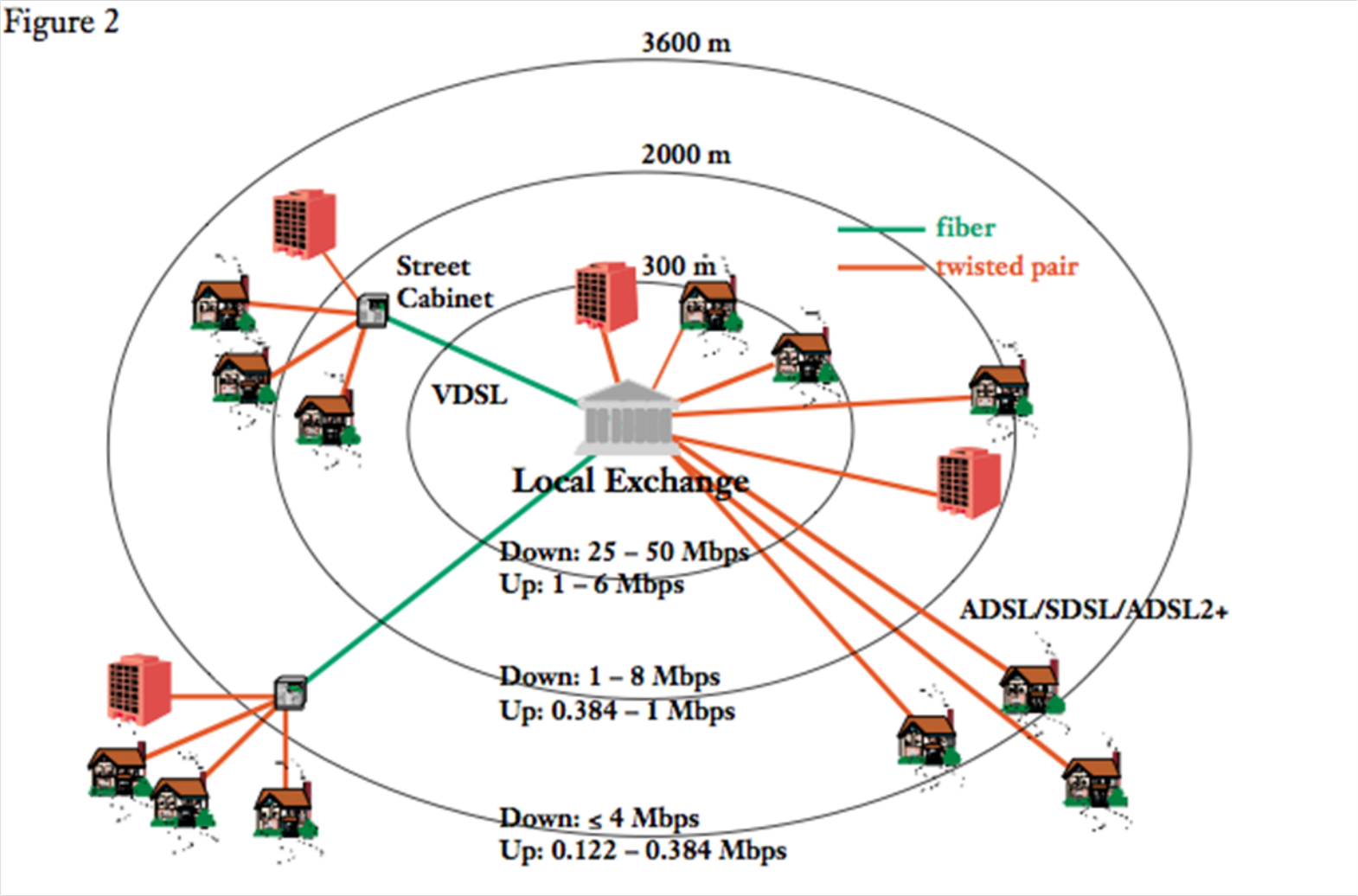


การส่งข้อมูลความเร็วสูงผ่าน DWDM

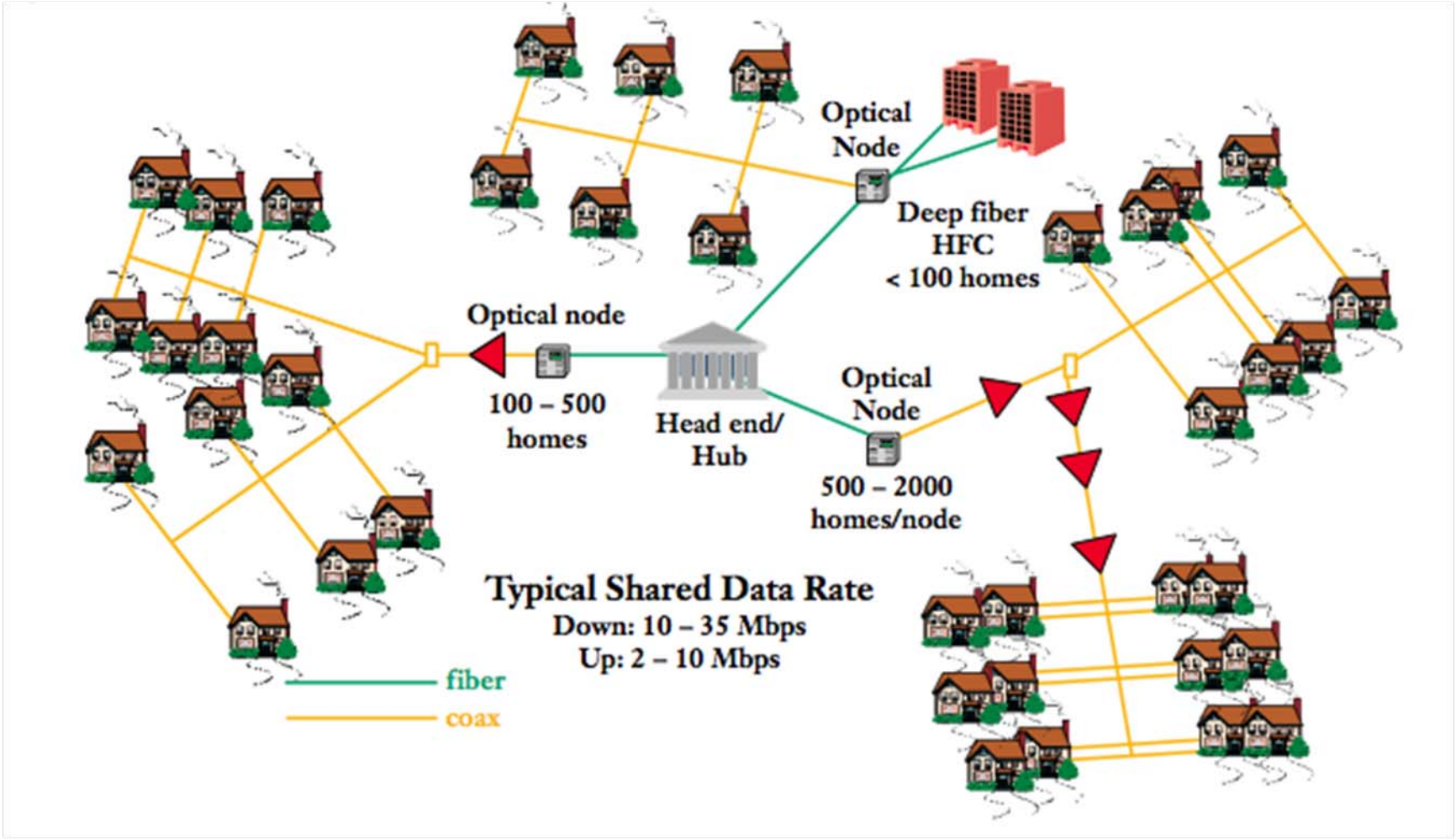
- รูปแบบเดิมต้องมีสายสัญญาณหลายเส้นเพื่อส่งข้อมูลให้ได้ความเร็วรวมที่ต้องการ
  - **12 เส้น x2.5 Gb/s =20 Gb/s**
- DWDM ช่วยให้สายสัญญาณหนึ่งเส้นมีหลายช่องสัญญาณตามความยาวคลื่นแสง



Broadband: xDSL



Broadband: Cable TV/HFC



กูเกิ้ล : โครงการ FTTH 1 กิกะบิตถึงบ้าน

Google

test ultra-high speed broadband networks in one or more trial locations across the country. Our networks will deliver Internet speeds more than 100 times faster than what most Americans have access to today, over 1 gigabit per second, fiber-to-the-home connections. We'll offer service at a competitive price to at least 50,000 and potentially up to 500,000 people

Google has named Kansas City, KS, as what it implied would be the first partner city in which it will test 1-Gbps fiber to the home (FTTH)

30 march 2011

http://www.google.com/fiber/kansascityks/index.html

หัวข้อ

- แรงผลักดันการใช้เครือข่ายความเร็วสูง
- เทคโนโลยีเครือข่ายความเร็วสูง
- การประยุกต์ใช้งาน
- โมโบล์บรอดแบนด์

การถ่ายทอดภาพคุณภาพสูง

- ต้องการ 20 Mb/s ต่อสตรีมเพื่อถ่ายทอดภาพ 1080p

Royal Wedding 29/04/11

William and Kate's Royal Wedding Will Require 800,000,000Mbps of Bandwidth and Break the Internet

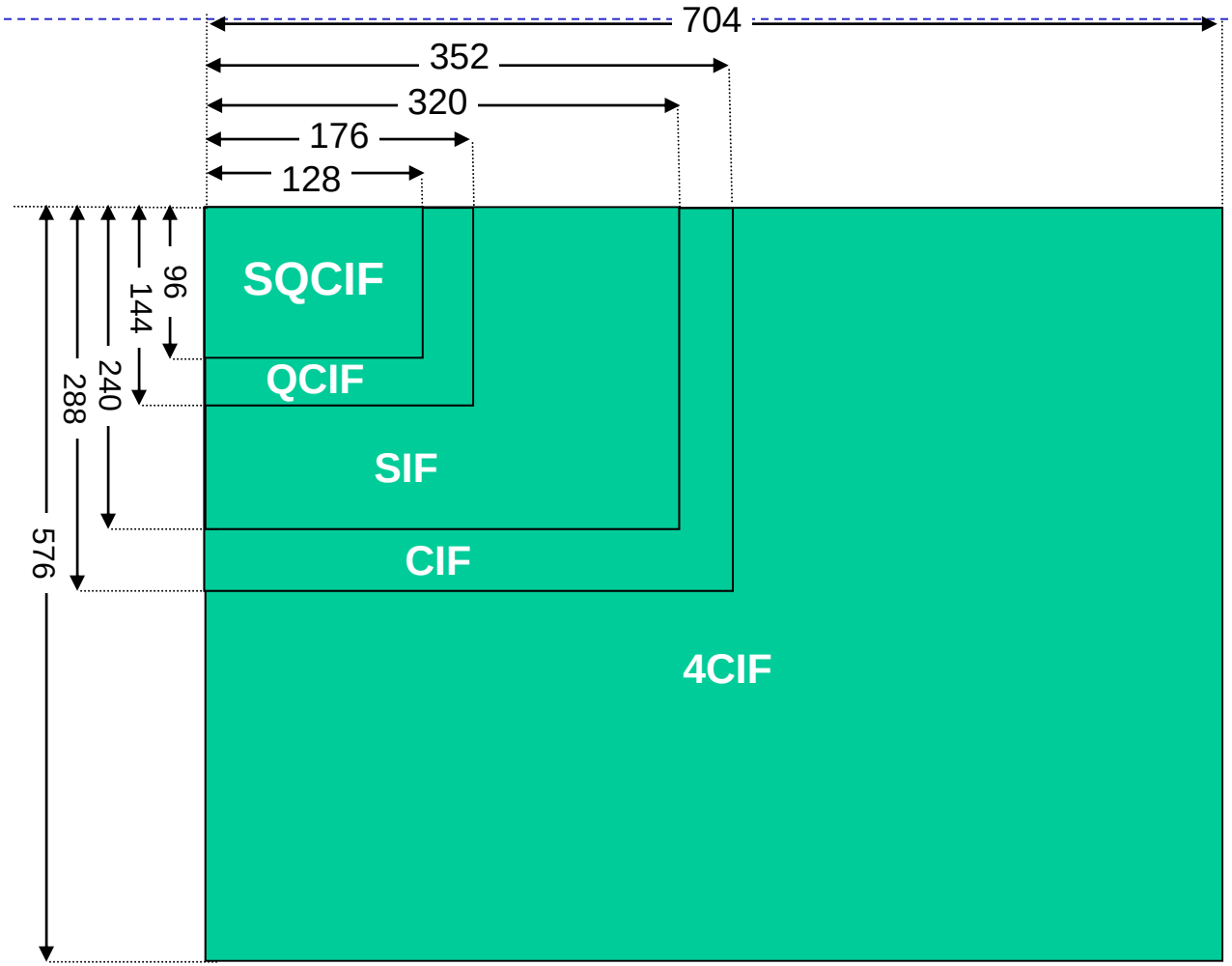
PC MAGAZINE

Share 220 Email Print

Sebastian Anthony - ExtremeTech – Thu Apr 28, 5:32 am ET

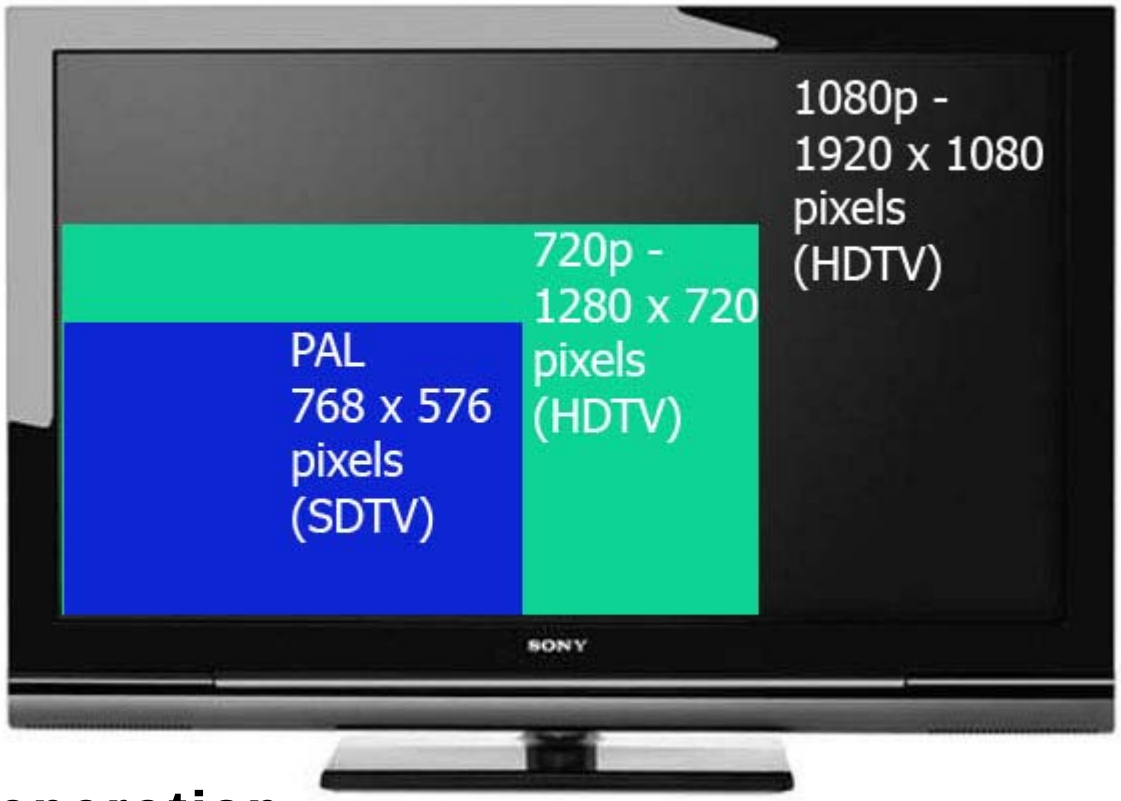
- 2 billion on TV
- 400 million on youtube
- 800,000Gbps, for a total of 100,000GB of data transferred every second
- 6,000,000GB per minute.

ตัวอย่างฟอร์แมตการส่งวิดีโอ



CIF= Common Intermediate Format

HD Video



- **Next Generation**
  - **Extreme HD : 2560 x 1440**
  - **Ultrahigh HD : 7680 x 4320**

อัตราเร็ว

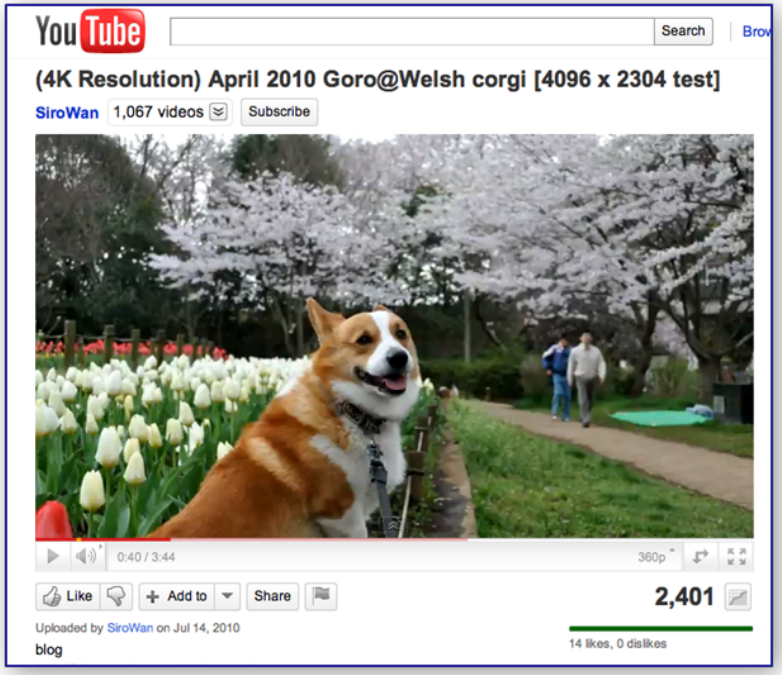
Format	Resolution	Bit Rate	Storage
SQCIF	128x96@15fps	4.4 Mb/s	0.55 MB/s
QCIF	176x144@15fps	9.1 Mb/s	1.14 MB/s
CIF	352x288@30fps	73 Mb/s	9.12 MB/s
HDTV	1920x1080@30fps	1.5 Gb/s	187 MB/s

การบีบอัดช่วยลดแบนวิดธ์

Format	Resolution	Bit rate	Storage
SQCIF	MPEG-4	24 - 147 kb/s	3 - 18 kB/s
QCIF	MPEG-4	50 - 303 kb/s	6 - 38 kB/s
CIF	MPEG-4	0.4 – 2.4 Mb/s	50 – 304 kB/s
HDTV	MPEG-4	8.3 - 50 Mb/s	1 - 6 MB/s

เทคโนโลยี HD ยุคถัดไป

- In July 2010, upload HD YouTube for registered user
  - 4096 x 2304 (16:9)
  - 4096 x 3072 (4:3)



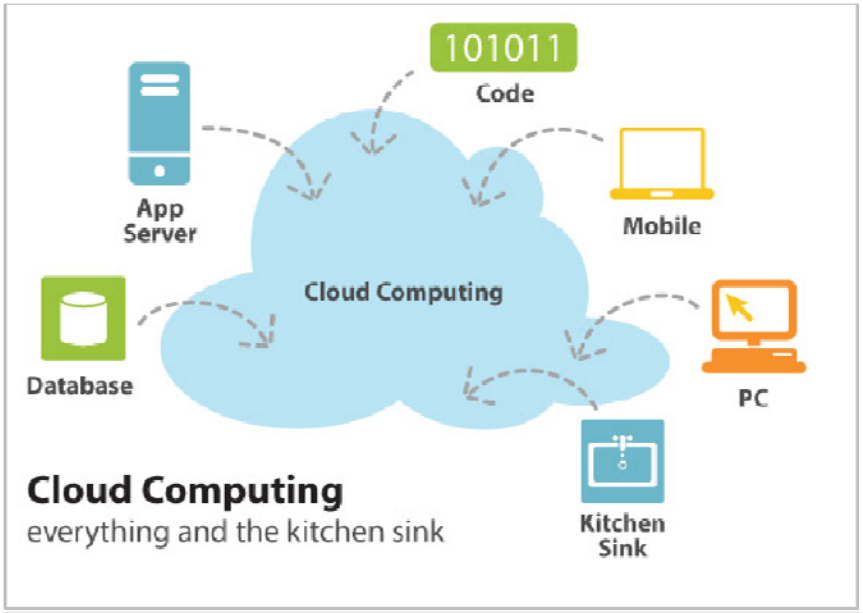
Type	WxH	Ratio	#Pixels
4K	4096x2304	16:9	9,437,184
8K	8192x4320	256:135	135 35,389,440

ส่งภาพ 40 Gb/s

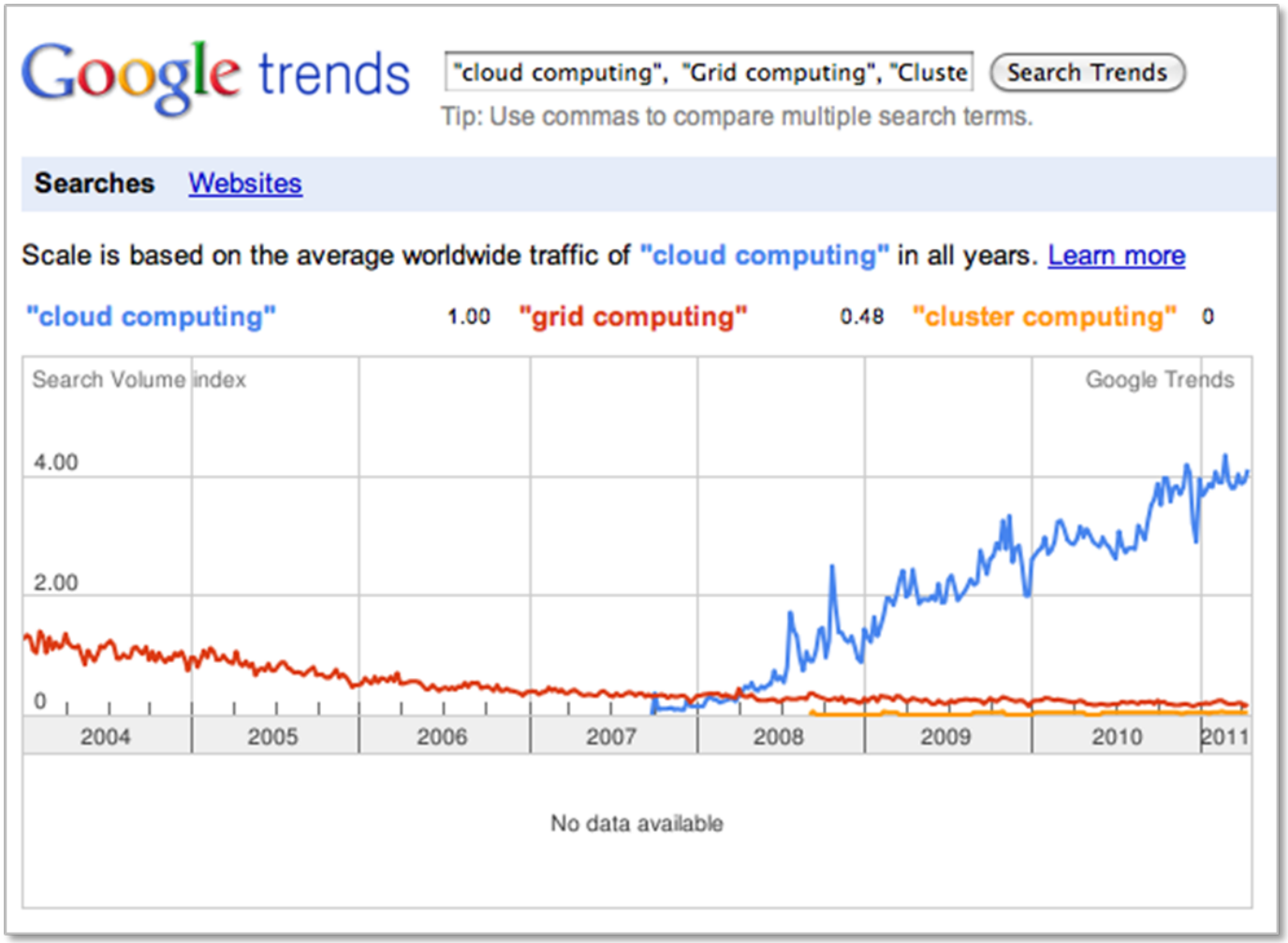
- World first 40 Gbps Video Streaming
- 15 LED (5x3) with 12800x4800 (61.44 Mpixels)

เคลาด์คอมพิวติ้ง

- a style of computing in which **dynamically scalable** and often **virtualized** resources are provided as a serve over the Internet

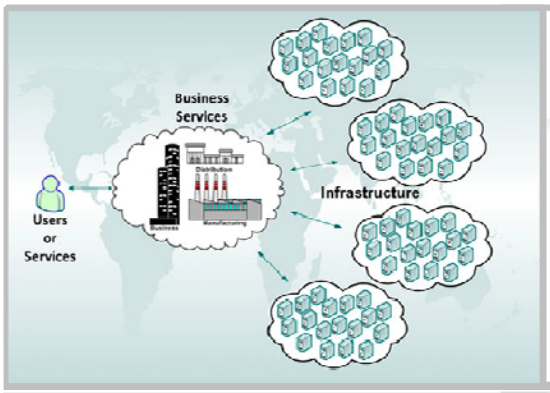


Cloud/Grid/Cluster



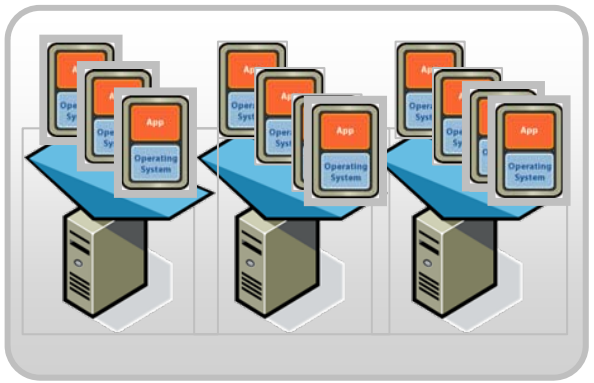
รากฐานของเคลาด์คอมพิวติ้ง

Cluster Computing



Grid Computing

Virtualization



ลักษณะสำคัญของเคลาด์คอมพิวติ้ง

- **Virtual**
  - software, databases, Web servers,OS, storage and networking as virtual servers

- **On demand**
  - add and subtract processors, memory, network bandwidth, storage.

***C**ommon, **L**ocation-independent, **O**nline Utility on **D**emand*

- Common implies multi-tenancy, not single or isolated tenancy
- Utility implies pay-for-use pricing
- on Demand implies ~infinite, ~immediate, ~invisible scalability

บริการเคลาด์ต้องการช่องสัญญาณความเร็วสูง

ZDNet UK / News and Analysis / Infrastructure / Networking

Cloud pushing telecoms into bandwidth boost

By David Meyer (@superglaze), ZDNet.co.uk, 9 June, 2009 16:36

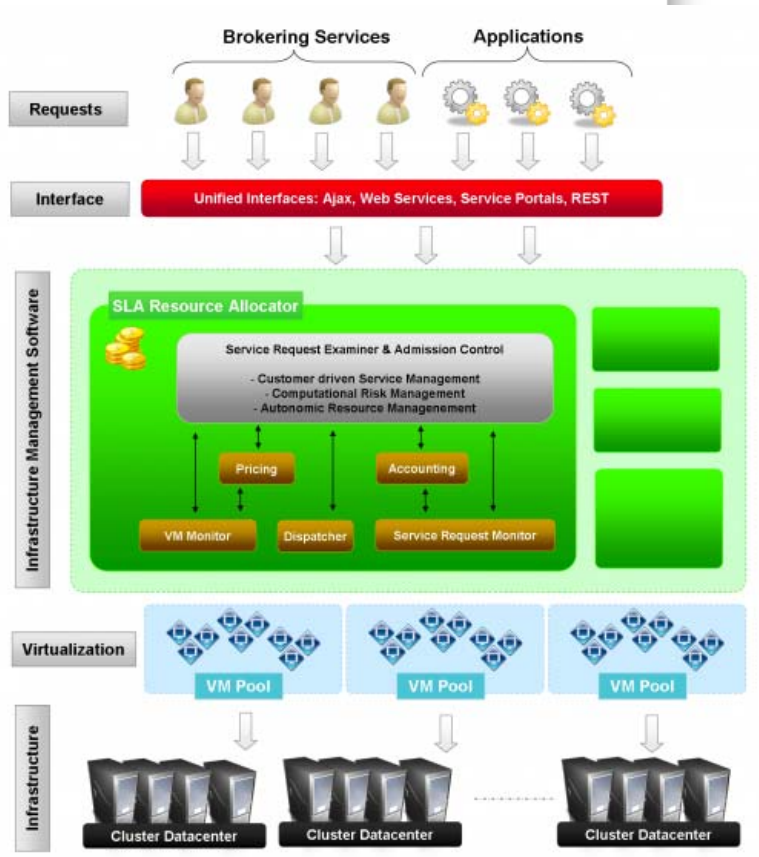
Topics

Cloud computing, Bandwidth, Net neutrality, 100Gbps, juniper networks, Nortel, Cisco, Ovum

NEWS **Cloud computing and net neutrality ar**
operators to upgrade their core network band

In turn, top industry players such as Nortel, Cisco a
speed 100Gbps Ethernet products in response to o
told ZDNet UK.

http://www.zdnet.co.uk/news/networking/2009/06/09/cloud-pushing-telecoms-i



Social Network : A Facebook Case

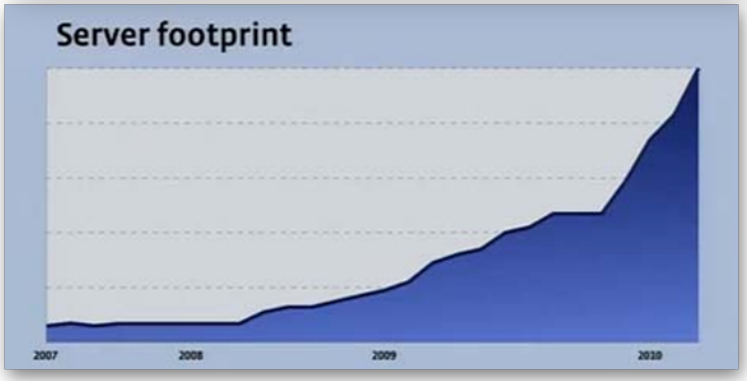
Facebook data centres need Terabit Ethernet

100Gbps throughput not enough, says engineer

By Stephen Lawson | Published: 09:57, 03 February 10

ถูกใจ มาเป็นคนแรกจากเพื่อนของคุณที่ชอบสิ่งนี้

Facebook's data centres already need 100-Gigabit Ethernet and ideally could use 1-Terabit Ethernet, according to a senior network engineer at the company.



- Facebook Data Center with estimated 100,000 Servers (60,000 last year)

"*Facebook has so many servers, and those servers can process data so fast, that they could fill **64 Terabit Ethernet** pipes in the backbone of one data centre*"

http://news.techworld.com/data-centre/3211798/facebook-data-centres-need-terabit-ethernet/

หัวข้อ

- แรงผลักดันการใช้เครือข่ายความเร็วสูง
- เทคโนโลยีเครือข่ายความเร็วสูง
- การประยุกต์ใช้งาน
- โมโบล์บรอดแบนด์

ทิศทางพัฒนาการเครื่องมือสื่อสาร

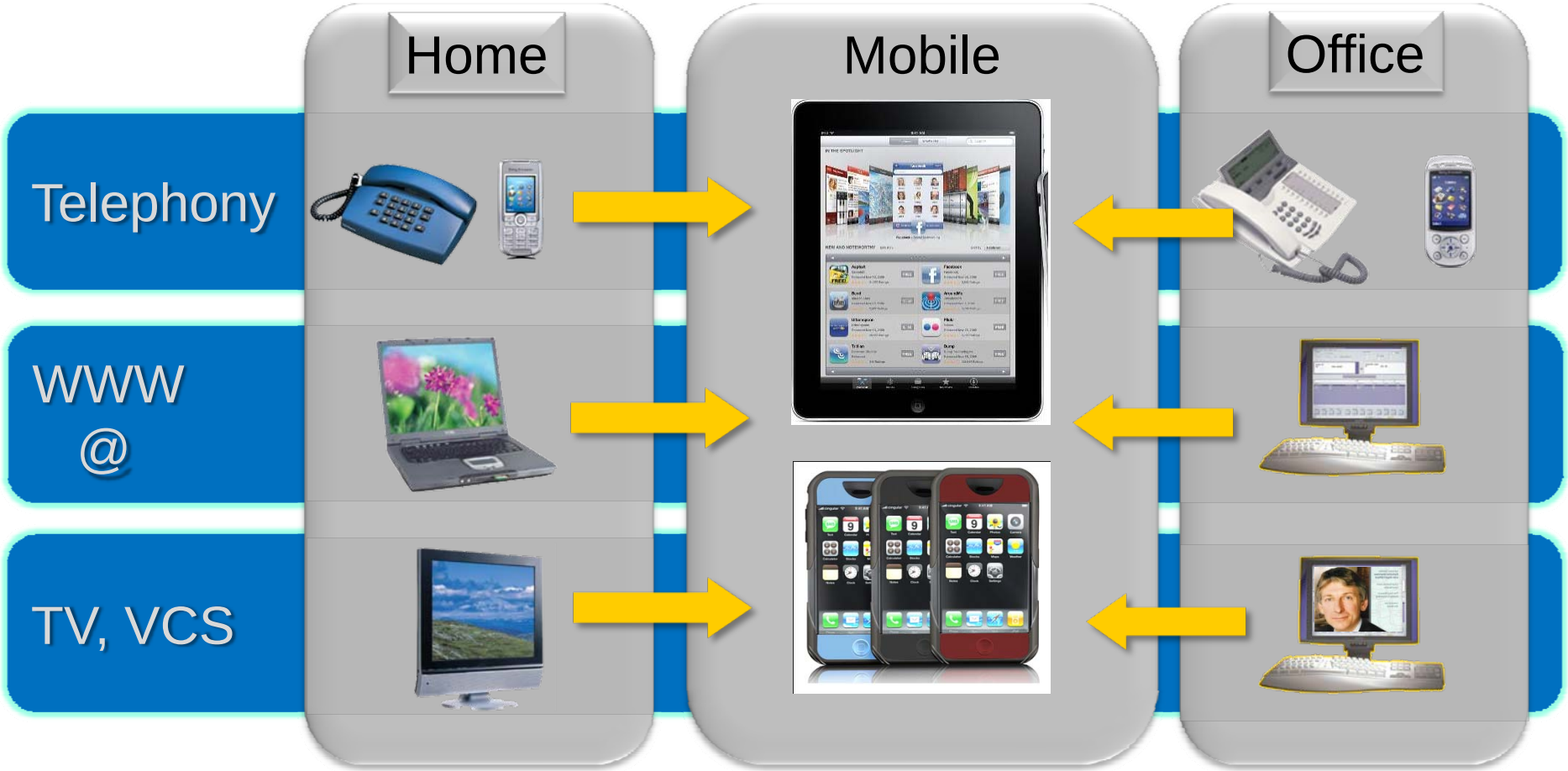
1982-2002

ยุคโทรศัพท์เคลื่อนที่พกพา : โมไบล์

2002 - 2012

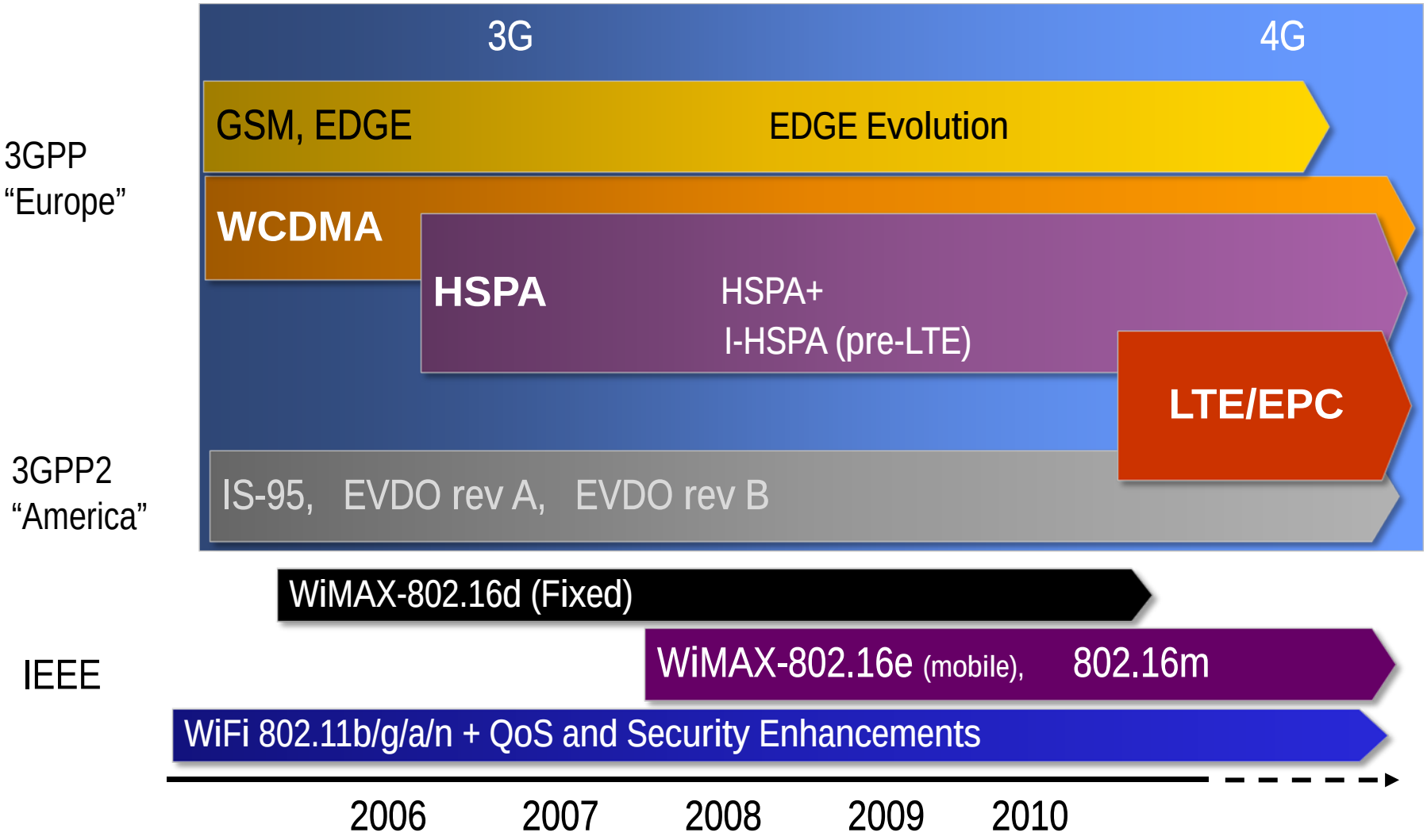
ยุคโมไบล์อินเทอร์เน็ต

โมไบล์กับตลาด Triple Play



Source: Ericsson

พัฒนาการของโมไบล์บรอดแบนด์



เปรียบเทียบสมรรถนะการส่งผ่านข้อมูล

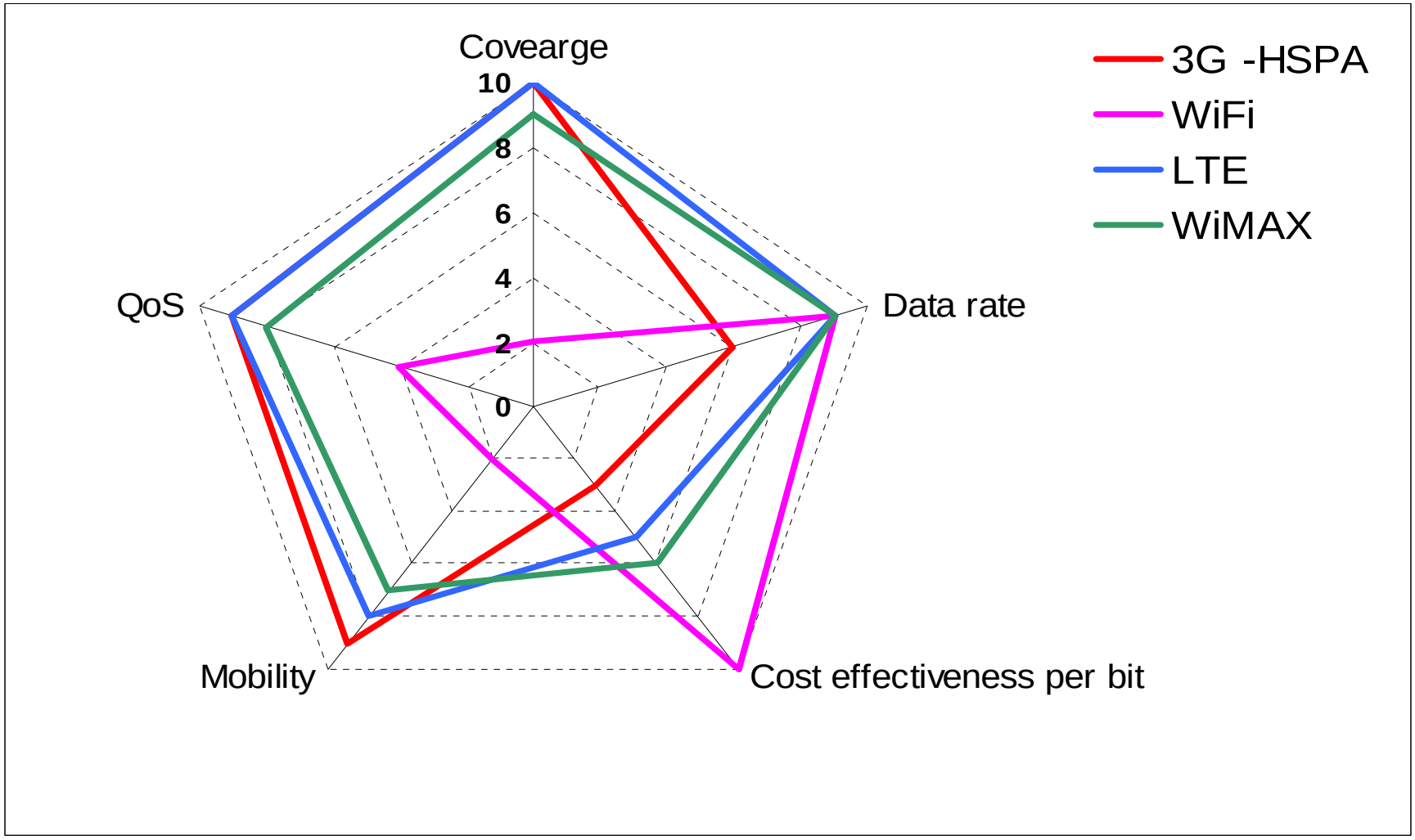
Technology	Required Spectrum	Standards Completion (Expected)	Peak Throughput (Mbps)		Avg. Spectral Efficiency (bits/sec/Hz/Sector)		Sleep to Active Latency
			DL	UL	DL	UL	
802.16e/Mobile WiMAX Release 1.0 2x2 MIMO TDD	10 MHz (5:3)	Dec. 2005	40	17	1.4	0.7	< 40 ms
HSPA (Release 6) FDD	2x5 MHz	Mar. 2005	14	6	0.5	0.3	250 ms
HSPA+ (Release 8) 2x2 MIMO FDD	2x5 MHz	Dec. 2008	42	12	0.8	0.5	50 ms
LTE (Release 8) 2x2 MIMO FDD	2x10 MHz	Mar. 2009	86	38	1.6	0.8	10 ms
LTE (Release 10) 4x4 MIMO FDD	2x10 MHz	(Q1 2011)	160	80	2.4	2.1	<10ms
802.16m 4x4 MIMO TDD	20 MHz (5:3)	(Q3, 2010)	170	90	2.9	2.5	<10 ms

All peak throughput numbers (except for WiMAX 1.0) exclude the impact of control & coding overhead
3GPP data rate numbers are from 3GPP document TR 25.912, page 55 and average of NGMN documents for LTE
3GPP Latency numbers are from 3GPP 25.999 & 3GPP 36.912
3GPP LTE Release 10 numbers are from the 3GPP ITU-R IMT-Advanced submission TR 36.912 with L=3 for pragmatic overhead calculation
WiMAX Release 1.0 uplink assumes virtual MIMO
802.16e/WiMAX 1.0 spectral efficiency numbers are based on NGMN evaluation methodology
802.16m is based on ITU-R IMT-Advanced submission evaluation and for urban macro –cell

ระบบ 3G สำหรับแอพลิเคชันไอพี

Initial LTE will focus on data while leveraging 3G for voice

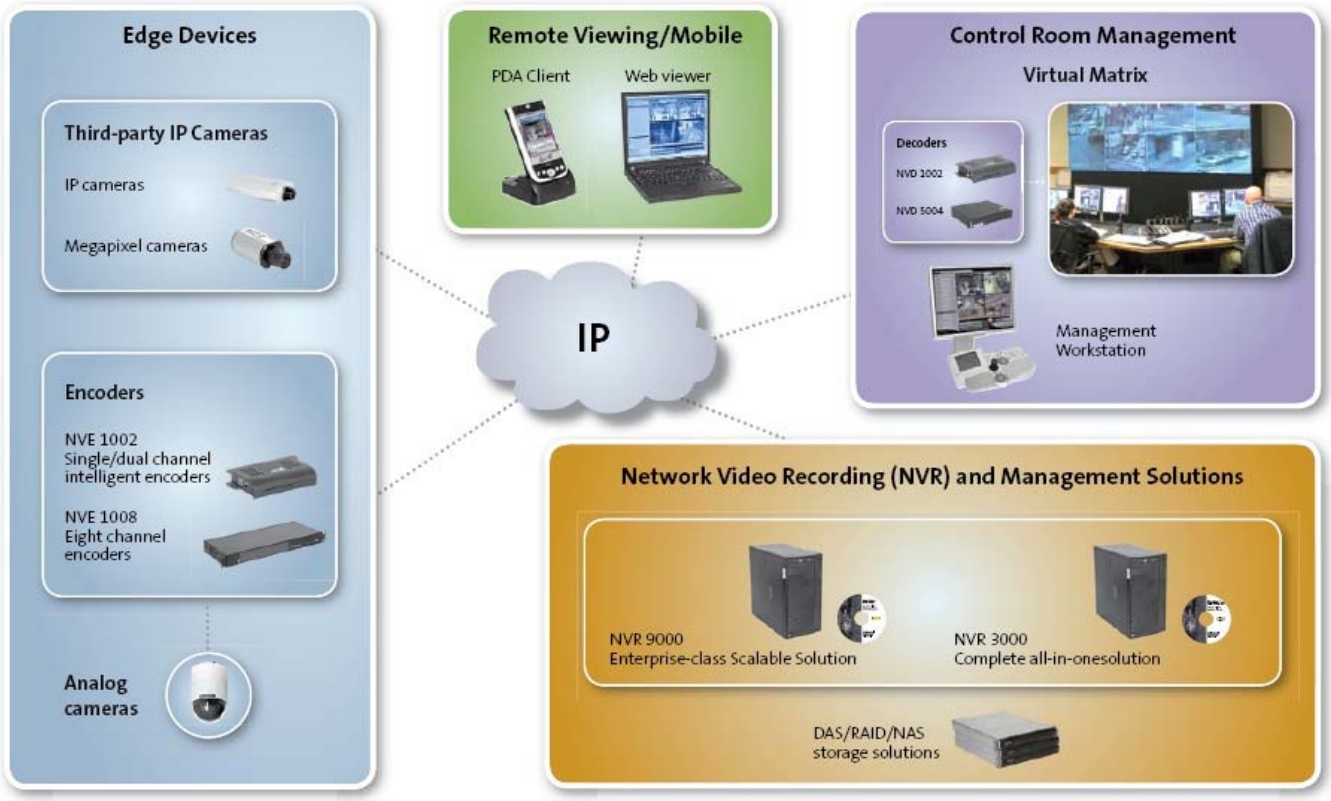
เปรียบเทียบเทคโนโลยี



แอพลิเคชันสำหรับโมไบล์บรอดแบนด์

ตัวอย่างประยุกต์ด้านวิดิโอ

- Large venues can have 100's of cameras
- Need high bandwidth connectivity solution



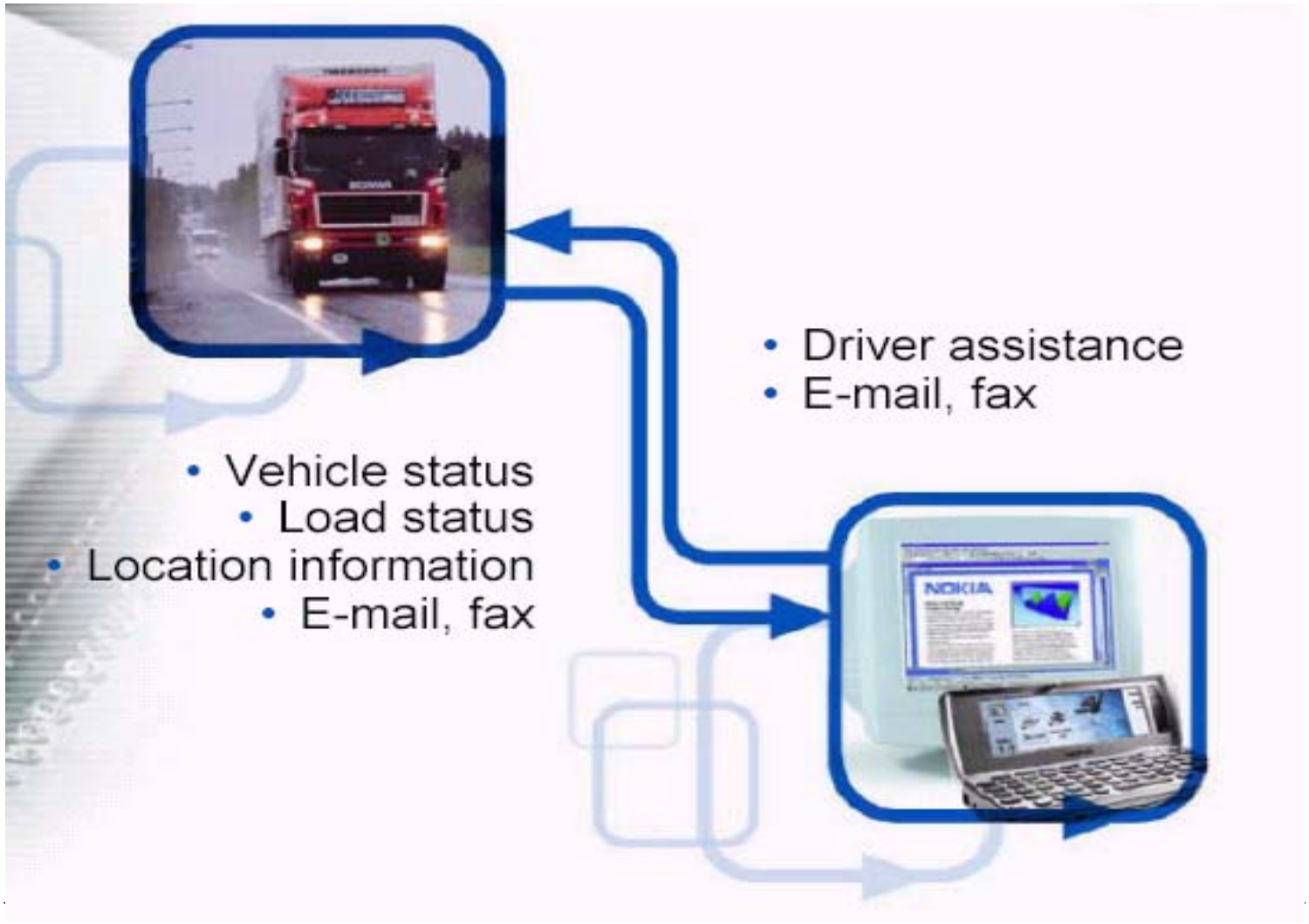
บริการ M2M

M2M: automated flow of data from machine to machine

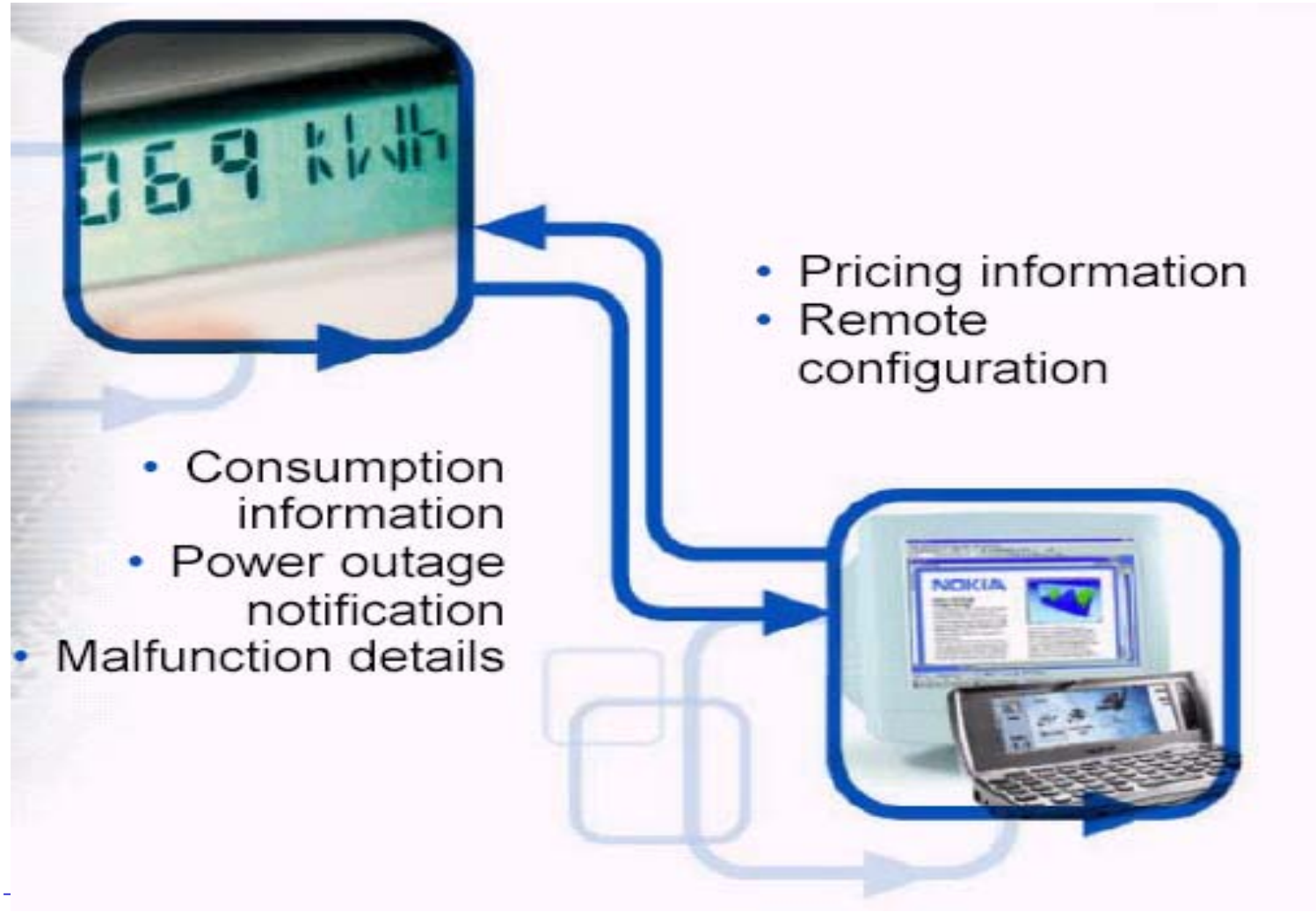
- **M2M enables large set of applications by embedding every day devices with mobile transceivers**
- **Cellular M2M can offer significant advantage for new services and applications**
  - **Ubiquitous coverage**
  - **Mobility support**
  - **Broadband rates**
  - **Lower cost through standardization**

- **Reference : http://www.m2malliance.de**

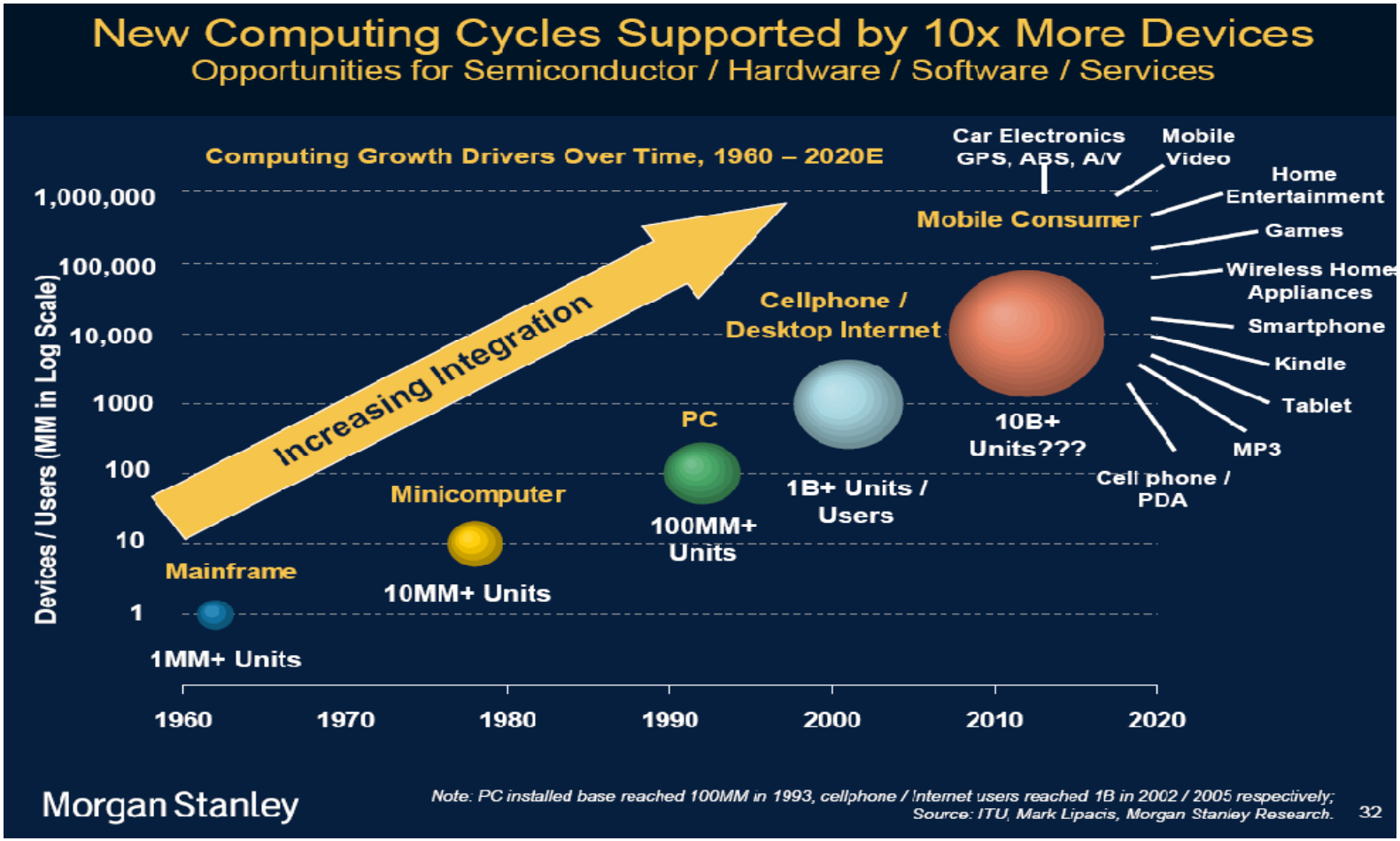
ตัวอย่าง M2M : โทรมาตร



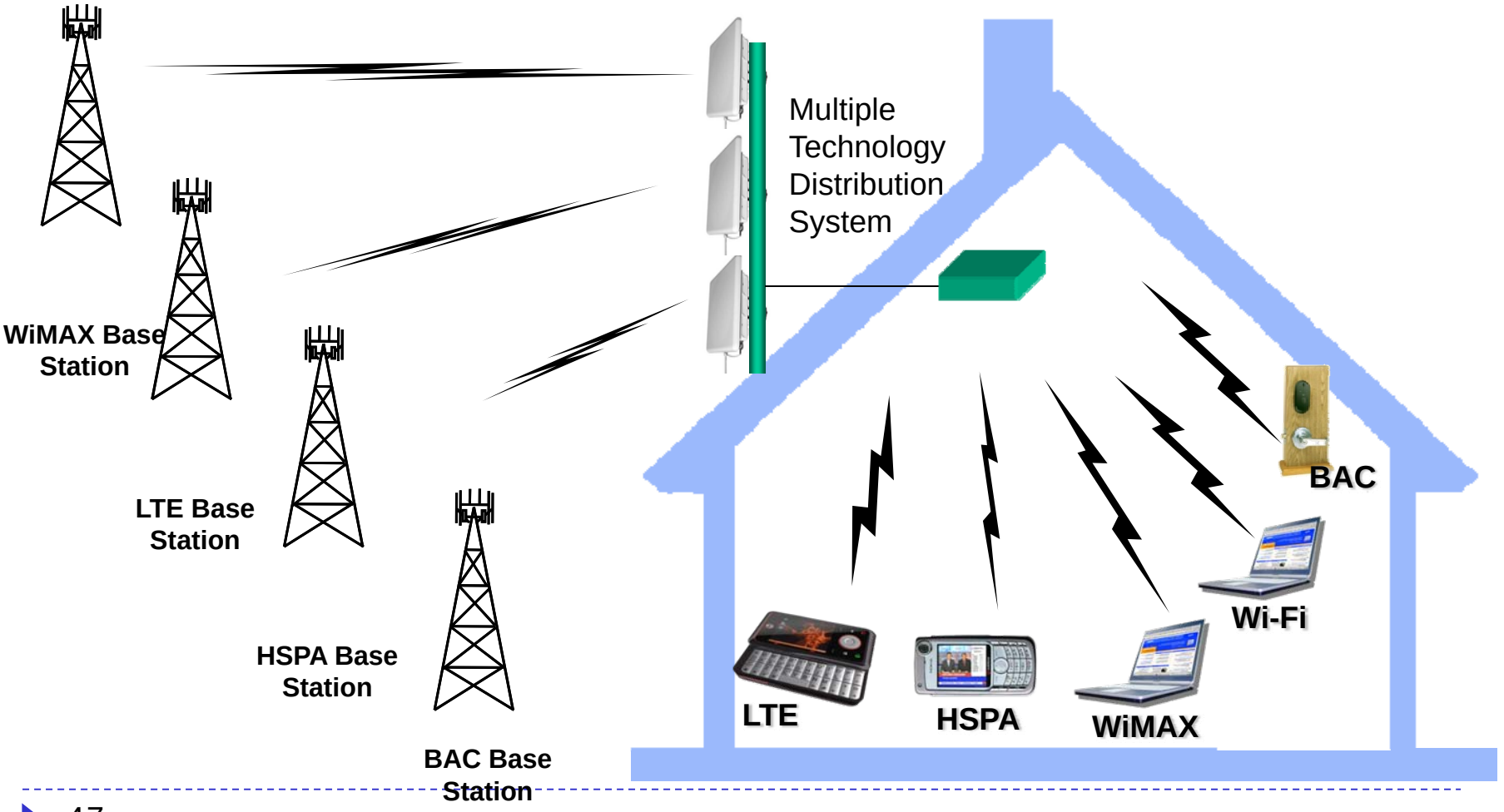
ตัวอย่าง M2M : การบริหารยานพาหนะขนส่ง



การขยายตัวของโมไบล์



รูปแบบเครือข่ายอนาคตที่ผสมผสานหลายเทคโนโลยี



คำถาม-คำตอบ