목 차

- AVVID
- CDN
- WLAN

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차세대 네트워크 기술

Data/Voice/Video

Optical

Wireless

Intelligent Software

Advanced Hardware

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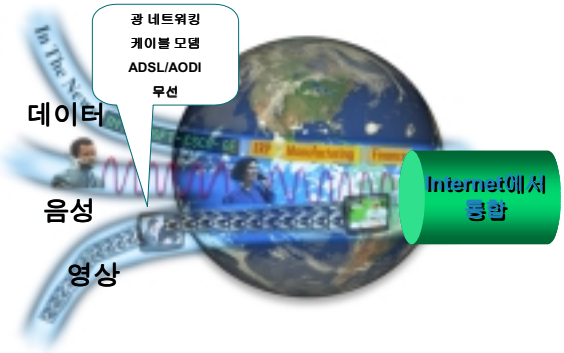
3

통신 기술의 통합 흐름 (Voice /Video/Data 의 IP로의 통합)

- 데이터 네트워크와 음성 네트워크가 통합되는 단일한 네트워크
  - 여러가지 다양한 네트워크 인프라에서 패킷으로 트래픽이 통합
  - 통합의 매개체는 인터넷
- 음성 트래픽 보다 데이타 트래픽이 압도적으로 많은 환경
- 다양한 현재 데이터 전산환경의 다양한 어플리케이션과 통합
  - Unified Messaging
  - CTI, Call Center
- 새로운 형태의 다양한 비즈니스 기회
  - 전화와 데이타의 통합에 따른 다양한 부가 서비스 창출
- 언제 어디서나 데이타와 음성을 간편하게 사용
- 데이터는 요금 부과, 음성은 무료화가 가능



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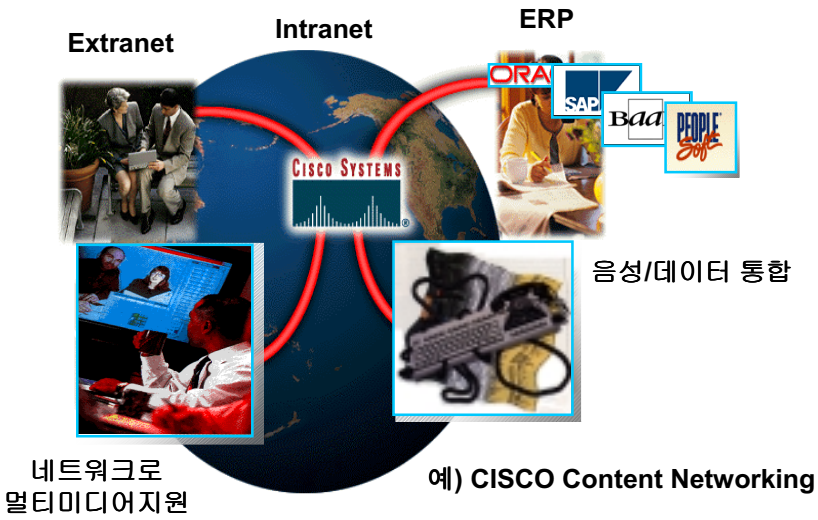
어플리케이션과 통합된 네트워킹



Internetworking 에서 Content Networking으로의 전환

Internetworking	Content Networking
Reaching a destination (L3)	Accessing Content (L7) from the most responsive source
Static Host names / addresses	Dynamic Web pages/URLs
Policies for network device management	Policies for content caching, load balancing, application recognition

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Mobile Network 혁명

- By 2002 over half of all call minutes will be on mobile networks IDC
- New Standards will encourage Mobile Data (2005 - $80B)
- Mobile internet deployed now

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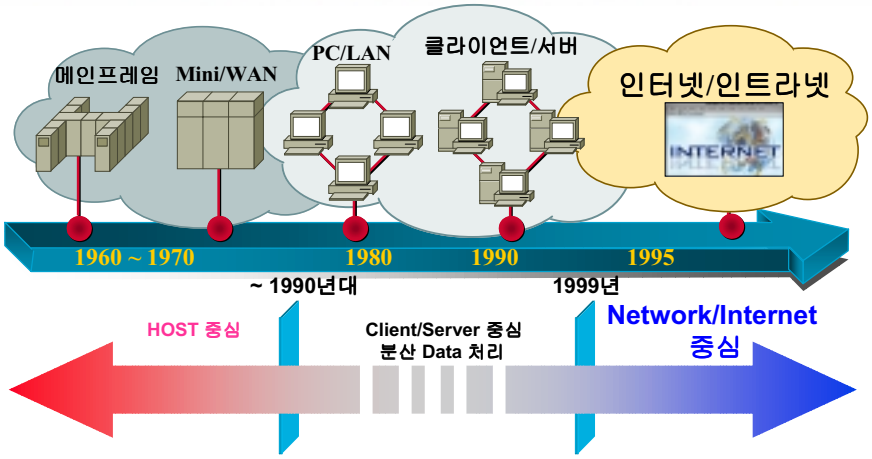
전산환경의 변화



1999~ : 글로벌 인터네트워킹 시대, 새로운 세상 (New World,IP World)

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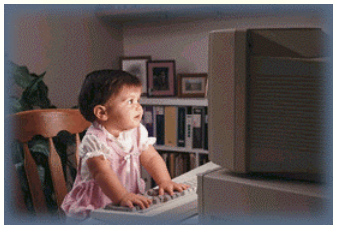
Network시대의 환경변화

1 Internet 세대



2

풍부한 Content 와
광대역 Access

3 ***Drive need for scalable Content Delivery and New Hosting Services***

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Application의 네트워크 요구사항

지난 5 년간 . . .

Network enabling of relatively simple applications

향후 5년 . . .

Enabling more demanding networked applications
e-Learning, e-Commerce, e-Communication

Key strategic applications will require . . .

Higher Bandwidth

Higher Reliability

Better response times

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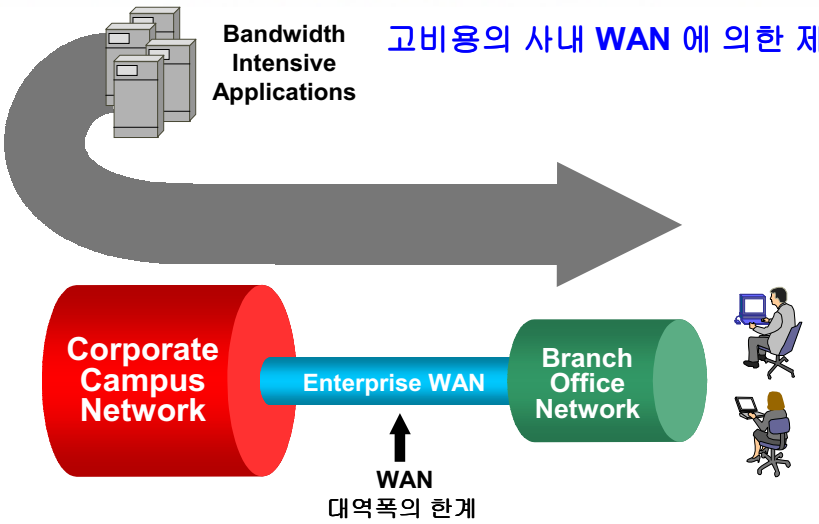
기업내부 네트워크 제약



고비용의 사내 **WAN** 에 의한 제약

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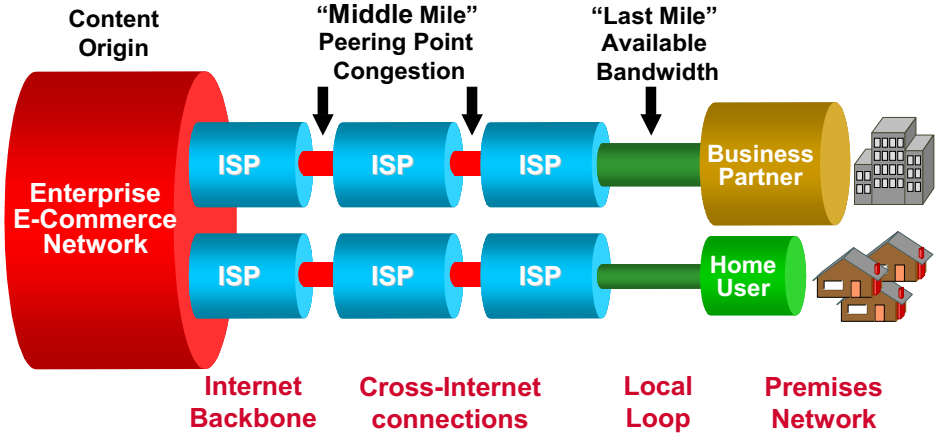
기업외부 네트워크 제약

Internet상의 병목에 의한
E-Business application 제약



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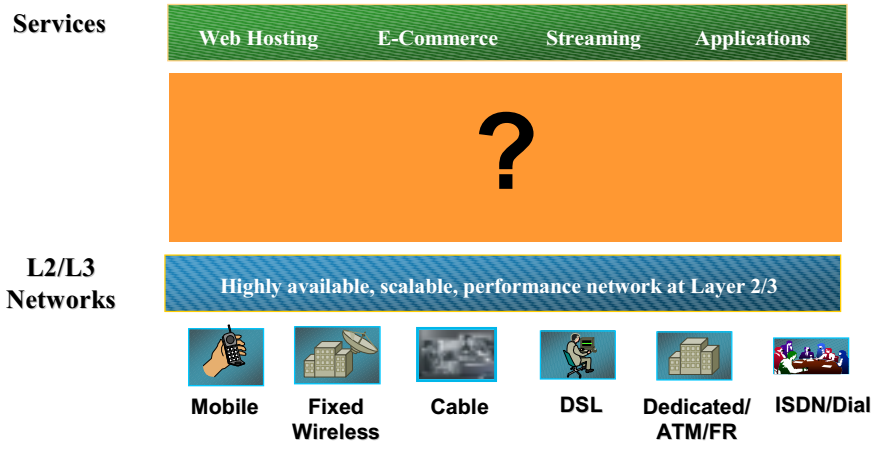
Internet Business 구성 모델



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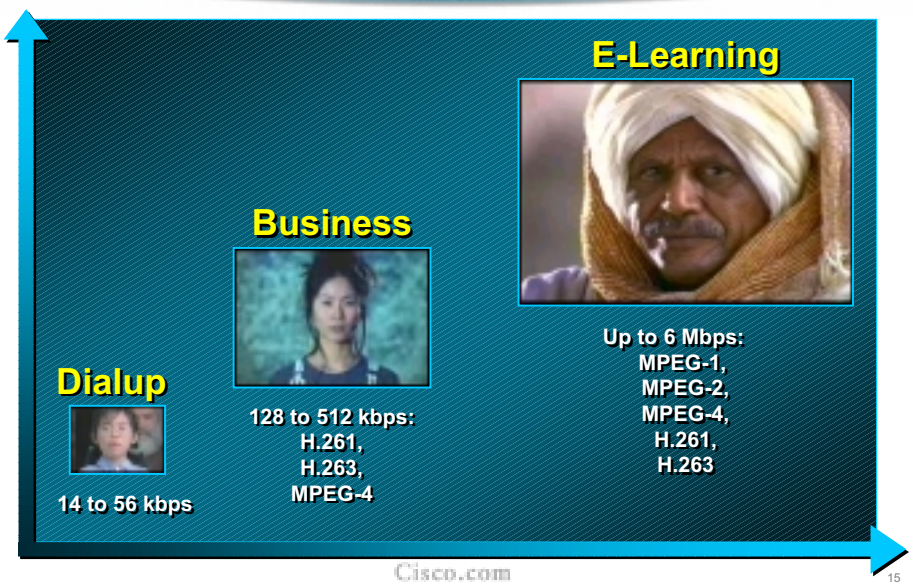
E-Learning을 위한 Network 대여폭



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CDN(Content Delivery Network) 정의

An end-to-end content delivery system leveraging services in the IP core network and content aware layer 4 - 7 capabilities to optimize end user access to content.

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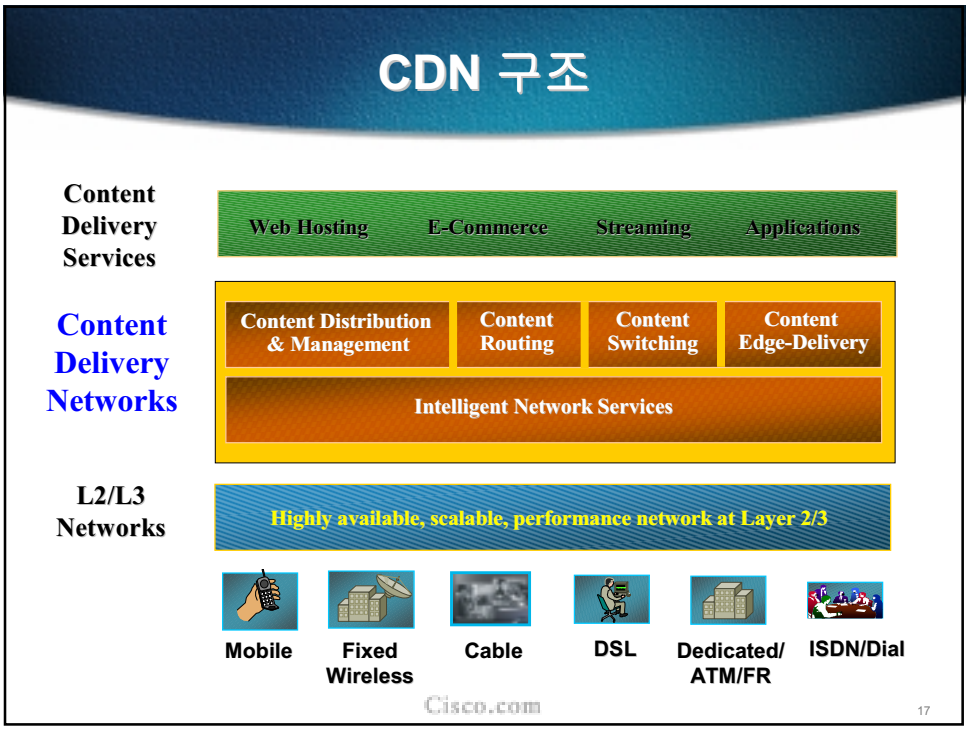

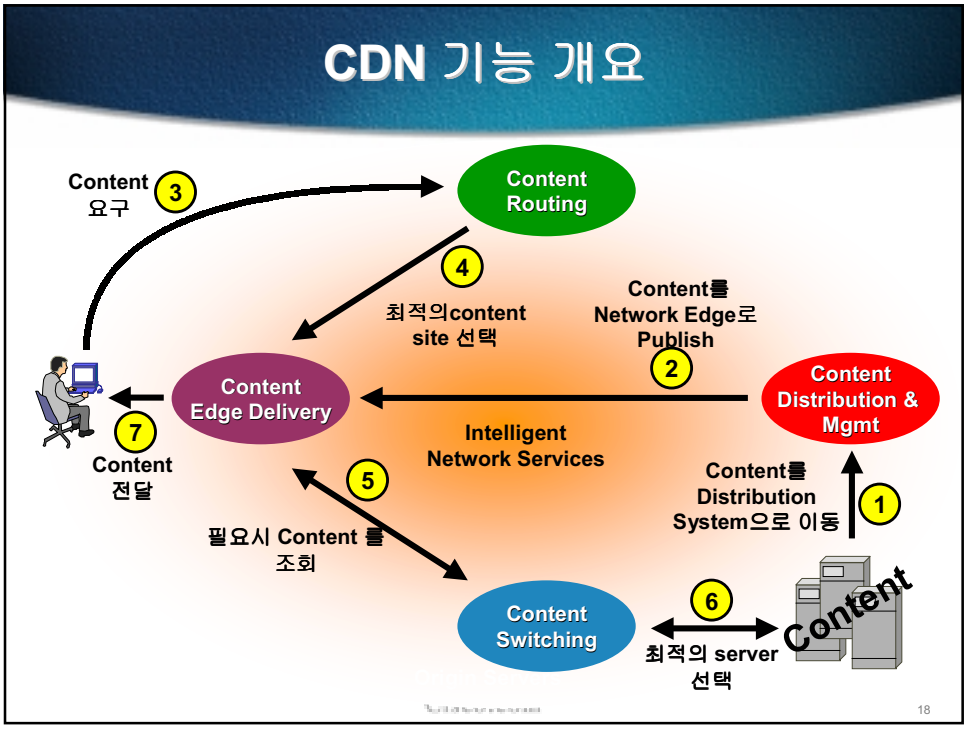

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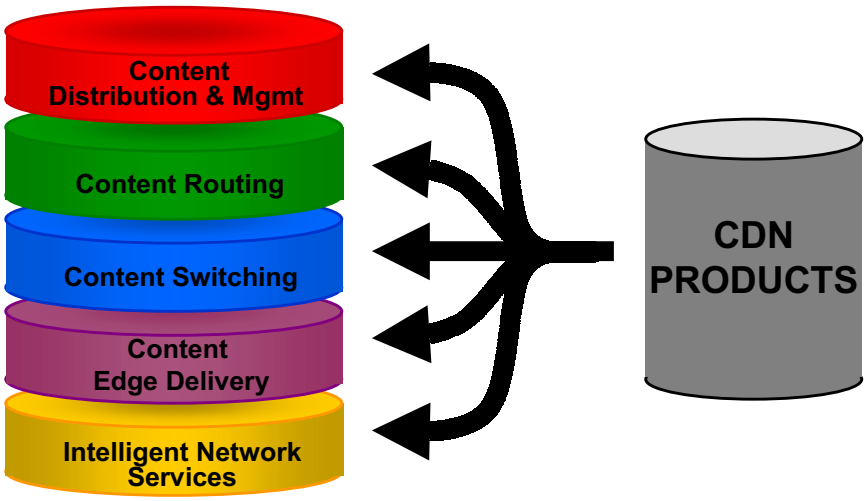
- CDN 구성

CDN의 5대 서비스 요소



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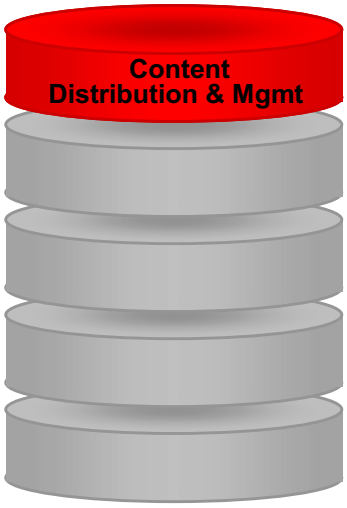
CDN의 5대 서비스 요소
Content Distribution & Mgmt



- Global centralized provisioning for content distribution
- Automatically distribute content to network edge
- Management service for CDN monitoring
- Configuration management for delivery nodes at network edges

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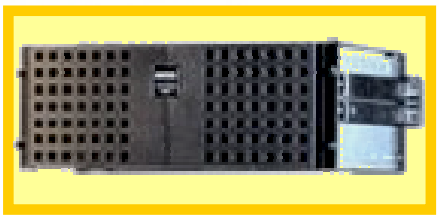
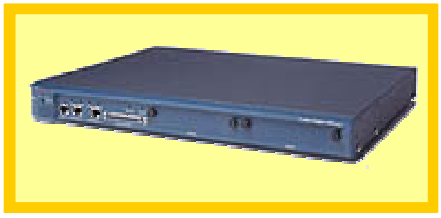
Content Distribution Managers 제품

CDM 4600 Series:

- Management for CDN
- CDN policy & configuration database
- Content, customer registration & domain assignment
- CDN Network monitoring
- CDN Accounting interface
- Enterprise content registry
- Peering/Billing (Future)



CDM 4650 / 4670



CDM 4630

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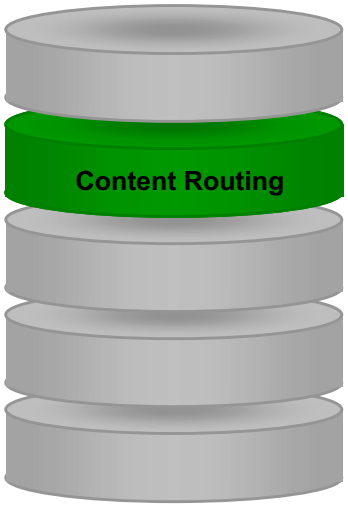
CDN의 5대 서비스 요소
Content Routing



- Best Site Selection process
- Redirects or Routes requests from users to the best site
- Best site selection metrics include:
  - presence of content
  - geographic proximity
  - network conditions
  - Site load and Server load

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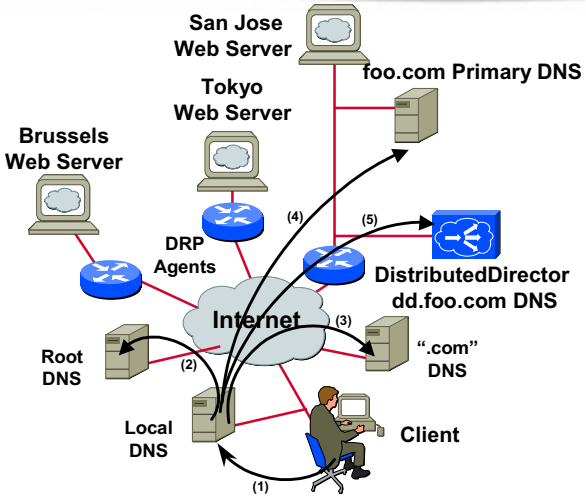
DistributedDirector 조회 순서



Step

(1) Client asks local DNS "What is the IP address of www.foo.com?"

(2) Local DNS queries "Root" DNS server for www.foo.com's IP Address.
Root DNS refers local DNS to ".com" DNS server

(3) Local DNS queries ".com" DNS server for www.foo.com's .
".com" DNS refers local DNS to "foo.com" DNS server

(4) Local DNS queries "foo.com" DNS server for www.foo.com's.
"foo.com" DNS refers local DNS to DistributedDirector

(5) Local DNS sends query to DD (dd.foo.com is authoritative nameserver for www.foo.com subdomain)

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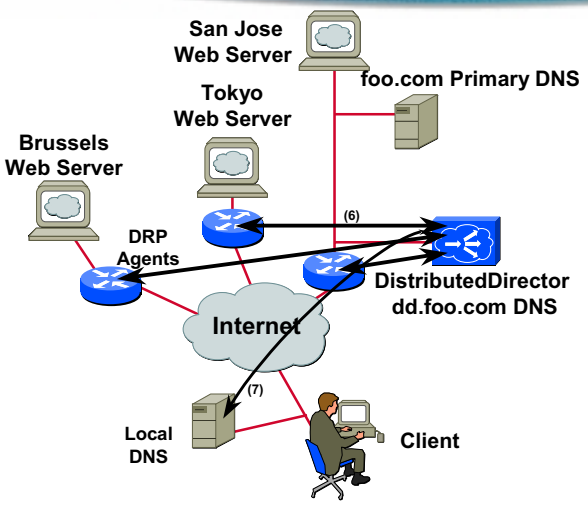
DistributedDirector 조회 순서



Step

(6) DD "knows" IP addresses of servers and DRP Agents

DD issues DRP queries to agents to gather required metric information

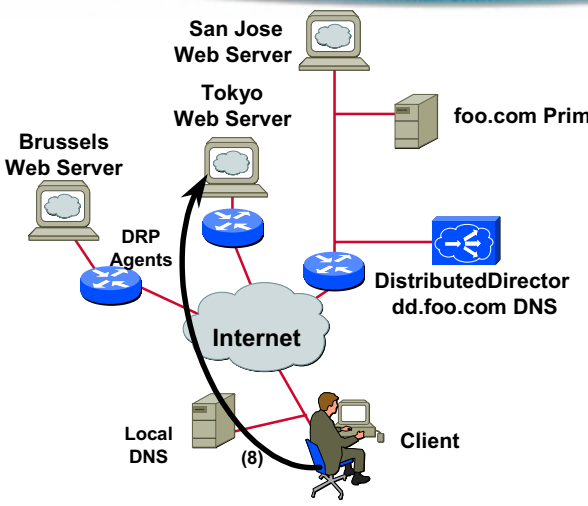
DRP Agents respond

"Distance" is from DRP Agent/distributed servers to local DNS

(7) DD sorts metrics and returns single IP address of "best"server to client's local DNS

Local DNS returns IP address to client

DistributedDirector 조회 순서



Step (8)

Client connects to server at returned IP address

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Content Routing 제품

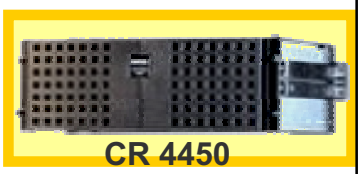
CR

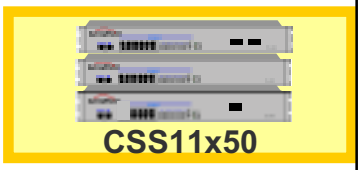
- **DistributedDirector Server Algorithm**
  - Routing based on routing metrics
  - NS records support for hierarchical routing
  - BGP Route maps (policy)
  - Dynamic Feedback Protocol for LD/DD interaction
- **Boomerang Server Algorithm**
  - DNS 'Triangulation' Algorithm
  - Transparent Server Selection
  - Server health check w/ HTTP GET

Content Routing 제품

CR

- **SightPath SODA Server Algorithm**
  - Routes requests to optimal content engine
  - Scales to >1K nodes
  - DNS hierarchical routing mechanism based on Sightpath SODA architecture
  - Dynamically adapts to changing network conditions (learning)
- **CAPP Server Algorithm * Pre Web-NS 4.0 ***
  - Demand based content replication – "hot content"
  - Staged Content Replication based in Content Rules
- **Web-NS 4.0 Tiered Proximity Algorithm**
  - Routing based on Proximity
  - Best Site – Best Server Selection Coupled
  - Hierarchical architecture – multiple tiers
  - NS records support for hierarchical routing





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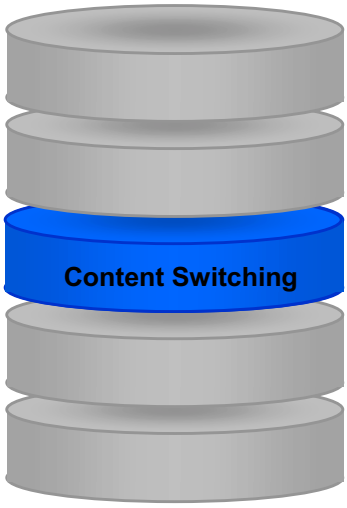
CDN의 5대 서비스 요소
Content Switching



- Best Server or Content Engine Selection
- Intelligently load balances traffic across servers or Content Engines
- Gracefully removes 'problem' servers from the rotation
- Automatically inserts "well-behaved" server to the rotation
- Selection is based on:
  - Server Availability
  - Server Load
  - Server Response Time
  - Content Availability
  - L3/L4 information (IP address, TCP port, …)
  - L5-L7 content (URL, Cookie, ...)
    - *–(Note that HTTP is an L5 protocol/application, NOT L7)*

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Content Switching
L4 와 L5-L7

- **L4 Content Switching Capabilities**
  - Protocol
  - TCP/UDP Port
  - Stateful & Stateless Failover
  - SLB Algorithms
  - SLB NAT/PAT
- Application Probes
  - HTTP Probes
- Catalyst 6000, 4840G, IOS-SLB

- **L5-L7 Content Switching Capabilities**
  - HTTP Host Tag
  - Entire URL
  - Dynamic Cookie
  - File Extensions
  - + ALL capabilities of L4!
- Persistence Features
  - Source IP, SSL, Cookie Insert, Cookie Passive, HTTP Redirection
- Content Switching Policies
  - User configurable Content Rules
  - Broad Range of Services Per Content Rules
  - Content Verification System
- CSS 11050, 11150, 11800, LD

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General Load Balancing Algorithms

- Round Robin
- Weighted Round Robin
- Least Connections
- ACA
- Weighted ACA

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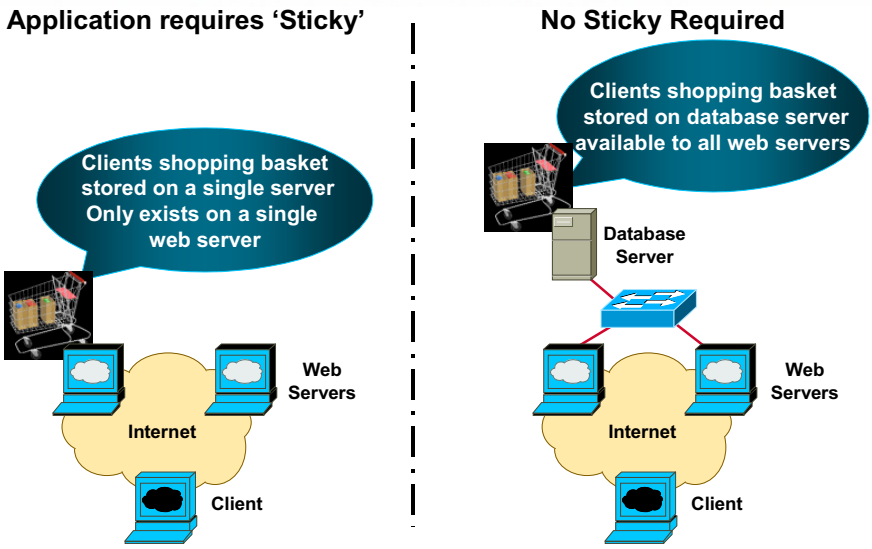
Sticky Connection의 필요



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Cisco CSS 제품군 DoS Attack 방어 기능

- SYN Flood
- Illegal Addresses
- Illegal Ports
- NAT
- LAND Attack
- Smurf and Fraggle
- Teardrop, Ping of Death, Boink, Bonk
- DoS Logging- CSS, Syslog, SNMP Trap

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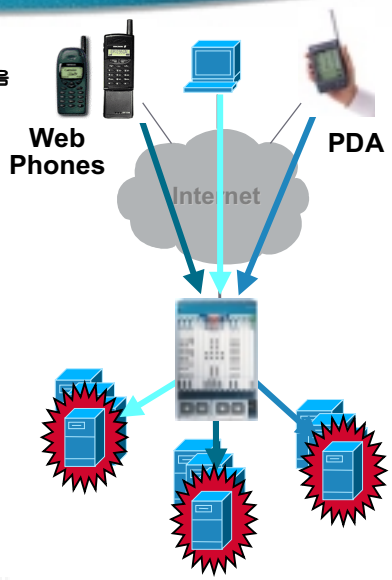
단말 환경에 따른 Web Services 기능지원

•다양한 단말 Type에 따라 서버 그룹지정을 다르게 할 수 있음
•단말 type 외에 사용언어등 다양한 HTTP Header 내용에 따라 서버를 지정 할 수 있음



단말 Type 에 따른 예

Step 1: Web Browser requests URL: www.yahoo.com/myportfolio

Step 2: Internet phone requests URL: www.yahoo.com/myportfolio

Step 3: PDA requests URL: www.yahoo.com/myportfolio

Step 4: Switch determines best server for each request based on browser type or language support in HTTP request header

Step 5: Switch delivers requested content to each device

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HTTP 1.1 기능 지원

•HTTP 1.1의 기능인 여러 개의 동시Request를 각각의 서버에 분산 하여 서비스제공을 받을 수 있는 기능

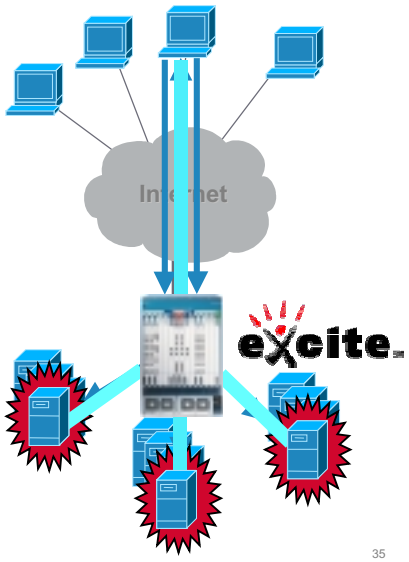
Step 1: User clicks: www.excite.com/cars
Browser gets IP Address from DNS
Browser sends TCP SYN (connect?)

Step 2: Switch sends TCP SYN ACK

Step 3: Browser sends URLs:
www.excite.com/main
www.excite.com/picture1
www.excite.com/banner2
www.excite.com/text4

Step 4: Switch determines best server for each request

Step 5: Switch aggregates responses in a single TCP connection



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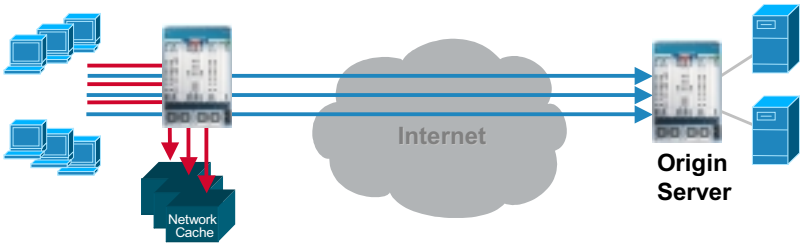
지능형 Cache Bypass 기능



- URL, file type별로 Cache기능이 필요없는 Content에 대하여 Cache로의 흐름을 Bypass하여 전체 성능 향상을 도와 주는 기능
- Transparent - no browser configuration required
- Improves performance by bypassing cache for non-cacheable content or cache failures
- Content policy allows include, exclude (bypass), or block actions based on Access Control Lists
  Based on IP address, TCP port or URL

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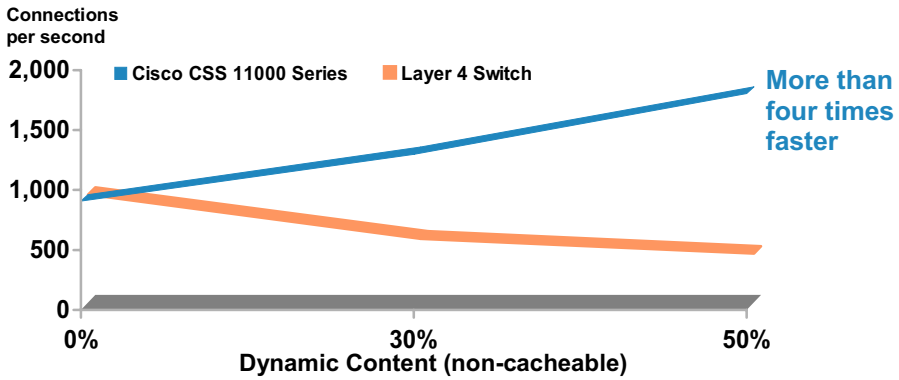
지능형 Cache Bypass 성능



Dynamic Content가 증가할 경우 일반 Cache 지원구조에서는 성능이 저하되지만, CSS경우 전체 성능이 개선됨

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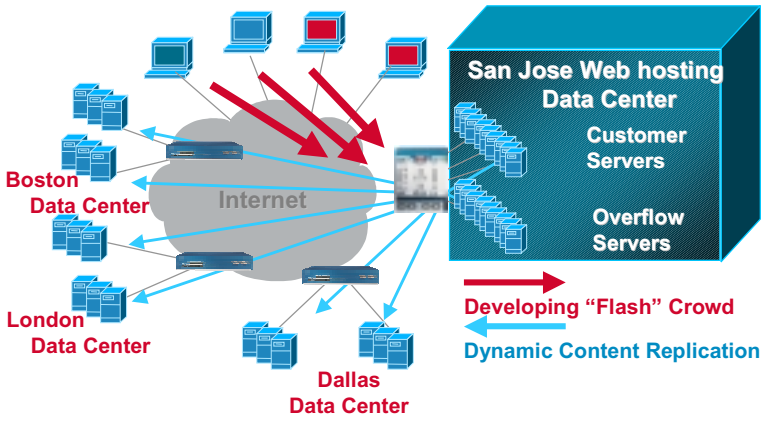
Flash Crowd Insurance



WEB Request폭주시 임시로 Content를 다른 서버에 복제하여 한시적으로 서버 용량을 확대하여 서비스 제공을 지원할 수 있는 기능

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Content Switching제품 (L4-L7)

CSS 11000 Family

CS

- **CS-11800**
  - 20 Gbps 8 Slot Modular Chassis
  - RPS
  - Up to 64 10/100 or 32 Gigabit Ethernet ports
  - NEBS1 Compliant

- **CS-11150**
  - 1 RU Fixed Configuration 5 Gbps Switch
  - Up to 16 10/100 & 2 Gigabit Ethernet ports
  - RISC Based Processor
  - 128 MB SDRAM

- **CS-11050**
  - 1 RU Fixed configuration 5 Gbps Switch
  - Up to 8 10/100 & 1 Gigabit Ethernet ports
  - RISC based processor
  - 128MB SDRAM

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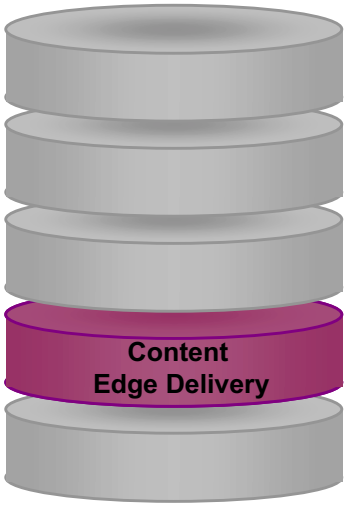
CDN의 5대 서비스 요소

Content Edge Delivery



- Provide content serving transparently to the user
- Content Edge-delivery Redundancy & Scalability
- Content Serving through:
- Transparent caching
- Reverse-proxy caching
- Streaming Media Service
- Content Serving of:
  - -Static files
  - -Real G2
  - -MPEG 1 & 2 support

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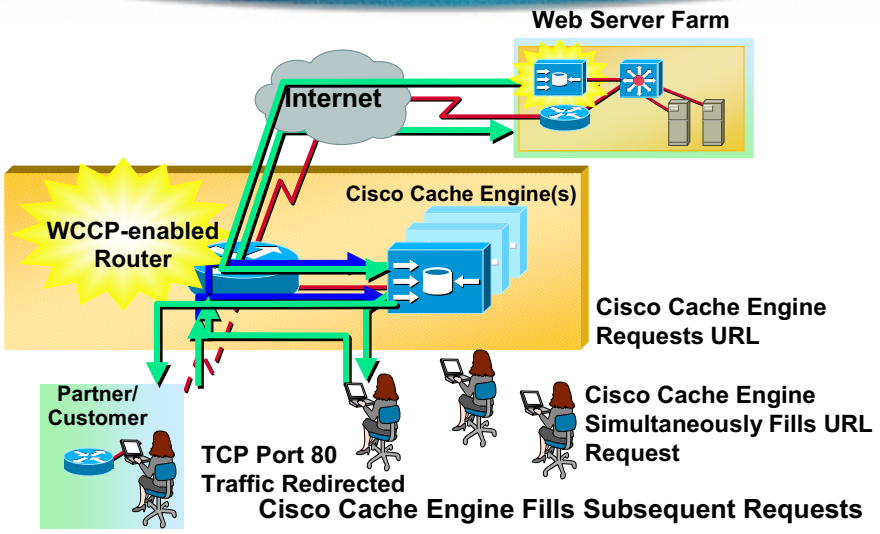
Cisco Cache Engine 운영방식



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Caching 종류

- Proxy Caching
  - Client's browser is configured to send all requests to the cache
  - Cache acts (proxies) on behalf of the client
- Transparent Caching
  - Cache is transparent to the client's browser
  - Cache is strategically placed in the path of network traffic where all the traffic is guaranteed to pass
  - Intercepts TCP port 80 requests
- Reverse Proxy Caching
  - Cache acts (proxies) on behalf of the origin server
  - DNS requests are resolved to an RPC
  - RPC's cache specific content
  - RPC's Can serve the following functions:
    Offloading of static (cacheable) content from servers
    Replication of content to geographically dispersed areas
    Replication of content for load balancing, and as an alternative to server expansion

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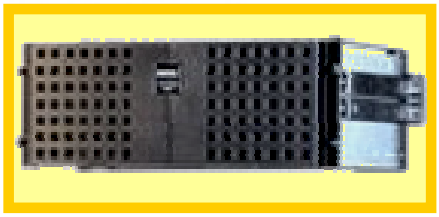
Content Engine 제품

CE

Content Engine 7320:

- Service Provider & Large Enterprise Deployment
- Caches Enabled Content
- Populated via Pull or Push
- Serves Requested Content



CE 7300 Series

Content Engine 500 Series:

- Enterprise Deployment
- Transparent caching & content delivery software modules
- Static files, Real G2, MPEG 1 & 2 support

CE 507 / 560 / 590

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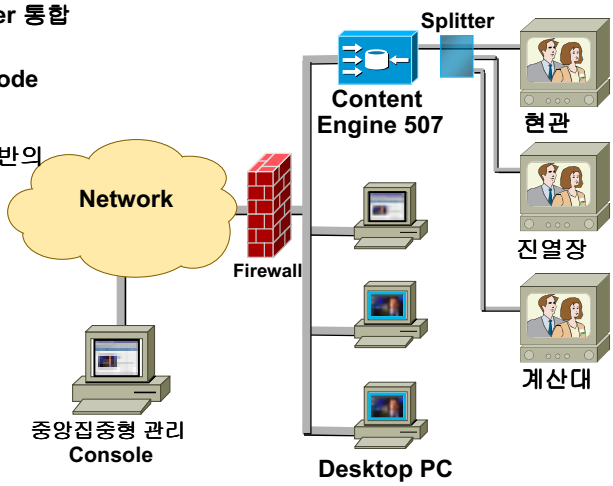
CDN솔루션 (예)
NTSC 또는 PAL 영상 출력 솔루션

- CE에 MPEG decoder 통합
- Media Files을 Video/Audio로 Decode
- NTSC 와 PAL 지원
- 중앙집중형 Web 기반의 VTR/VCR 제어
- 적용
  - Kiosk
  - Video Wall
  - Point-of-Sale



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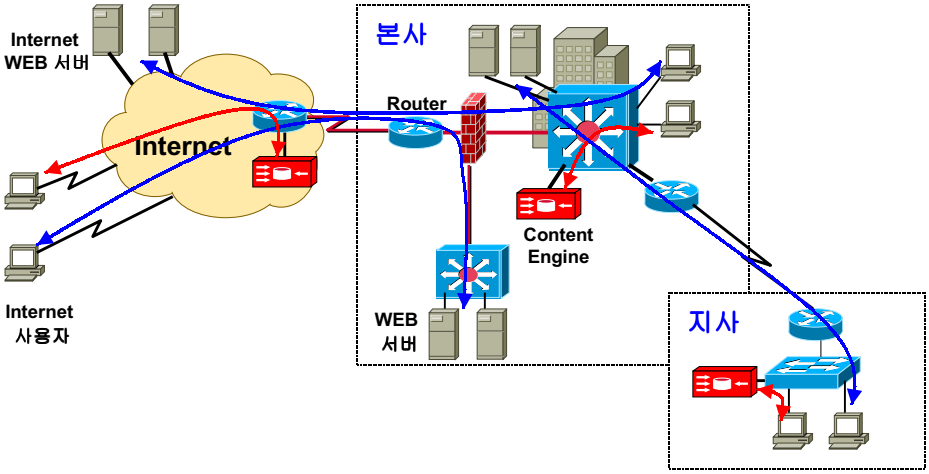
Content Engine을 이용한 회선비용 절감



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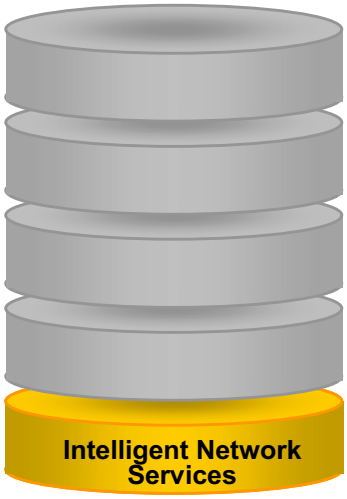
CDN의 5대 서비스 요소
Intelligent Network Services



- Intelligence within the Cisco IP infrastructure
- Required to build reliable and scalable Cisco CDNs
- A solid layer 2/3 core Cisco infrastructure is a key requirement
- Examples of Cisco's intelligent network services include QoS, (QDM and NBAR), VPNs, Security, and Multicast

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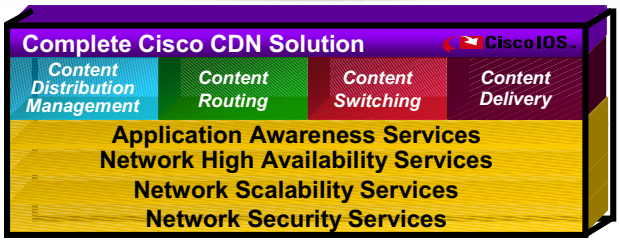
Intelligent Networking Services



- **QoS & VPNs**
  - –QoS policing, QoS marking, ToS, DSCP, 802.1q, NBAR
- **Security**
  - –State-full inspection Firewalls
  - –IOS Firewall Feature set
  - –ACLs, Extended ACLs and Wire-Speed RACLs & VACLs
  - –Intrusion Detection
- **Multicast**
- **L2/L3 Features**
  - –STP Enhancements: UplinkFast, BackboneFast, PortFast, BPDU Guard
  - –Private VLANs,
  - –Fast Convergent IGPs and Reliable Proven code: IOS

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Contents를 위한 네트워크 QoS 서비스

Network-Based Application Recognition (NBAR)

- **Problem: How to classify modern web-based and client/ server applications**
- **NBAR enhances bandwidth management, providing intelligent classification by:**
  - **URL (wildcards)**
  - **www.cisco.com vs www.xyz.com**
  - **www.cisco.com/orders.htm vs www.cisco.com/faq.htm**
  - **Dynamically assigned ports**

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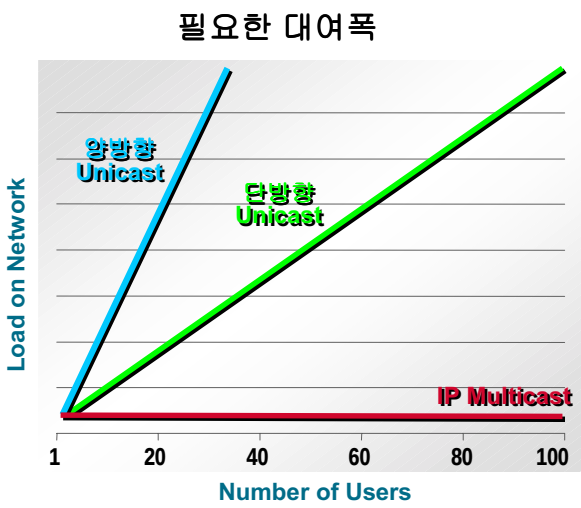
Video 서비스를 위한 Network 대여폭 산정

- Videoconferencing
  양방향 Unicast
- Video-on-Demand
  단방향 Unicast
- Broadcast
  IP Multicast



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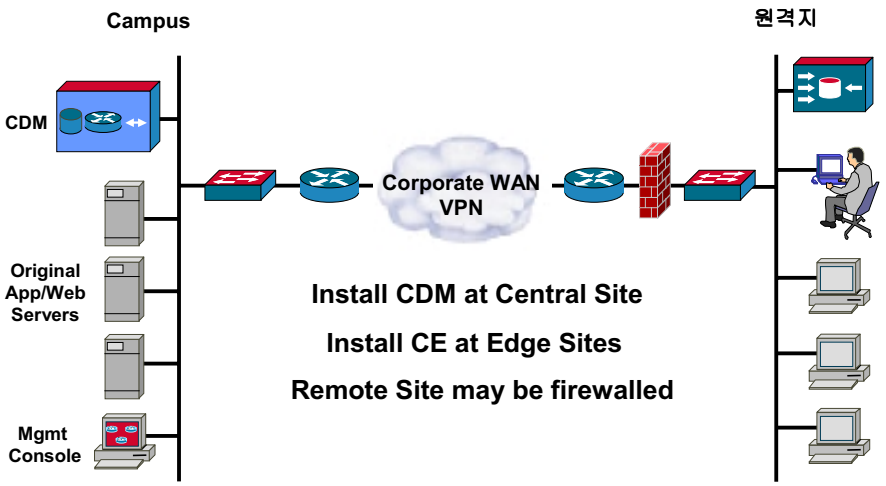
CDN을 적용한 멀티미디어 업무
Step 1. CDN Setup



Install CDM at Central Site

Install CE at Edge Sites

Remote Site may be firewalled

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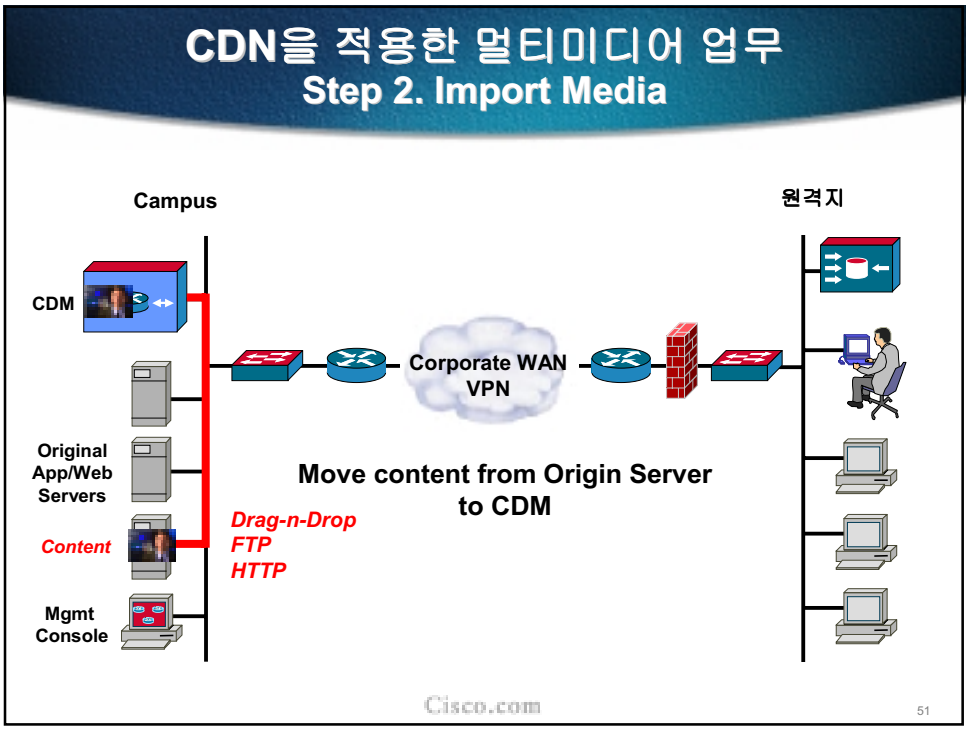

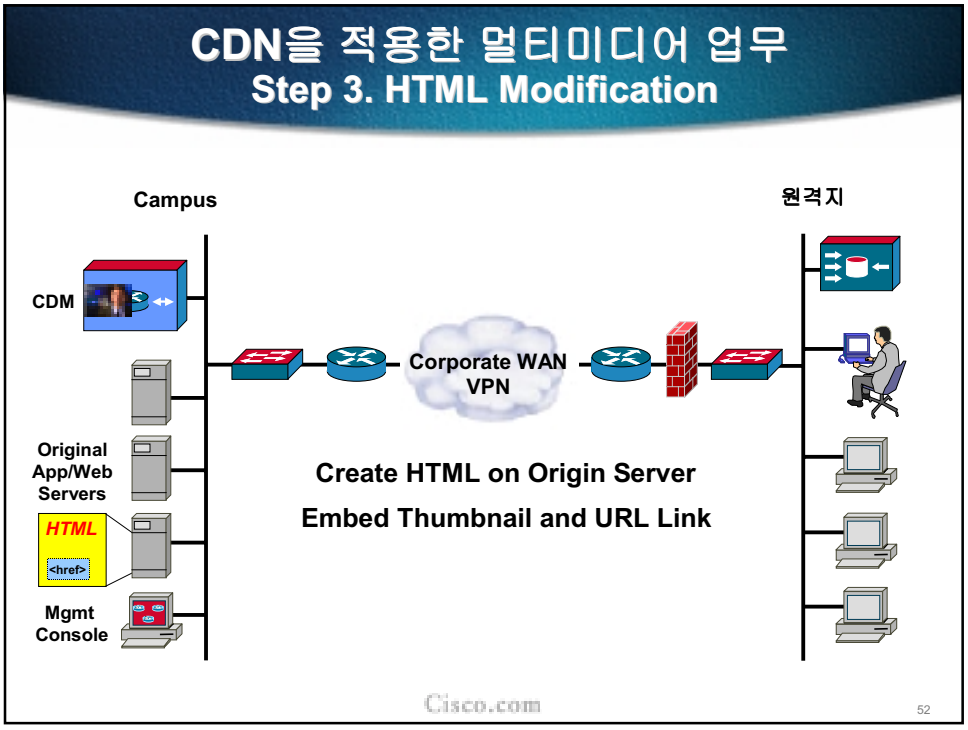

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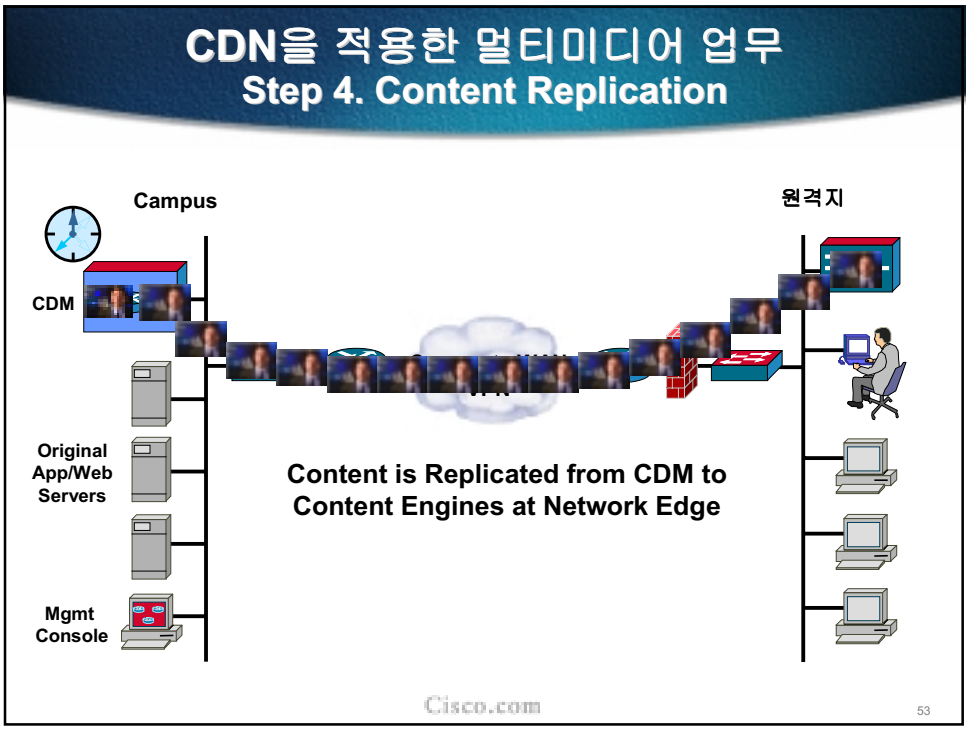

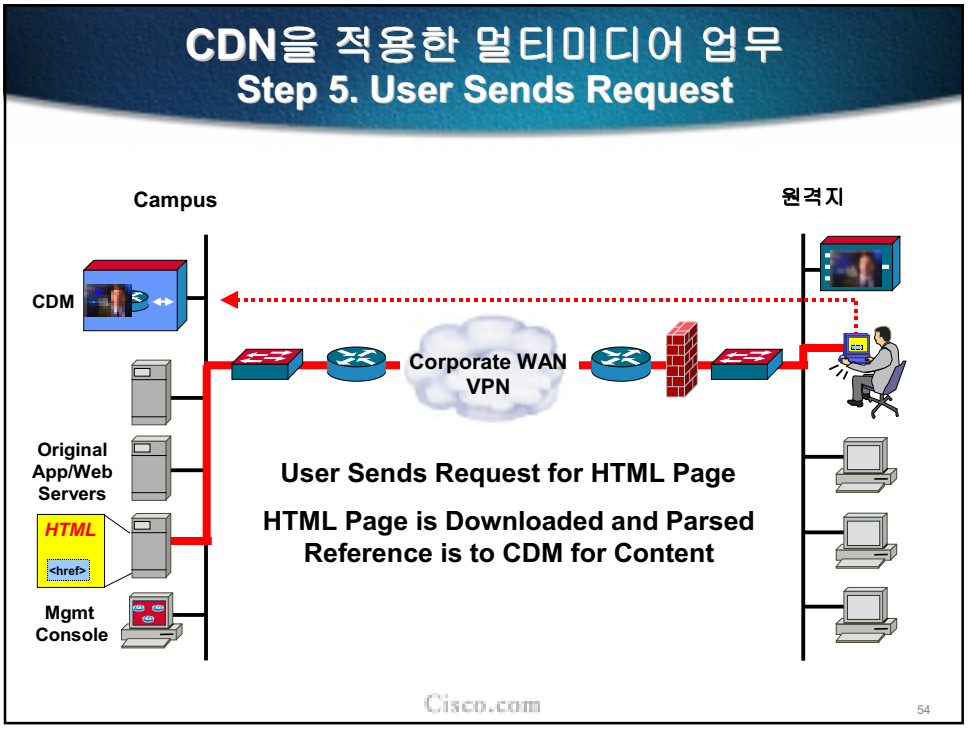

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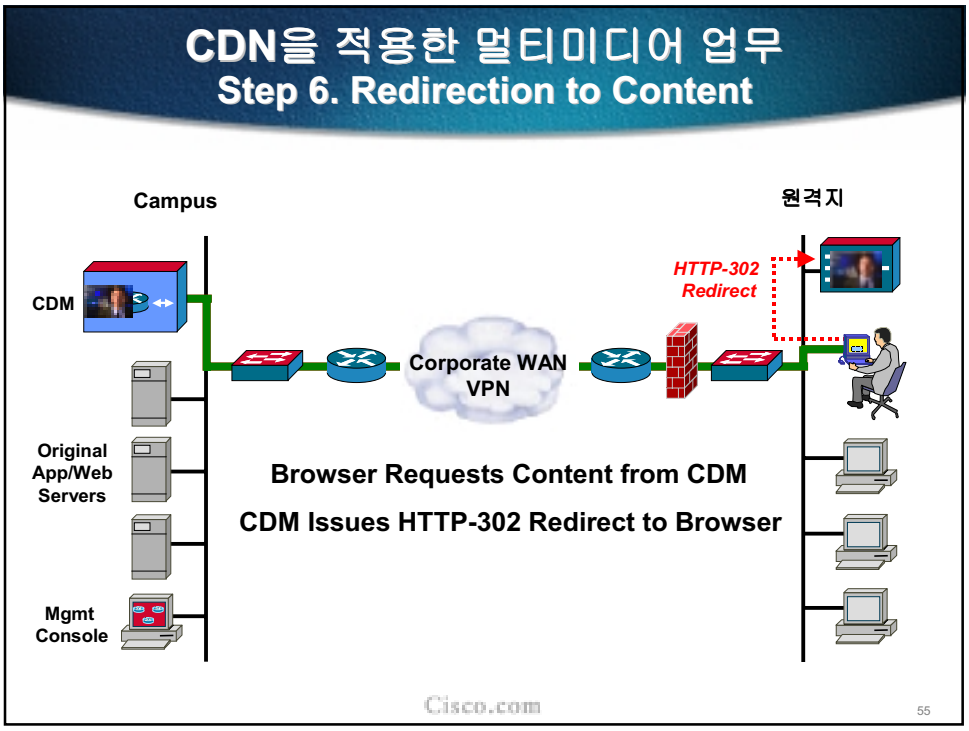

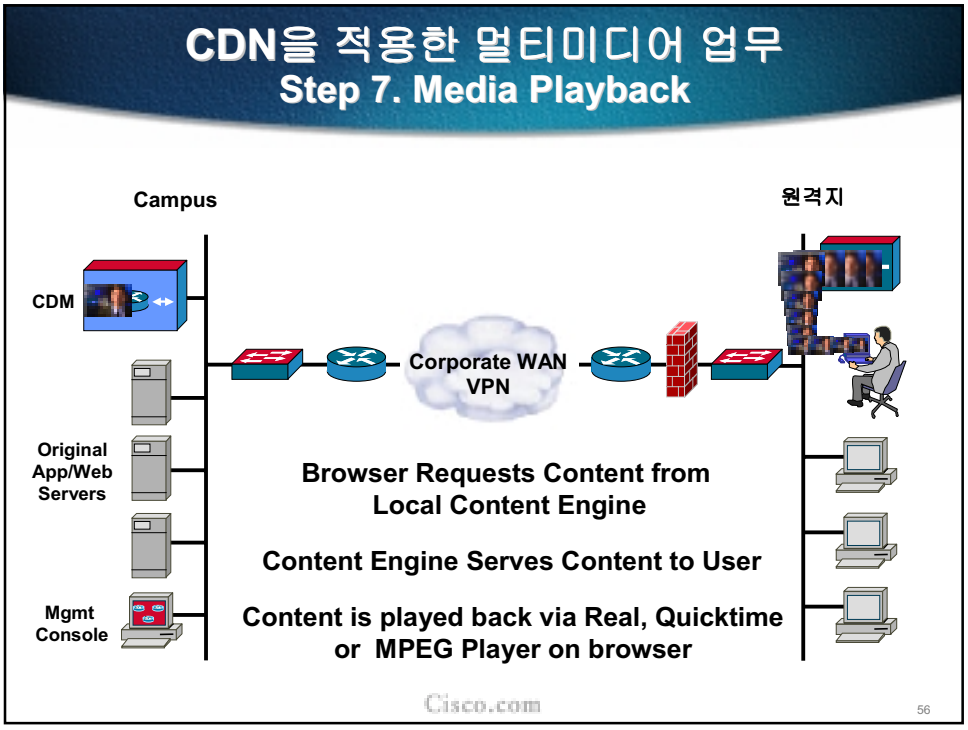

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Cisco의 Content Delivery Network

- *One Architecture* for highly available, scalable, flexible content delivery/services:
  - Server load balancing
  - Caching
  - Content delivery
  - Live streaming media
- Easy to use and administer
- Fast, secure, assured delivery of content
- Low cost of ownership/fast ROI

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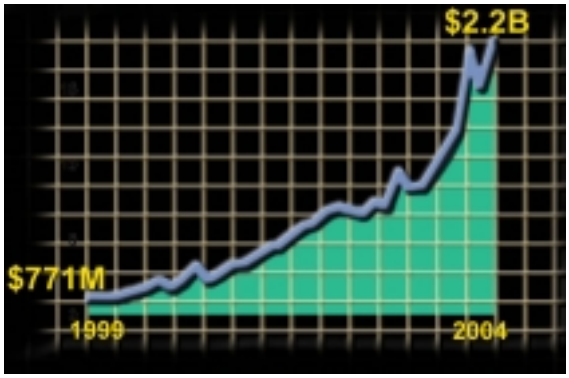
WLAN Market Growth

- Higher speeds
- Interoperability
- Lower prices



Source: Cahners In-Stat Group, February 2000

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Key Market Drivers

- Standardization
  - IEEE 802.11b standards
- Technological maturity
  - Better security—128-bit encryption
  - Longer range access points
  - 11Mbps throughput speeds
- Horizontal applications
  - Extension of wired solutions
  - Connecting mobile workers

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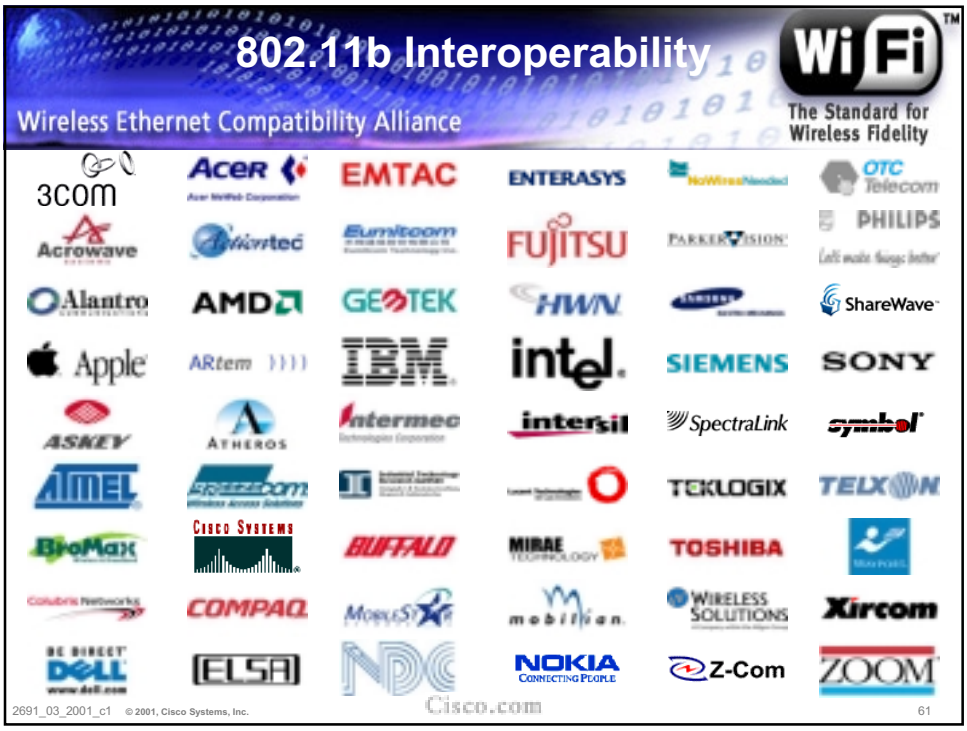

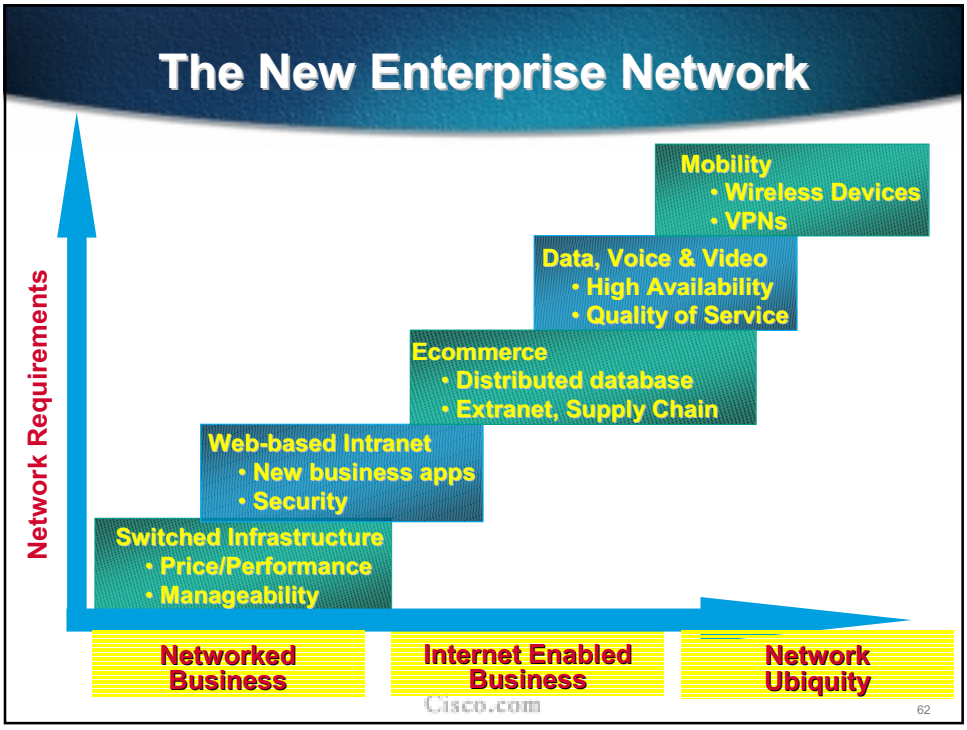

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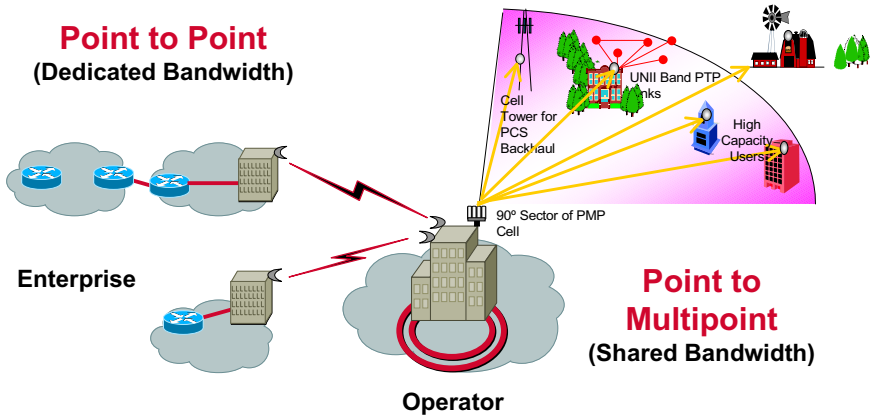
Broadband Fixed Wireless



uBR 7200 router family with wt2700 radio interface

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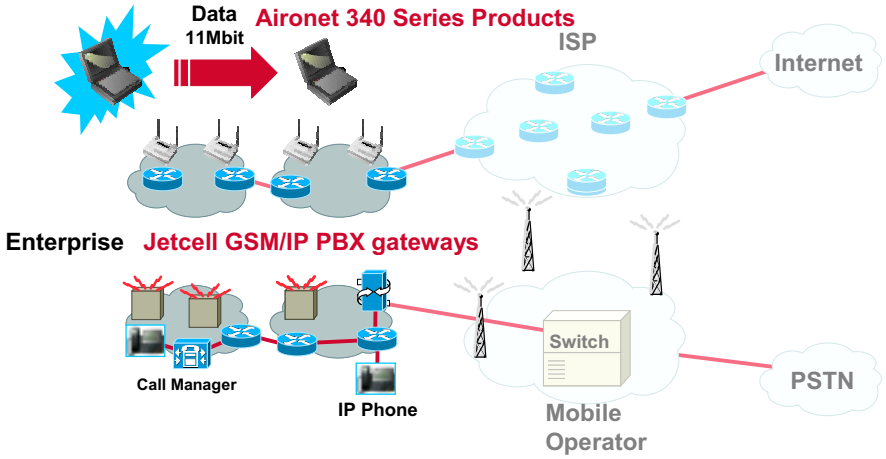
Wireless Office
Data and Voice



- High speed data (WLAN 802.11) for business & campus
- Wireless voice (VoIP) & data for in-building

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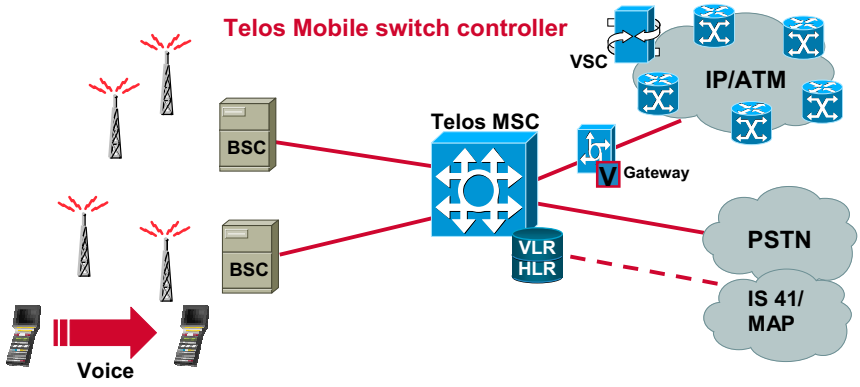
Mobile Wireless TDM Voice



- Scaleable GSM/CDMA/IS 136 solution for today's network

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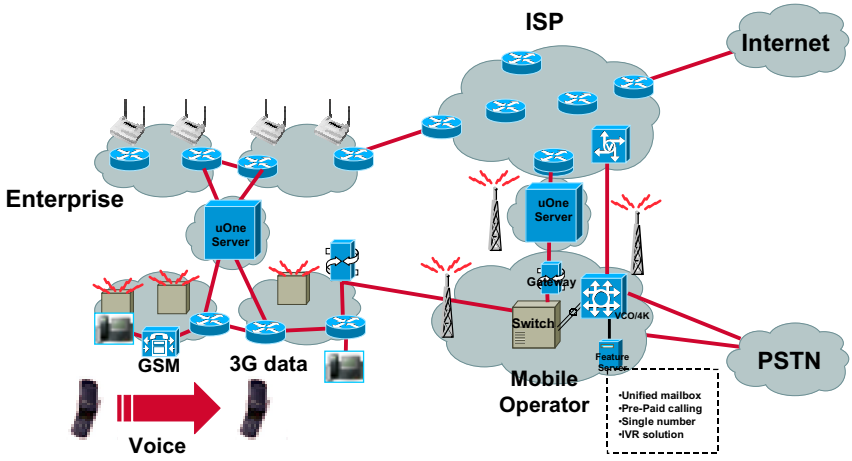
Wireless Unified Communications Vision



- Multiple deployment options for multiple class of users

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무선 LAN 기술 소개

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What Are Wireless LANs?

They are:

- Local
- In-building or campus area coverage for mobile users
- Up to several miles for point-to-point (LAN to LAN)
- Radio or infrared
- FCC licenses not required
- Customer owns the equipment (no usage charges)

They are not:

- Wide area
- Cellular phones
- Pagers
- Packet Data
  - Ardis
  - CDPD
  - RAM Mobile Data
- PCS

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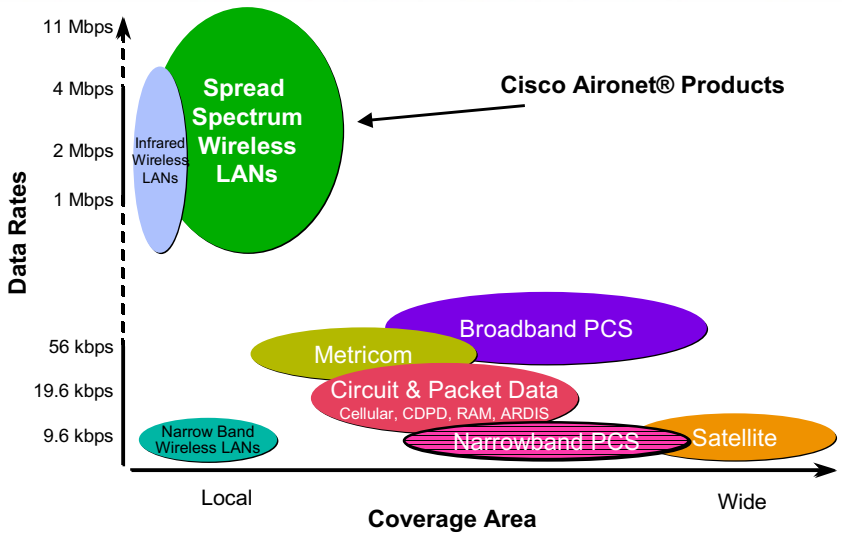
Overview of Wireless Data Network Offerings



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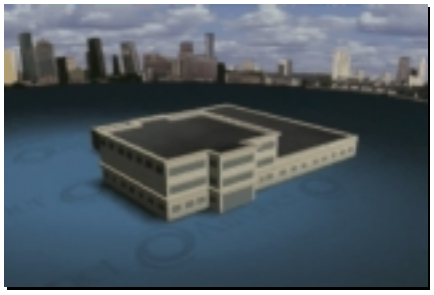
WLAN Evolution

- **Small, Medium and Large Enterprises**
  - **High power and performance**
- **Telecommuter**
  - **Cost and Manageability**



Speed	11Mbps	22 Mbps	6-54 Mbps	**100 Mbps**
Network	802.11b Standard	.11g	.11a Std	Superset
Radio	2.4 GHz		5 GHz	

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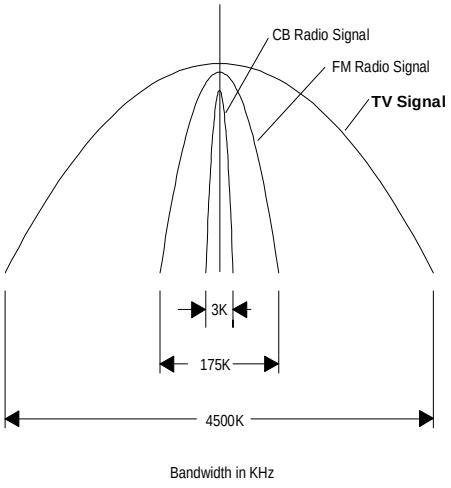
Radio Modulation



- **More Information = More Frequency Spectrum Used**

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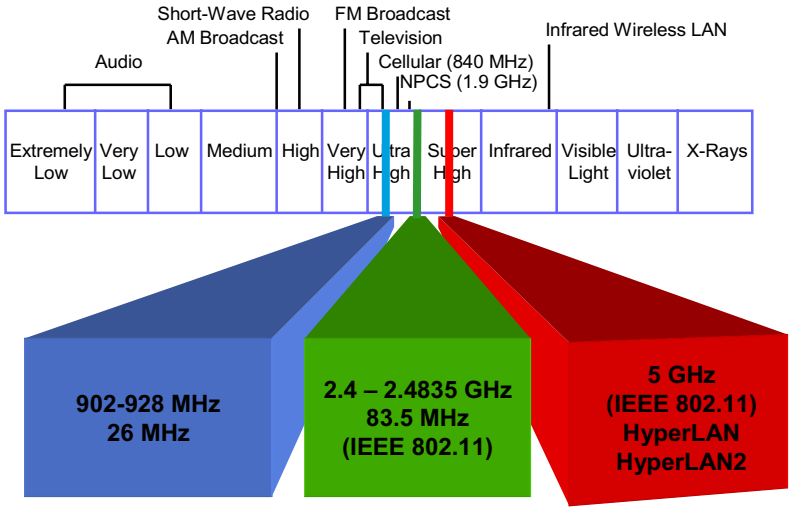
ISM Unlicensed Frequency Bands



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900 MHz vs. 2.4 GHz vs. 5GHz

	900 MHz	2.4 GHz	5 GHz
Pros	Greater range than 2.4 GHz (for inbuilding LANs)	Global Market IEEE 802.11 Higher data rates (10+ Mbps)	Global Market IEEE 802.11 Higher data rates (20+ Mbps)
Cons	Maximum data rate 1 Mbps Limited bandwidth Crowded band	Less range than 900 MHz (for In-building LANs)	Much less range than 900 or 2.4 GHz Higher-cost RF components Large antenna required

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IEEE 802.11 Standard—Development

IEEE 802.11 became a standard in July 1997.

Two technologies are defined:

- DSSS - 2 and 11Mb
- FHSS - 1 and 2 Mbps

- IEEE 802.11B became a standard in September 1999.
  - Only one RF technology was defined–DSSS @ 11-Mbps

802.11 defines a high-performance radio.

802.11 promises true vendor interoperability (over the air).

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Frequency Hopping vs. Direct Sequence

- **Frequency Hopping**
  - Older technology
  - Designed for easy interference avoidance
  - Has been slower
- **Direct Sequence**
  - Throughput
  - Range
  - Reliable

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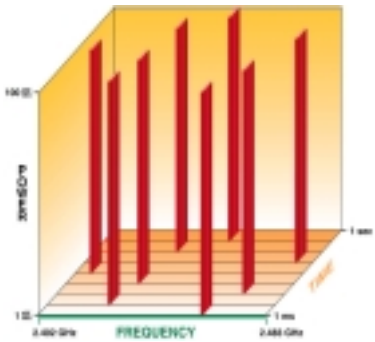
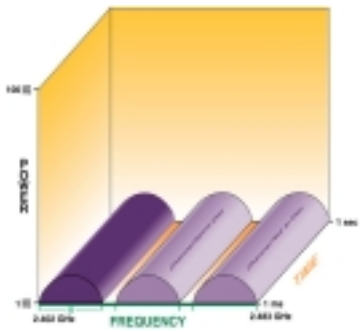
Spread Spectrum Approaches

Frequency Hopping



Direct Sequence



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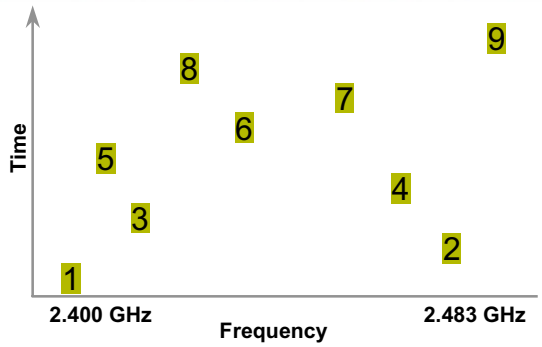
Frequency Hopping



- 79 Channels, 1 MHz Each
- Changes frequency (Hops) at least every 0.4 seconds
- Synchronized hopping required

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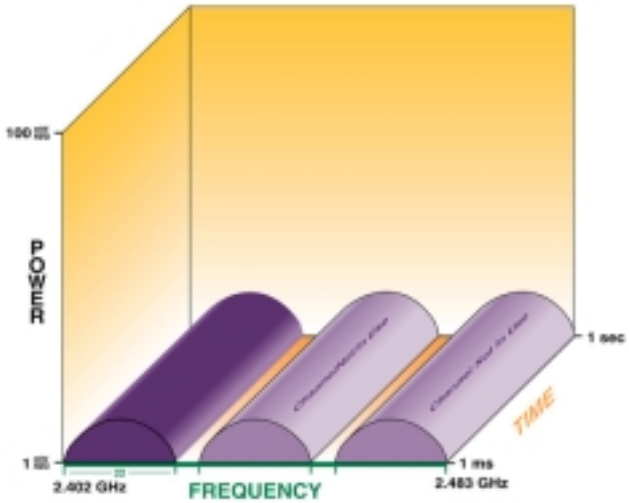
Direct Sequence



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Direct Sequence Modulation

- **Each data bit becomes a string of chips (chipping sequence) transmitted <u>in parallel</u> across a wide frequency range**
- **Minimum chip rate per the FCC is 10 chips for 1 and 2MB (BPSK/QPSK) and 8 chips for 11Mb (CCK) datarates.**

If the data bit was: 1001

Chipping code is : 1=00110011011 0=11001100100

Transmitted data would be:

00110011011	11001100100	11001100100	00110011011
1	0	0	1

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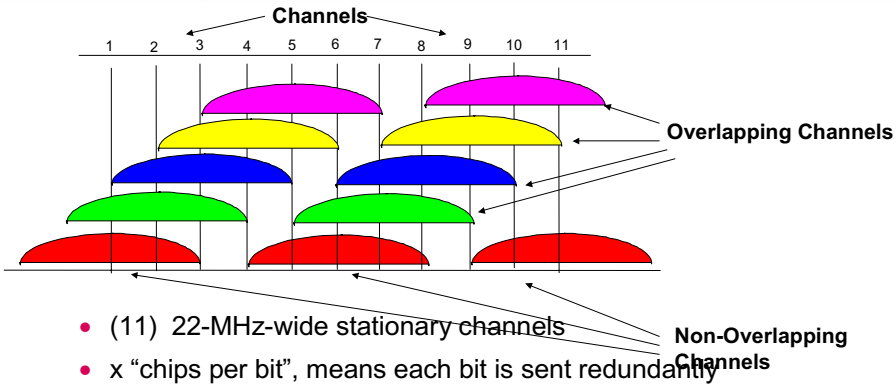
Channels—802.11 DS



- (11) 22-MHz-wide stationary channels
- x “chips per bit”, means each bit is sent redundantly
- 11-Mbps datarate
- 3 nonoverlapping channels (1, 6, and 11)
- 3 APs can occupy same area - set at different frequencies

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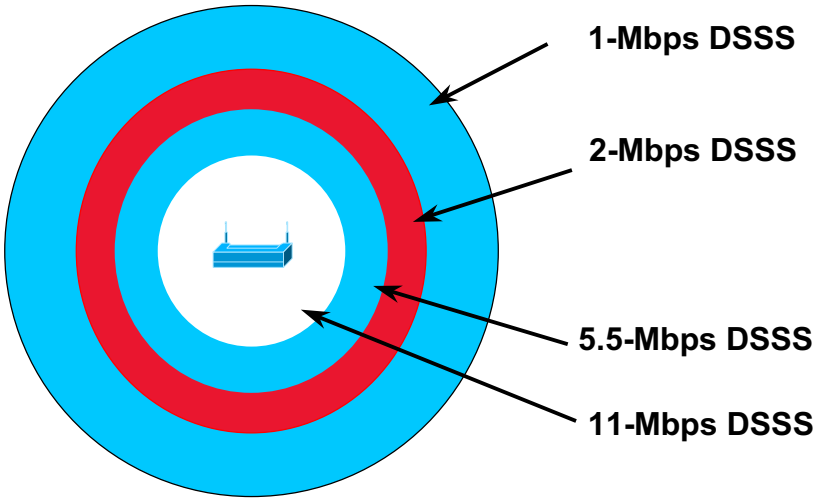
Access Point Coverage and Data-Rate Shifting



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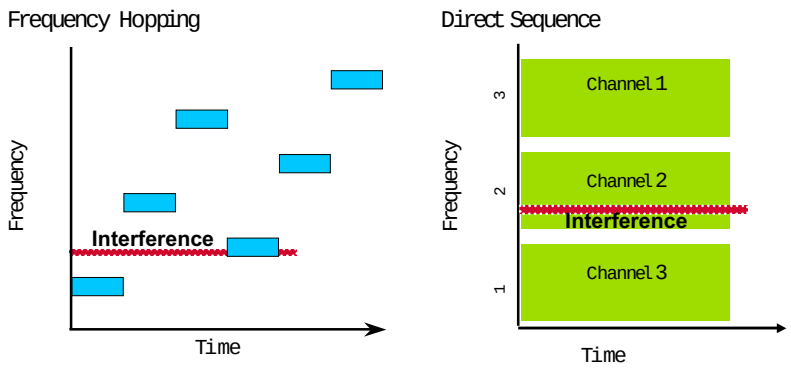
FH vs. DS: A Summary on Interference Handling



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Data Rates—DS vs. FH

- The "over-the-air" data rate at a given range and given similar implementation will favor DSSS by a factor of 2 to 1.
- A 1-Mbps DSSS system should have twice the range of a 1-Mbps FHSS.
- A 2-Mbps DSSS system will offer comparable range to 1-Mbps FHSS technology.
- For these reasons, the data-rate advantage goes to DSSS.

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In-Building Wireless LANs

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In-Building Wireless LAN—What it Is

Access points and client adapters working together to communicate data over radio frequencies

- **Overlay to existing wired networks**
  - **Enabling mobility**
- **Free standing network when wires aren't feasible**
  - **Enabling fast, flexible LAN's**

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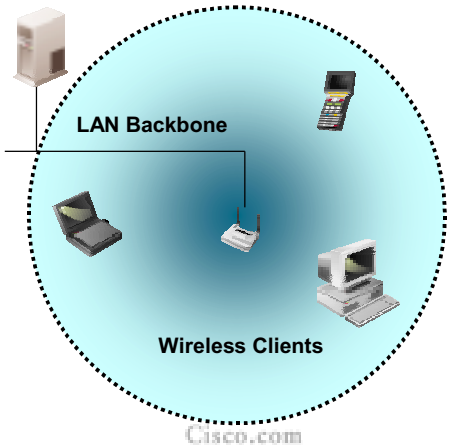
In-Building Wireless LANs—How it Works

Typical Single Cell Configuration



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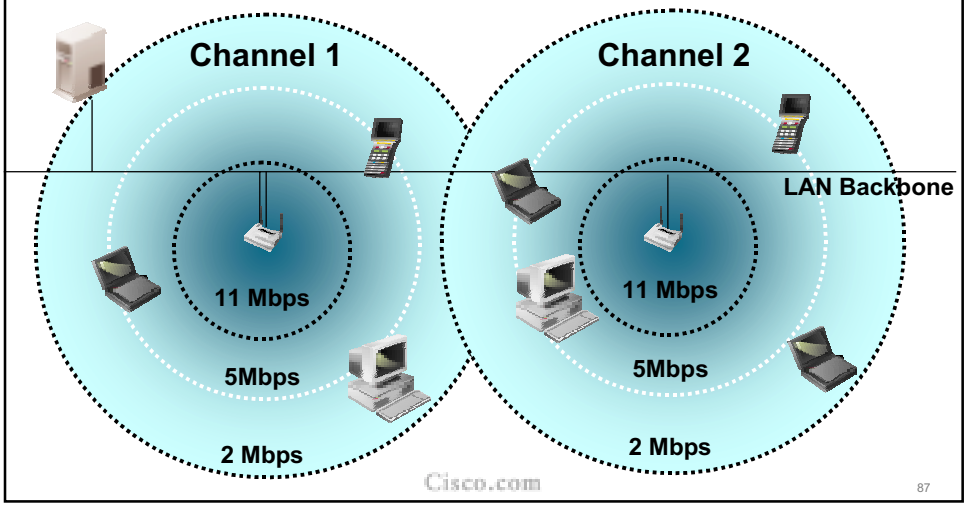
In-Building Wireless LANs— How it Works

Typical Multi-cell Configuration



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Building-to-Building Wireless LANs

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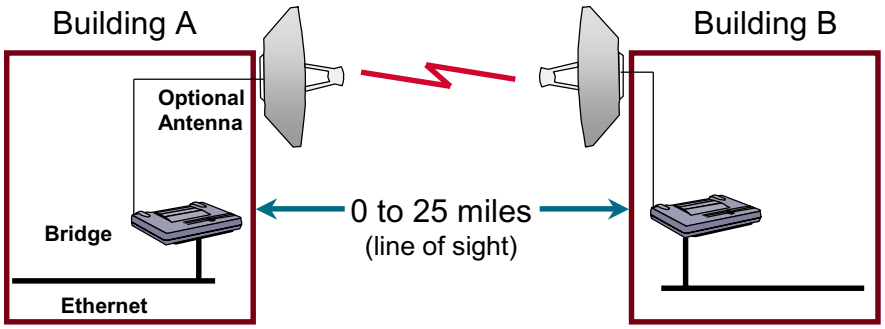
Wireless Bridge—How it works

Point to-Point Configuration



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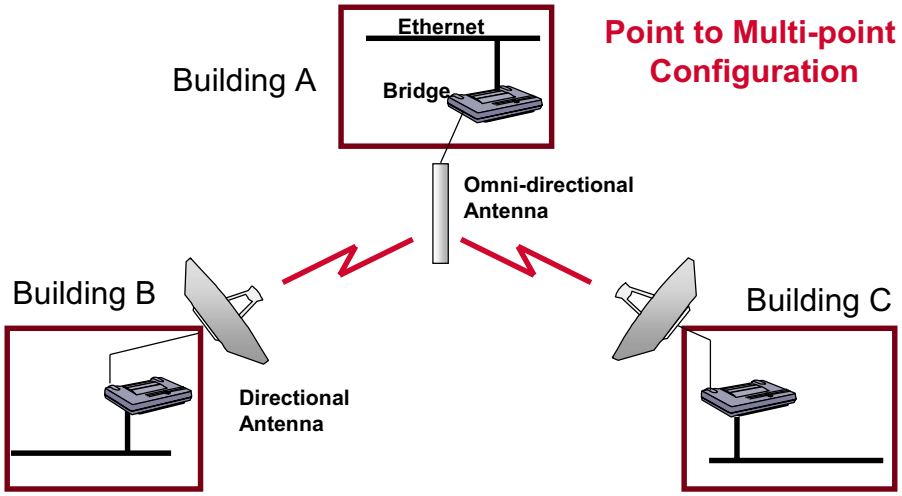
Wireless Bridge—How it works

Point to Multi-point Configuration



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Cisco 무선 LAN Solution소개

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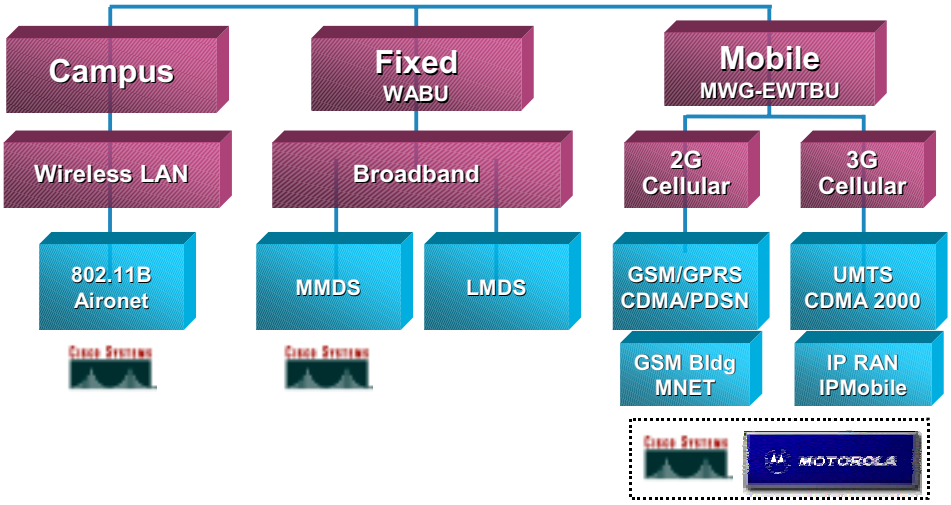
Cisco Wireless at a Glance



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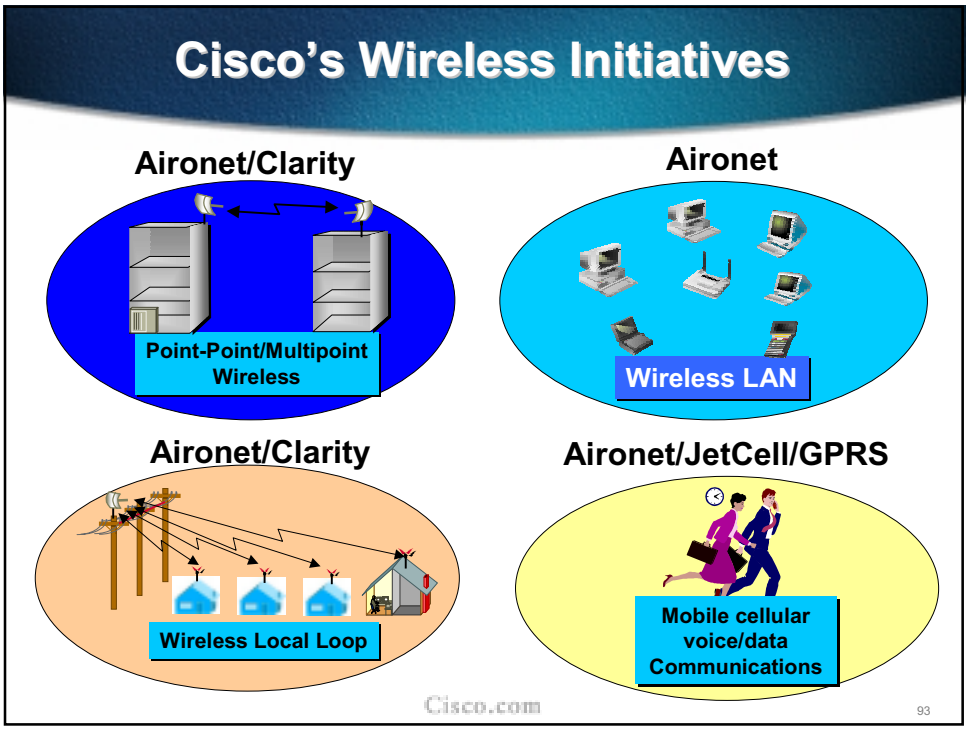

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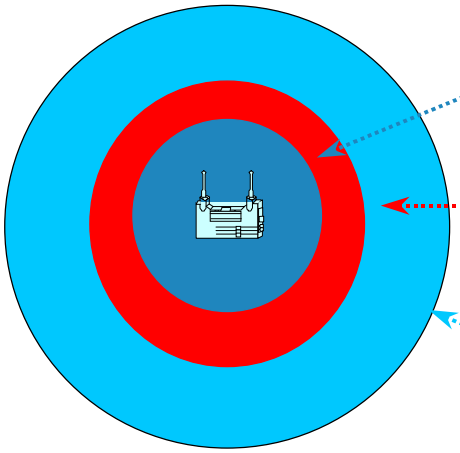
WLAN Vision: Power and Range



11 Mbps DSSS
80-100 feet radius @ 30mW
100-150 feet radius@ 100mW

5.5 Mbps DSSS
100-130 feet radius@ 30mW
130-150 feet radius@ 100mW

2 Mbps DSSS
200-275 feet radius@30mW
250-350 feet radius@100mW

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Cisco 무선랜 제품 사양

		제품 SPEC 및
보안기능		40,128 Bit Encryption 지원
AP간 Roaming기능		지원
유선과의 Interface		RJ-45, 10/100MB 지원
제품설치 용이성	LAN Card	P&P 기능 제공
	Access Point	사용자 설정 최소화로 간편한 설치
지원 OS		Win95/98/2000/CE, NT, Win3.x,Linux, Mac
통신상태 확인 기능		전용툴 (Aironet Client Utility) 사용
LAN Card 소비 전류		• Power Save Mode : 10 • RX : 250 • TX : 350
P 지원		AP 350
최대 Client 수 (AP 한 대)		2,048
사용주파수 Channel 수		13
타사 제품간 간섭 정도		사용 주파수가 겹칠 경우
자체 진단 도구 유무		전용 Tool 제공 (Aironet Client Utility)
전파감도 측정 기능 제공 유무		전 Tool 제공 (in t te onito)
n e ent 방법		P, elnet, C n le, P,
장비 특성		Dual Antenna 내장으로 수신감도 탁월, BOOTP/DHCP를 통한 Auto Configuration 가능
전송거리		• 400 • 0
	사무실	• • 25
송신 (AP)		30 , 00 (AP350)
제품보증 기간		• AP : 1년 • LAN Card : 3년

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WLAN 보안기능

- First generation
  - SSID
  - Static 40 or 128-bit WEP
- Cisco 차별화 기능
  - 네트워크 접속 시 중앙 집중적 사용자 인증 (ACS2000 v2.6) (SW V.11.x or AP350)
  - Dynamic 128-bit WEP
  - HW encryption
  - VPN 기능 지원
  - Access Control Lists 지원
- Future plans
  - Rogue AP detection
  - 3rd Party RADIUS server 지원

Wireless LAN 기술적 제약사항
Radio Frequency: Office Interference

유형	예	Cisco Solution
방해전파	전파특성상 타 전파에 의한 Bandwidth 감소.	100mW의 출력으로 높은 S/N에서도 11Mbps Throughput을 유지. 또한 Directional/Omni-directional 안테나 옵션을 이용하여, 감도를 높일 수 있음.
AP/안테나 설치	전원공급(Power Supply) 설치에 따른 위치 문제점,	Inline Power Supply(기존 Inline Power를 지원하는 Cisco Switch와 LAN 선으로 연결)
전파 방해물	AP 위치 선정 시 예상되는 전파 방해물에 의한 Datarate 감소지역	Cisco Client Utility 중 Site Survey Tool을 이용하여, Signal 감소 지역을 탐지할 수 있음. 결과에 따라 AP를 적절히 설치할 수 있음. 또한 결과에 따라 알맞은 안테나를 선택할 수 있음.

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Wireless LAN 기술적 제약사항
Security

유형	예	Cisco Solution
Encryption Overhead	Wireless 상에서 고성능 WEP을 이용시 발생하는 성능 저하(10-15%)	Cisco는 WEP optimization을 실현, 3DES(168bit) Encryption이용시 3-5% 만의 성능저하를 실현.
Key 관리 (Pre-shared)	AP 마다 다른 Key를 사용시 발생하는 Client(AP)쪽 Key관리	Cisco AP및 Client는 총 4개까지의 Key를 입력하여, 자동선택할 수 있음.
Key Management	Wireless LAN관리자가 Pre-shared key들을관리하기 위해, AP별로, Client별로 입력하는 번거로움.	11.0 SW/AP 350에서는Certificate관리를 통해, Administrative burden을 줄임(PKI). 또한 802.X 및 EAP을 지원.

Wireless LAN 기술적 제약사항
WLAN Enhancements

유형	Cisco Solution
Ad-hoc /Infrastructure /Workgroup Mode 지원	용도에따라, client Peer간에 Workgroup mode로 사용하거나(sample 1 참조), Wired Network에 연결되지 않은 AP와의 Ad-hoc Mode(sample 2 참조), 아니면, Wired Network에 연결된 Infrastructure Mode등으로 사용할 수 있음.
Aggregated 33Mbps Throughput	같은 Cell에 최고 3개의 non-contiguous channel을(1.6.11) 사용하여, 33Mbps의 효과를 올릴 수 있음(sample 3참조). 또한 Road-Balancing 역활도 함께 수행.
AP간 정보교환관 및 Rogue AP관리	Wired Network에 연결된 AP들은 서로 client association및 그 밖의 client정보들을 서로 교환함으로써, client들은 제 association없이 다른 AP로 접속할 수 있음(Roaming및 Load balancing, Fail-over 시). Fail-over(Sample 5 참조) Roaming(Sample 6 참조)
22Mbps upgrade지원	금년 8월경에 AP와 client의 image upgrade형식으로, 22Mbps upgrade를 지원할 예정.
Repeater/Bridging 지원	지역적 특성을 고려하여 AP와 AP를 Wireless로 연결하는 Repeater기능을 탑제했음. 총 7개 AP를 이어 client들과 Wired Network을 연결할 수 있음(sample 4참조). 또한 bridge와 여러 안테나를 사용하여, Building to Building, site to site을 연결할 수 있음.

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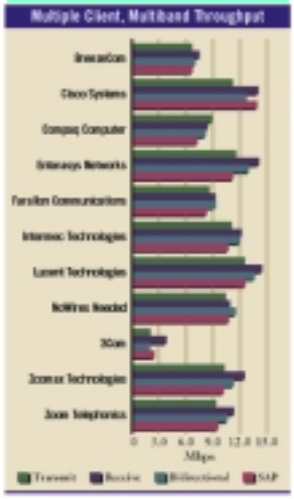
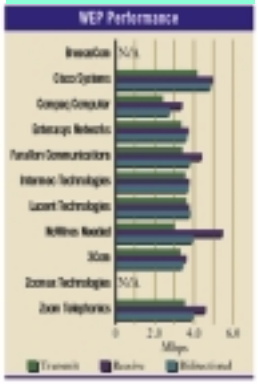
Cisco 장비 성능테스트 자료

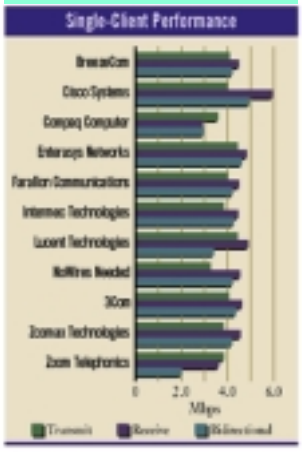
•Multiple Client Throughput 테스트



•WEP Performance 테스트



• Single Client Performance 테스트



• 자료출처 : Network Computing 2000년 7월, Editor's Choice

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