State of IPv6 in China:
Showcasing IPv6-based Applications in Beijing Olympics

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Agenda

- **IPv6: Where are we today…Briefly !**
- **Emerging IPv6 Network Trends & Services**
- **Evolution of IPv6 & Technology Overview in China**
- **Showcasing IPv6 & Applications in 2008 Beijing Olympics**
- **H3C 3Com IPv6 Transition and Apps**

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Status Quo of IPv4
What's wrong with IPv4? Limits Functionality and Restricts Innovation

- **Problems IPv4 is facing**

    - **Severe lack of IPv4 addresses and native security on IPv4 stack**

    - **Rapid expansion of routing tables**

    - **Proliferation of IP connected devices and demand for ubiquitous mobile access of data, voice, audio and video**

    - **Popularization of information appliances and various IP technology based applications**

- **Current solutions**

    - **Limitations of NAT for Multiple connection applications**
        - **Google Maps opens ~ 70 parallel connections**
        - **ITunes Store opens ~ 300 parallel connections**

Today the industry is on the verge of running out of IPv4 addresses and estimates of the depletion date point to mid 2011

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IPv6 implementation is not a matter of if rather, it is a matter of when.

- Virtually Unlimited addresses – the address length from 32 bits to 128 bits

- Simplicity – simplified and fixed basic headers, improving handling efficiency

With Millions of New Devices Becoming IP Aware, the Need for Increased Addressing and secure Plug-and-Play Networking Is Only Met with the IPv6 and solid transition plans from IPv4 to IPv6.

- Superior extensibility – Global reachability, flexibility, aggregation, multihoming, Auto configuration

- Plug and play – simplified address configuration and auto configuration

- Higher security – IPSec authentication and encryption at the network layer ensure E2E security

- Quality of Service – new flow label for fine granularity

- Higher mobility – Mobile IPv6

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Emerging Network Trends & IPv6 Services

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IPv6 – New services and application requirements

Growing Mobile and Broadband Services

Fast growing mobile market:

–**Mobile users exceed 3.17 billion by the end of 2009**

–**Data service become a main income source**

–**Mobile phones are becoming a multi-application terminal**

Traditional carrier: from legacy voice to integrated service provider

–**Broadband access make it realizable**

–**Many types of IP terminals per user (PC, STB, IP Phone, etc)**

–**Carriers do not operate a network, but a "value chain"**

–**Emerging Internet countries need address space, e.g.,**

–**China uses nearly two class A (11/2001), ~20 class A needed if every student (320M) has to get an IP address**

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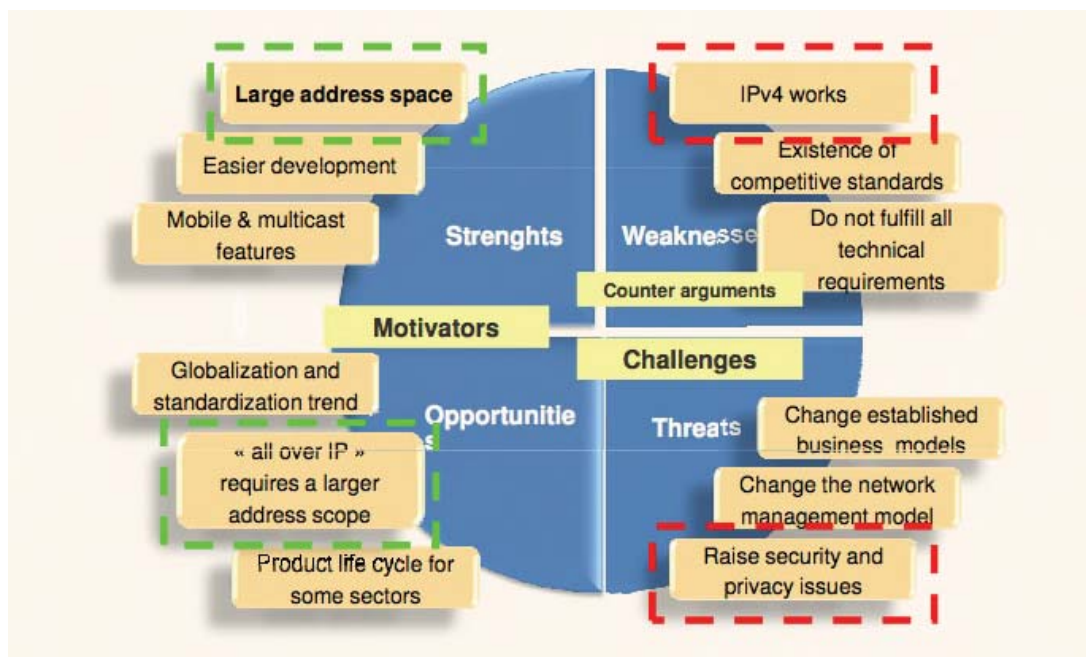## IPv6 – New services and application requirements
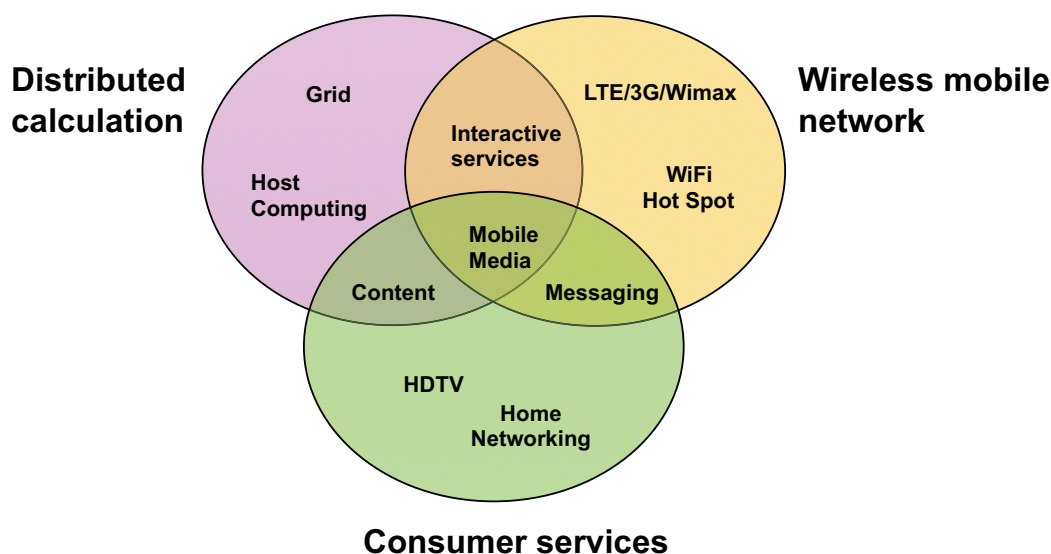### Plugging into the Converged Economy

- Opportunity to develop thriving ICT industry
  - Promote next generation network ecosystem
  - Foster Innovation and promote new apps
  - ICT research, training and education
  - Encourage international collaboration sharing expertise/best practices
- Number of address spaces
  - China estimated 105 million IPv4 addresses needed in 2007, the actual requirement was 135miilion
  - IPv6Addresses:3.4X1038
  - NGI will connect all of mobile devices not only computers
  - IP is everywhere Data, voice, audio and video integration is a reality
- Improved routing
  - Route aggregation reduces the size of routing tables
  - Simplified header reduces router processing loads

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Cross-sector IPv6 SWOT Analysis
- Motivators & Challenges

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Industrial Revolution Brought by IPv6

Distributed calculation

Grid

Host Computing

Interactive services

Wireless mobile network

LTE/3G/Wimax

WiFi Hot Spot

Mobile Media

Content

Messaging

HDTV

Home Networking

Consumer services

Within the coming years IPv6 will become an indispensable link between diverse services and network technologies, and thus will have central strategic importance in reducing costs and complexity
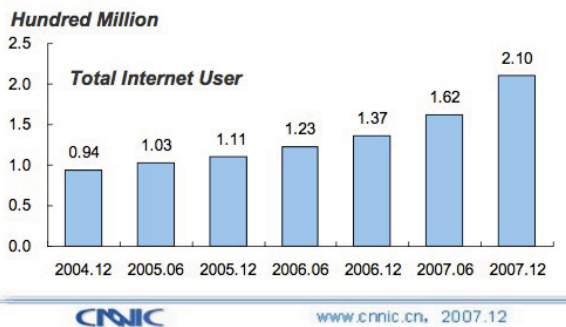
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IPv6 Drivers - Government

- China – Gov. spending 1.6 B yuan on IPv6-based CNGNI and used 2008 Olympics as IPv6 Showcase

- Similar initiatives:
  - Malaysia – Gov. has directed ISPs to deploy IPv6 next year and e-government services the following year
  - Thailand – released in early 2007 – similar to Malaysia
  - Japan – government may mandate IPv6 to Operators
  - Korea – MIC's IPv6 Promotion Master Plan, KOREAv6
  - Taiwan - IPv6 Development and Deployment" 6 year e-Taiwan project
 - India – point #6 of Government's 10 point IT plan

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Background and Evolution of IPv6 in China

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Always-on Internet connection is driving the IPv4 address demand

Hundred Million

Total Internet User

0.94 1.03 1.11 1.23 1.37 1.62 2.10

2004.12 2005.06 2005.12 2006.06 2006.12 2007.06 2007.12

CNNIC   www.cnnic.cn, 2007.12

[Ten thousand]

450% 164% 150% 111% 62% 51%

120 660 1740 4350 9200 14900 22500

2001年 2002年 2003年 2004年 2005年e 2006年e 2007年e

■ Estimated ■ Number of users (ten thousand) ── Growth rate

• Internet has grown to indispensable f actor for the nation to develop further
  - Growth of Internet in China
  - Mobile, the future of Internet
  - IPv6 is the only choice for China

• Out of 555M Total mobile cell-phone users, only 10% of the total users are using internet services (Source: MII)

  – Increasing number of pilot Sensor N etworks
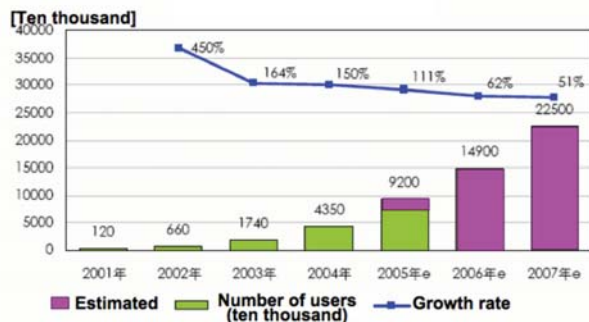
Trends in IPv4 allocations, 2005-2008
Total address holdings

| Economy	31-Dec-06	31-Dec-07	31-Dec-08	% increase 2007-2008
China	97,991,168	135,282,944	181,778,176	34.37%

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CNGI – A government framework to enable research and collaboration

- CNGI (national IPv6 project) is launched with eight government ministries and agencies
  - The budget of 1.6 billion RMB for the CNGI project (2004-2005)
  - Development and experiment on next generation apps and services
- The purposes of the CNGI project are to build 6 national IPv6 networks
  - 5 major telecommunications operators and 1 academic network (CERNET)
- IPv6-related critical technologies and applications.
- The motivation for CNGI and of IPv6
  - The IPv6 network helps to greatly raise efficiency
  - IPv6 enables E2E security
- Increase collaboration with foreign Governments (EU, Japan)

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CNGI Model and Evolution of IPv6 Services

Roadmap for IPv6 services and equipment
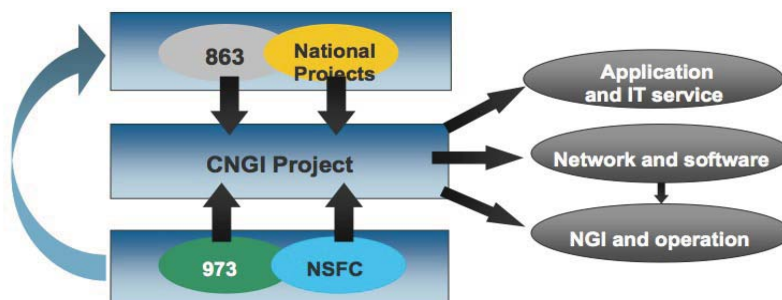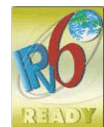
- Synchronize China IPv6 eco-system with international progress

- Demonstration network (300 CPNs)

- 6 core networks, CERNET China Telecom, China Netcom, China Mobile, China Unicom, China Railcom

- Research and development

    - Key technology, Middleware, Applications

- Mass production

    - Equipment and Applications

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CNGI – IPv6 Initiative
(China's Next Generation Internet)

➢The biggest IPv6 Infrastructure project in worldwide. Over 40 cities, national wide, 2.5G backbone (migrating to the 10G)

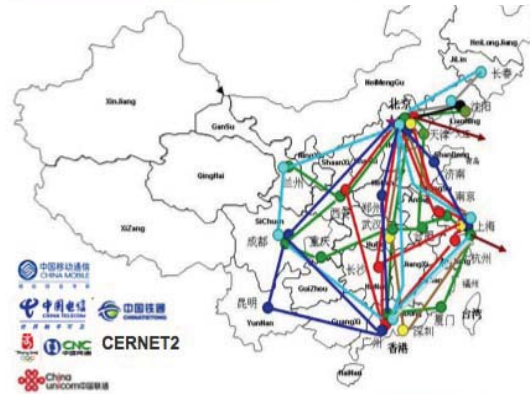➢The biggest IPv6 application development project in China,100+ projects funded by government

2002-2005

- *CNGI demonstration project*
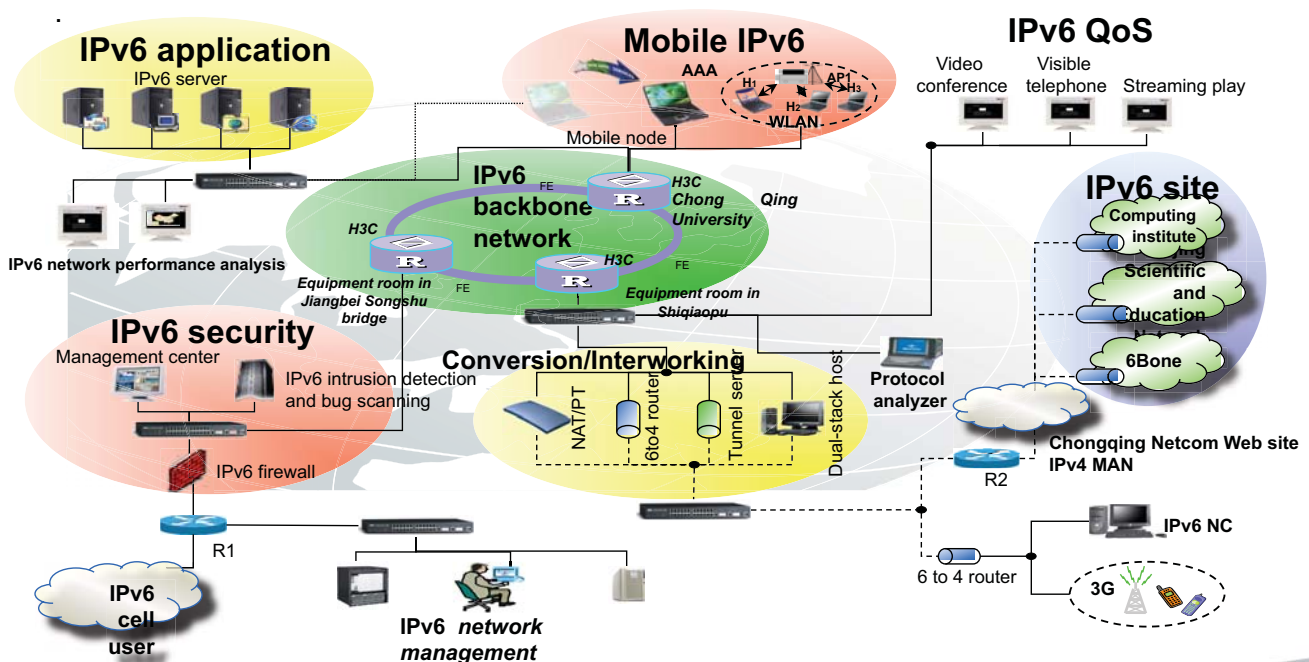- *Key technologies (Foster IPv6 based Apps and accelerate commercial adoption)*

2006-2010

- *IPv6 backbone access and applications*
- *Mass production*
- *Commercial application and service*

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CNGI & CERNET 2 IPv6 – Test Network

CERNET has been a member of the 6Bone since1998.

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CERNET2 – A Core Network of CNGI Backbone
# World largest IPv6 Research Backbone

- Development began more than five years ago. China, which has been an early adopter of IPv6, also unveiled the China Education and Research Network 2 (CERNET2) to be prepared for Olympic Games.

- The project began in 2003, with deployment to 25 points of presence in 20 cities across China and was completed in 2006.

- CERNET2 is an IPv6-only network, meaning that it is not running IPv4 concurrently with IPv6 and is only accessible through client systems and networks that are running IPv6.

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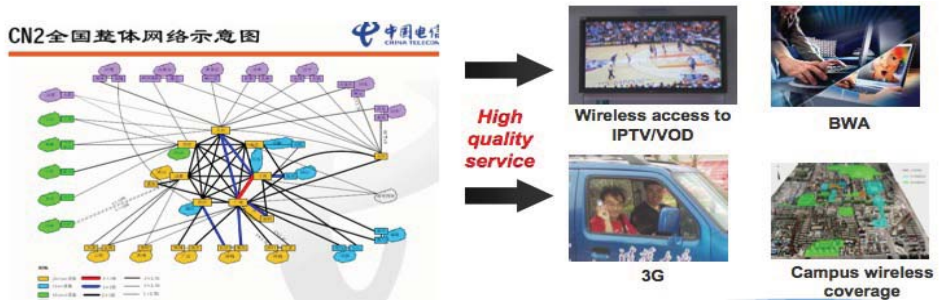
CERNET 2 – Backbone of IPv6 Research Network
in China

- CNGI-CERNET2 is China new generation network platform for education and science research

- 25 backbone nodes deployed in 20 main cities over China, like Beijing, Shanghai, Guangzhou, etc…

- The core node and management center locate in Tsinghua University.

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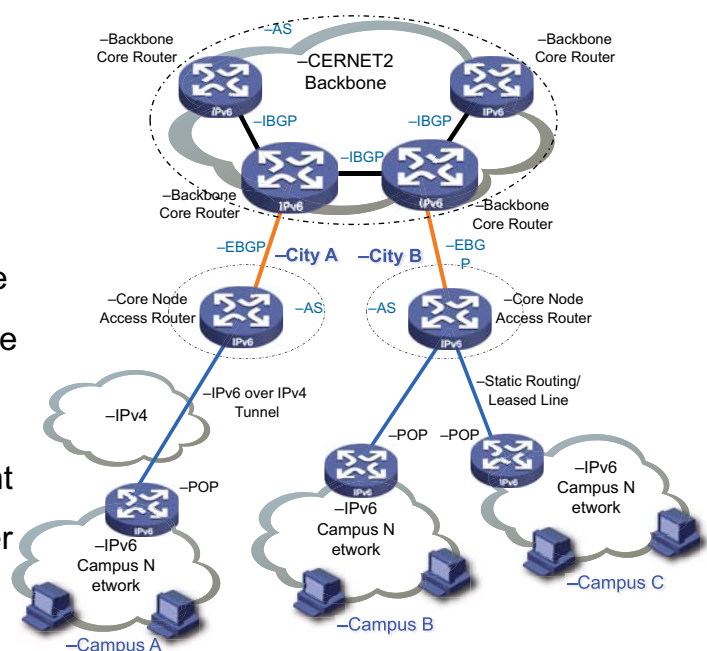
CERNET 2 - Objectives and Vision

- Biggest IPv6 production network
- Pure IPv6 Network
- Dual stack campus network 100 universities
- Multi-vendor Core Routers
- Authentic IPv6 Addressing Architecture
- IPv6 transition
  - Software: an IETF working group setup in IETF69, RFC4925
- Application trials
  - 6PlantLab
  - SIP over IPv6
  - IPv6 IPTV Applications
  - IPv6 based P2P Model Applications
  - IP Power Consumption Management
  - IPv6 Multicast trials

CERNET2 Backbone

*CERNET2 Backbone router monitor*

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Be unique, be different

- Protocol selection
  - Rest of the world: Dual stack
  - **CERNET2:**   **Pure IPv6**
- Equipment
  - Rest of the world: Single vendor
  - **CERNET2:**   **Multiple vendors**
- Complexity
  - Rest of the world: Single AS
  - **CERNET2:**   **Multiple AS**
- Transition
  - Rest of the world: IPv6 over IPv4
  - **CERNET2:**   **IPv4 over IPv6 (IETF softwire), IVI (IETF behave)**
- Architecture
  - Rest of the world: HOPI/GENI/etc
  - **CERNET2:**   **Authentic IPv6 address (IETF savi)**

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CNGI-CERNET2 IPv4-IPv6 Transition
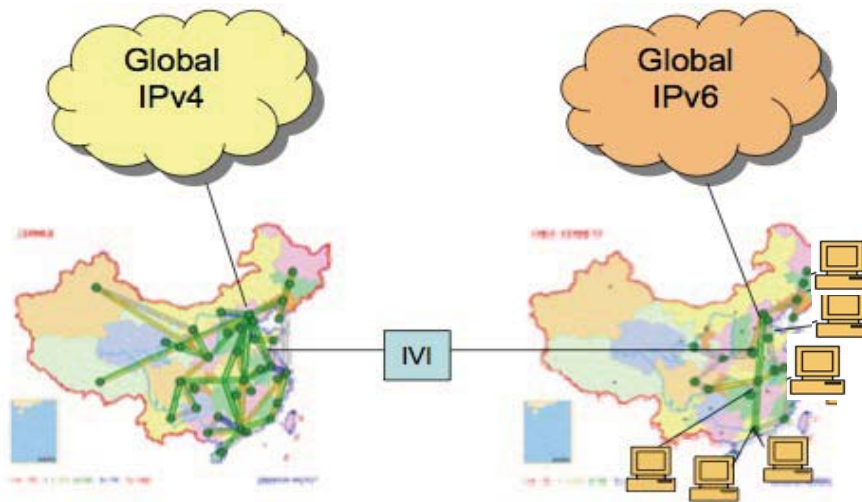
CERNET (IPv4)

2,000 universities
connected
20M users

CNGI-CERNET2 (IPv6)

100 universities
connected
400K users

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IPv6 Success Stories at Various Vertical Industries

Gov: 70% of network for central ministries and e-gov at all levels; 8 backbone network of 12 Golden X Projects

Education: over 90% of China's top 100 schools, over 1500 institutes of higher education; 80% of education MAN

Finance: Core IDC of BOC and ABC; high end routers in four major commercial banks in China

Transportation: Capital International Airport; Tibet Railway, MTR, Beijing Public Transportation Group

Power & Energy: State Grid Dispatching System; 5 Key Power Generation Group, PetroChina, China Chemical etc

Large enterprise: Over 100 of the Top500 enterprises, covers industries like steel, automotive, heavy machinery, chemical, retail

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Showcasing IPv6 at the 2008 Olympics -Widest ever use of broadband and mobility services

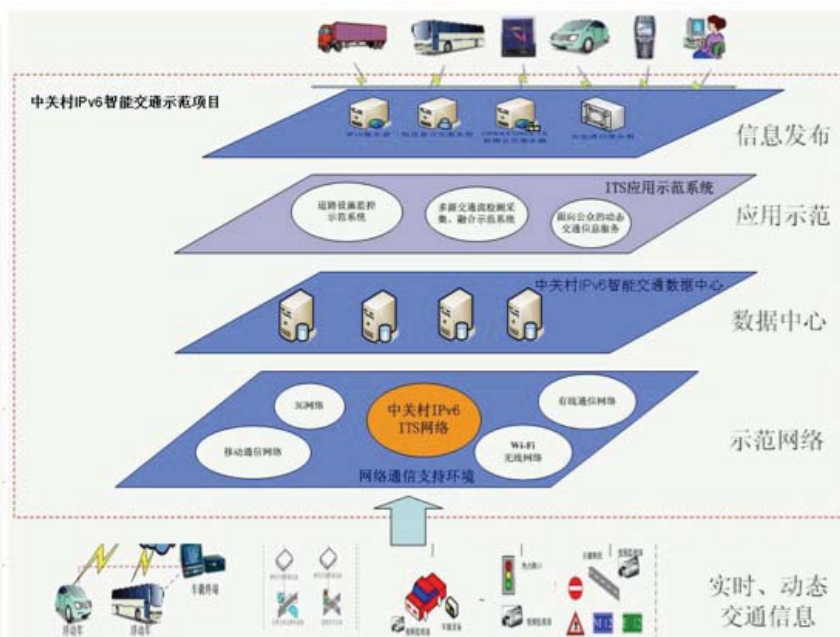IP based multicast communications convergence

Enhanced Security

Mobile IP seamless connectivity

Plug and Play

Plenty IP addresses

End-to-End Communications

Large information collection

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IPv6 Lighting and Facility Management System

Lighting and thermostats at the Olympic venues taken care of by the CNGI

Lightening Management & Control

- Using IPv6 based Facility Networking
- Area Management System, multiple facilities
- 1.4kmx2.4km with 18,000 lights
- 1,000 IPv6-based control nodes
- Significant Energy saving

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Behind the Scenes - Beijing Olympics

- The IPv6-enabled video cameras used in Beijing automatically configure their IPv6 addresses and other parameters when they're connected to the network.

- The cameras are then accessible and controllable through central software programs that automate their configuration.

- About 18,000 lights and thermostats distributed through the main stadium district in Olympic Park are controlled by 200 IPv6-enabled control nodes.

- The IPv6-based system has intelligence to control the lights in a manner that reduces energy consumption.

- Taxicabs that provide local transportation have been equipped with IPv6-based sensors. The sensors use wireless applications to transmit a taxi's location and traffic conditions to a central control center, which can assess traffic congestion and re-route the vehicles accordingly.

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IPv6 Reference : Leading-Edge Research Projects on CERNET

University-Industry Research Collaborations

- System oriented – IPv6 Intelligent Network storage (Video Surveillance, IPTV and VoD)

- Network monitoring and audit platform for CNGI

- Multimedia session service system to support mobile and roaming user

- Wireless sensor network and its nodes to support IPv6

- Common distance learning platform system

- P2P content access system IPv6 based

- University service platform– Network measuring / monitoring tools oriented NGI

- Research and test large scale wireless and mobile roaming

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IPv6 Reference :Pilot Services on CERNET

- **Government:**

  In protection zones, use cameras to monitor migration of migratory birds in real time.

- **Campus:**

  IPv6 wireless internet service, video on demand, mobile education system

- **ISP:**

  IPv6 backbone and access pilot network, IPv6 portal service, IPv6 voice service
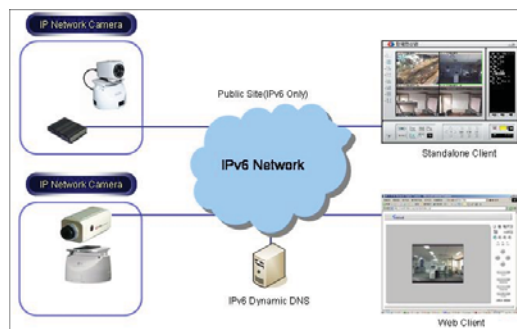
- **HDTV:**

  High-quality video on demand, video conferences and education programs for hospitals and research centers

- **SOHO:**

  Wired/wireless IPv6 internet gateway for SOHO

- **Home:**

  Monitoring safety passages, video on demand, IPv6 Web, P2P, IPv6 mobile home network

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IPv6 – Great Opportunity to Innovate and remove boundaries on E2E communication

- IPv6 provides services more open, more efficient, more reliable, more secured, lower power consumed and more economical;

- Exponential Growth in Internet and Mobile Users in China pushing the boundaries of IPv4 and augmenting IPv6 adoption.

- CERNET2 and vast IPv6 expertise, promotes the early adoption of IPv6 enabled applications and technology
  - Camera Surveillance
  - IP Power Management (Lighting/BMS)
  - RFID and USN (Ubiquitous Sensor Network)
  - P2P File Sharing
  - P2P Streaming (Multicast)
  - Remote Management

- As the world largest internet user country, China wants to leverage IPv6 Internet technology to turn it into a catalyst in the information technology innovation
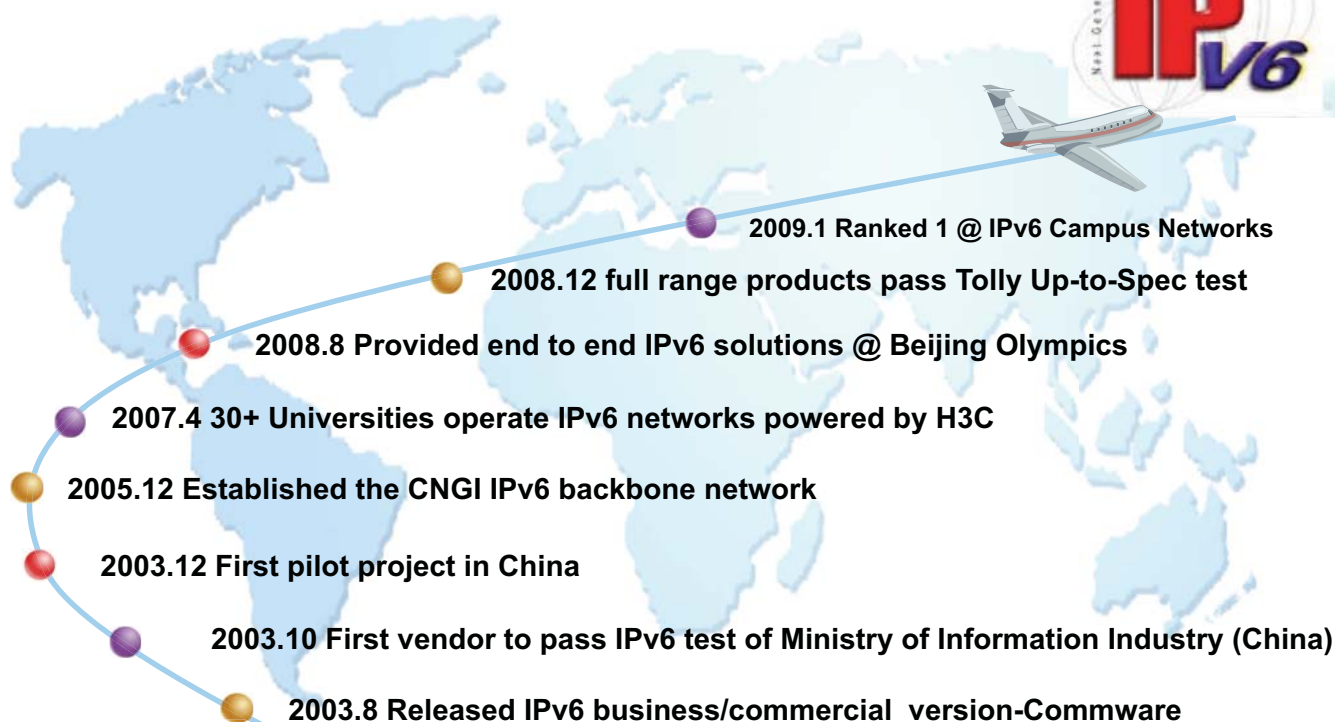
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IPv6 Applications – IP Surveillance System

Sample application: kindergarten monitoring
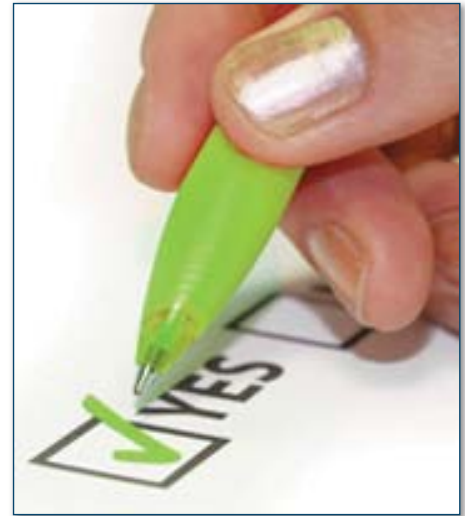– Providing great help for parents, kindergarten
management and safety

H3C & IPv6 Milestones in China

2009.1 Ranked 1 @ IPv6 Campus Networks

2008.12 full range products pass Tolly Up-to-Spec test

2008.8 Provided end to end IPv6 solutions @ Beijing Olympics

2007.4 30+ Universities operate IPv6 networks powered by H3C

2005.12 Established the CNGI IPv6 backbone network

2003.12 First pilot project in China

2003.10 First vendor to pass IPv6 test of Ministry of Information Industry (China)

2003.8 Released IPv6 business/commercial version-Commware

Today's IPv6 Network - Check List

- **Latest hardware design and silicon?**
  - Embedded new convergence applications
  - Wire-speed I& Full spectrum of IPv6 features
- **Open industry standards based architecture?**
- **Vendor has demonstrable "IPv6" credentials?**
- **IPv6 Ready Logo Phase-1 and Phase-2**
  - Verify protocol implementation and validate interoperability of IPv6 products and services

  http://www.ipv6ready.org/

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Thank You

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