

DMC International Symposium

**Research on Digital Infotheque
Prospects and Subjects**

デジタルインフォテーク研究の課題と展望

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Tomonori Aoyama

Keio University



Content

- **3 Axes for Evolution of Digital Content**
- **Volume**
- **Quality**
- **Time**
- **What is Digital Infotheque**
- **A Proposal of Digital Infotheque Project**
- **Summary**

Applications: e-Commerce, e-Science, e-Learning, e-Medicine, Digital Library/ Musium, Digital Entertainment, Web2.0, Web3.0,

Volume

Content Search
Content Distribution
Content Creation
Archive

Time

Quality

Federated Structure → Digital Infotheque

3 Axes for Evolution of Digital Content

デジタルコンテンツ発展の3軸

3 Axes for Evolution of Digital Content

デジタルコンテンツ発展の3軸

Volume: Information Explosion

Flowing Information

Stored Information

Quality: High Human Perception

High Utility

High Integrity

Time: Sustainability of Digital Content

Archive with long lifetime

Availability regardless of renewal

Volume: Information Explosion **(情報爆発)**

Flowing Information

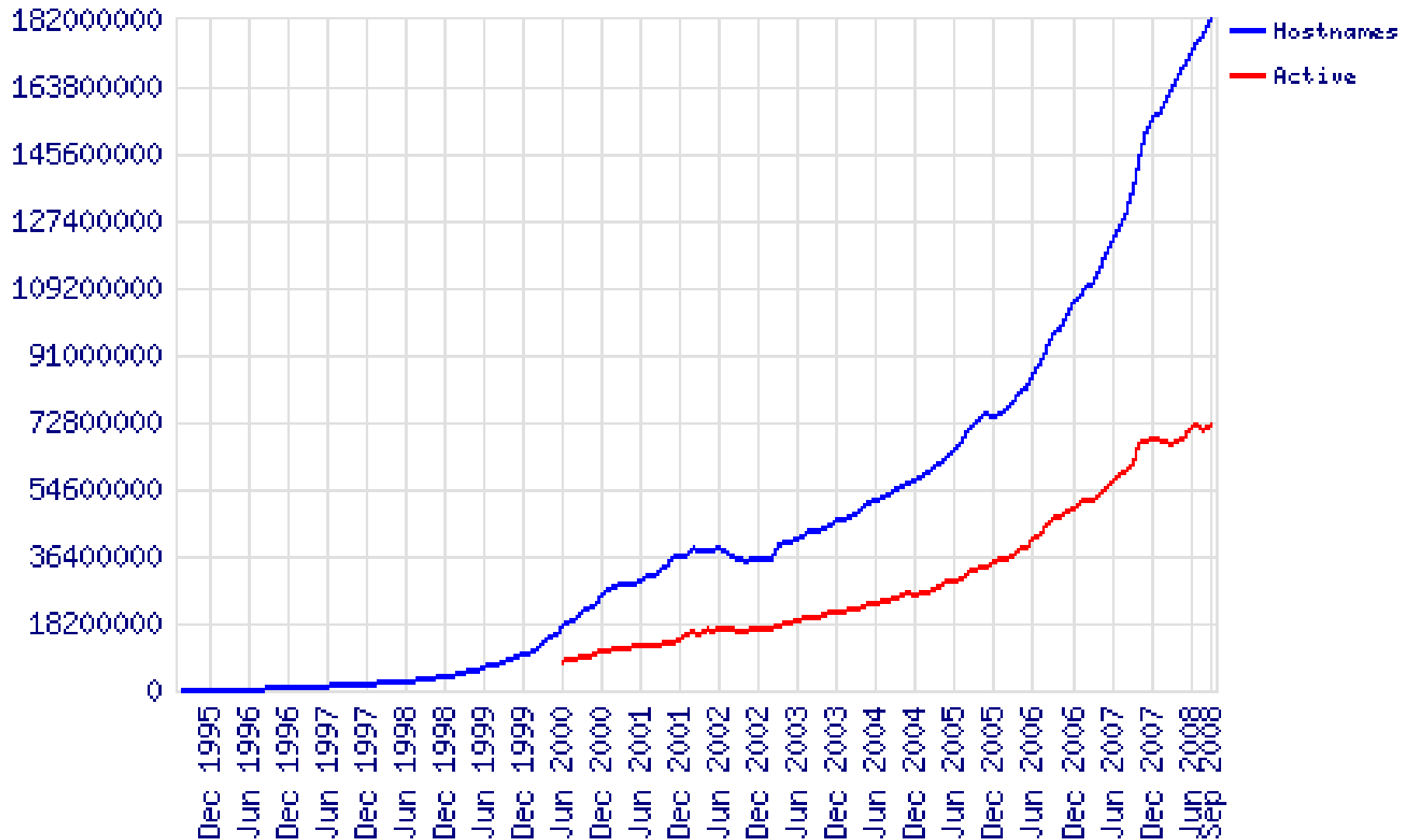
**Capacity of Networking
Backbone, Access
Multicast, CDN, P2P**

Stored Information

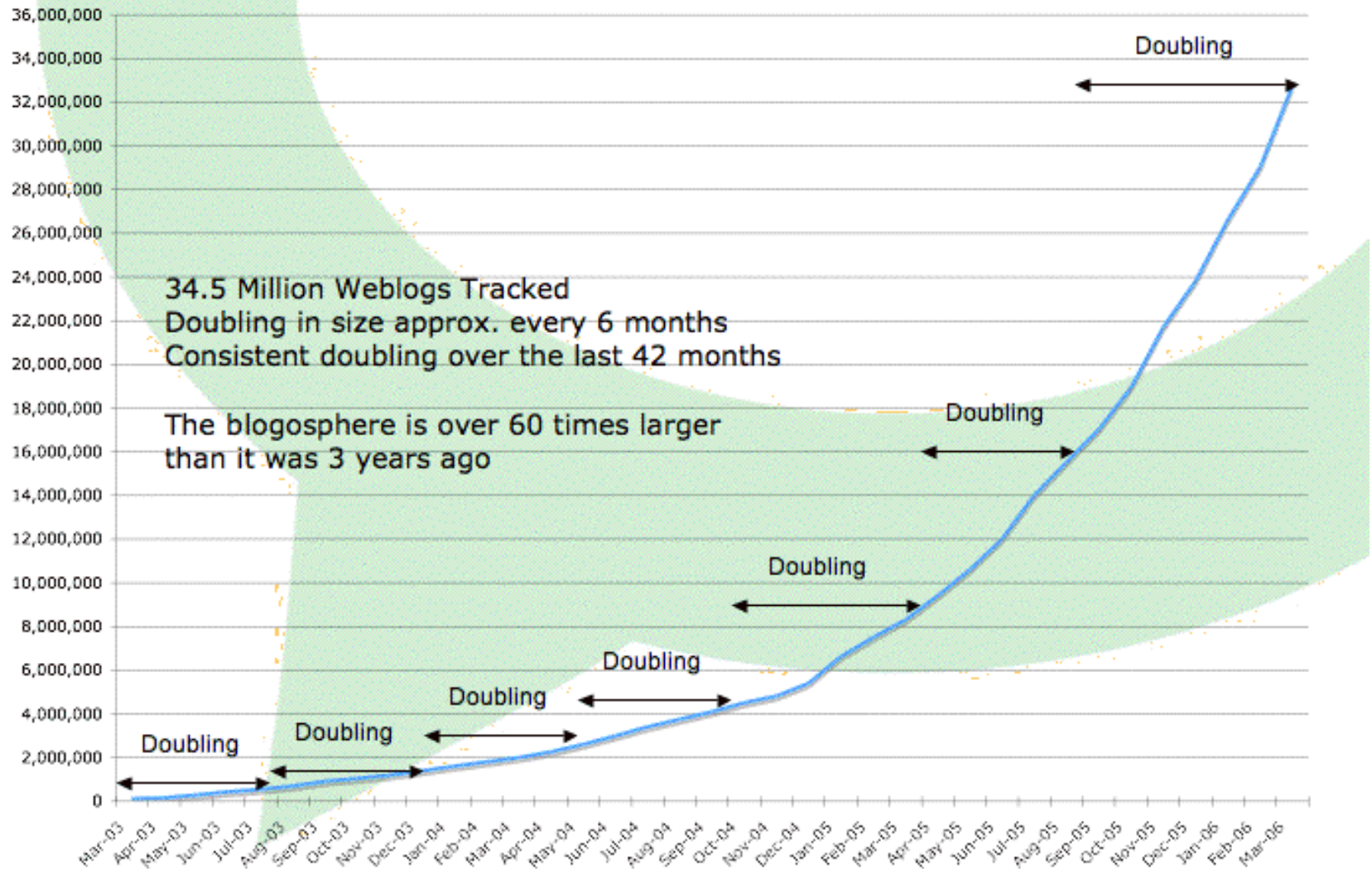
**Capacity of Storage
Content Search**

Total Sites Across All Domains August 1995 - September 2008

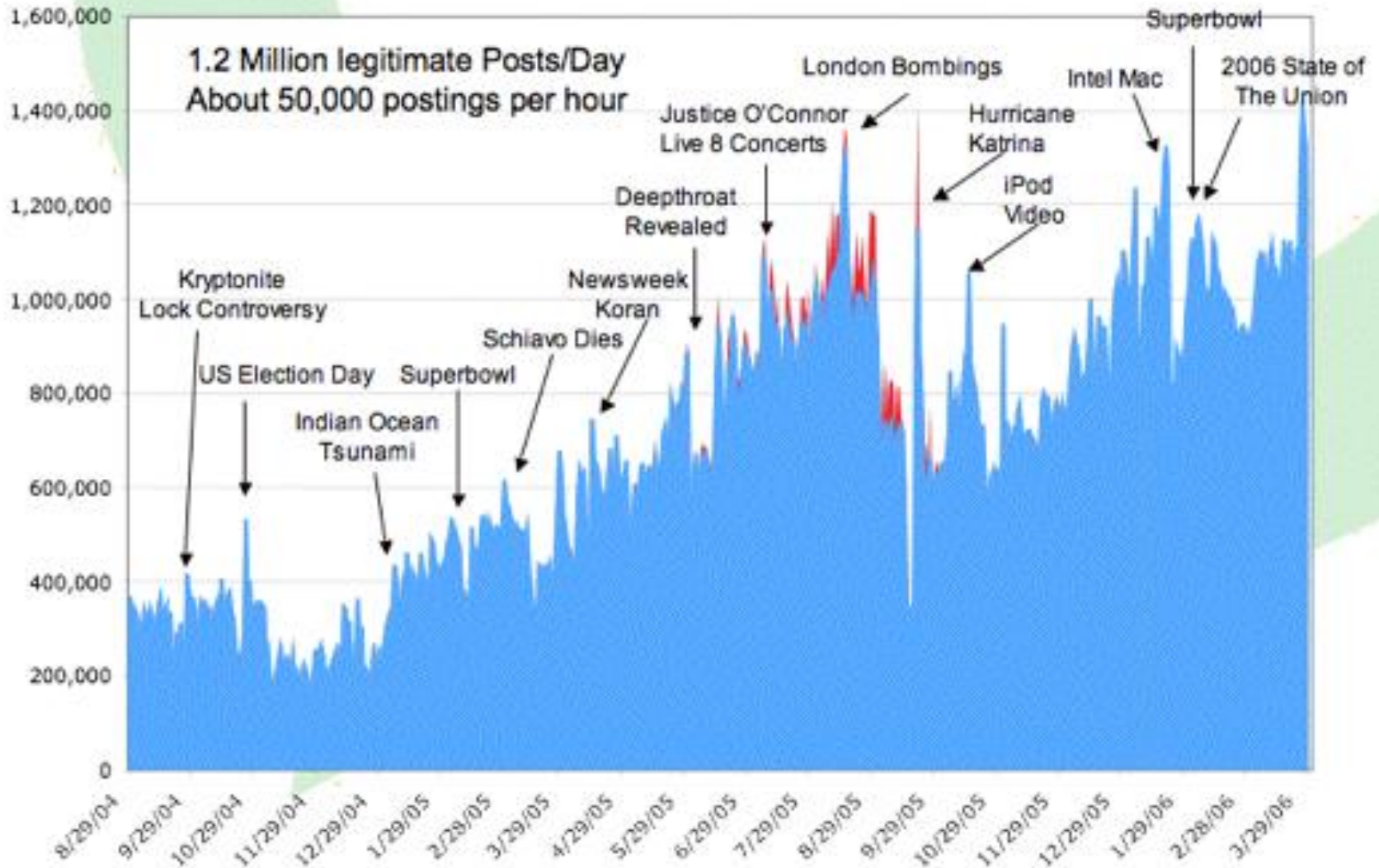
<http://news.netcraft.com/>



Weblogs Cumulative March 2003 - April 2006



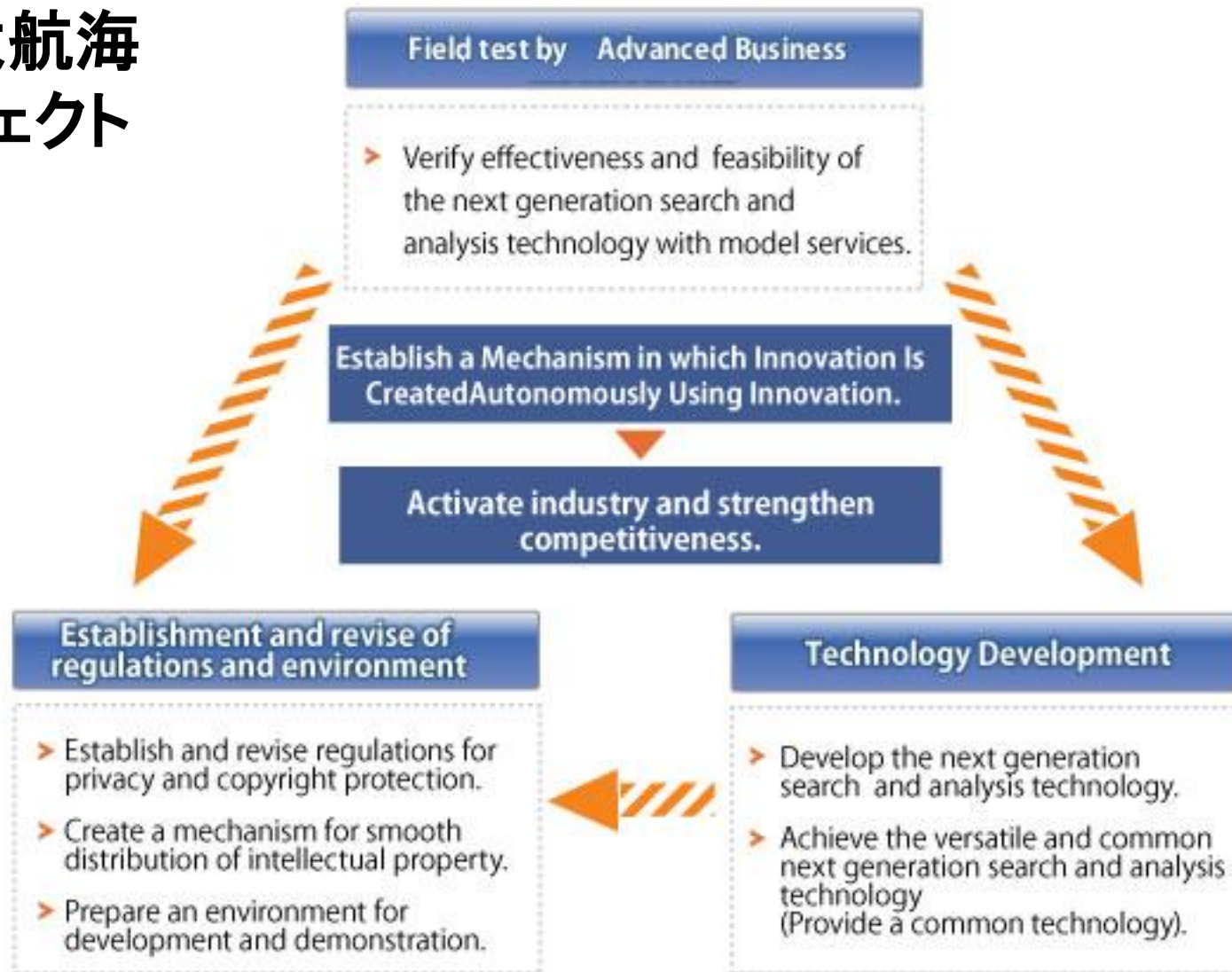
Daily Posting Volume



The Information Grand Voyage Project

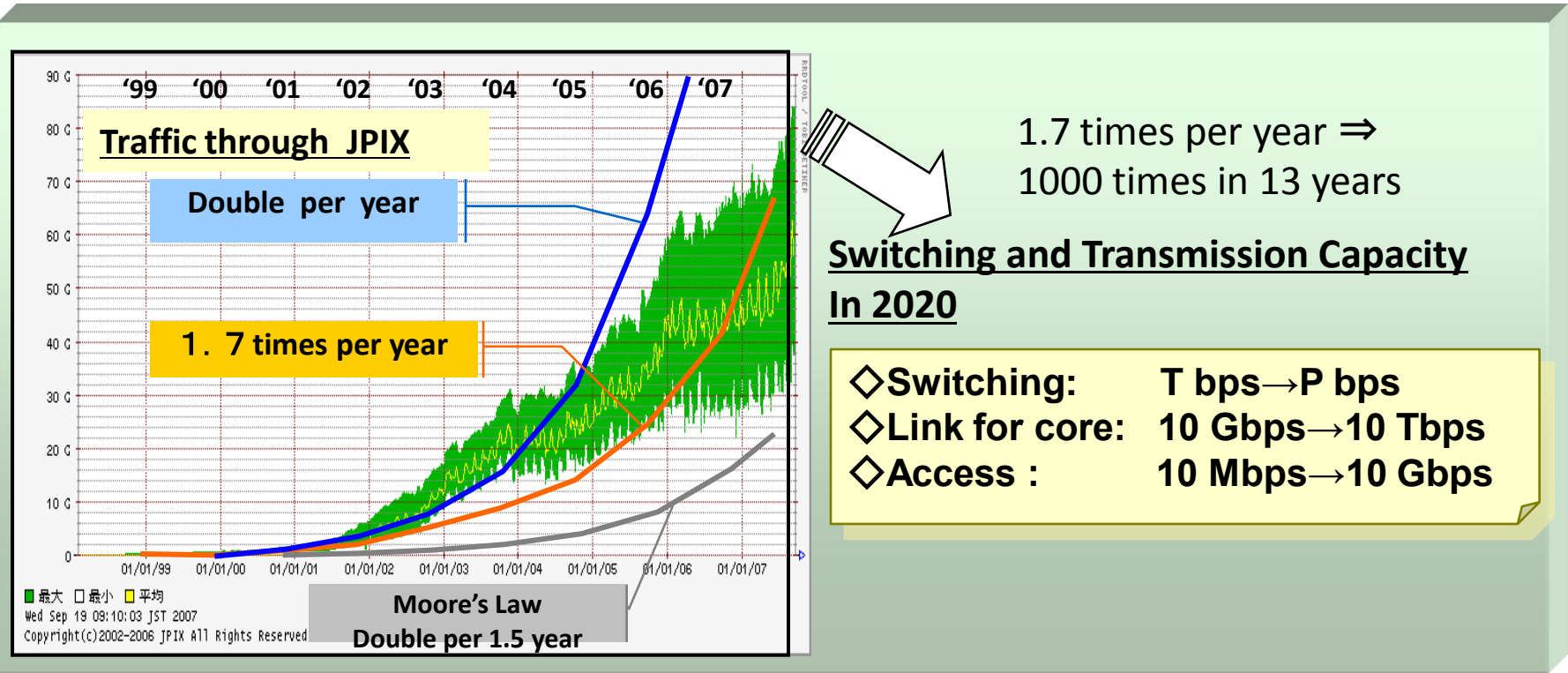
http://www.igvpj.jp/index_en/

情報大航海 プロジェクト



Expansion of Traffic over Networks

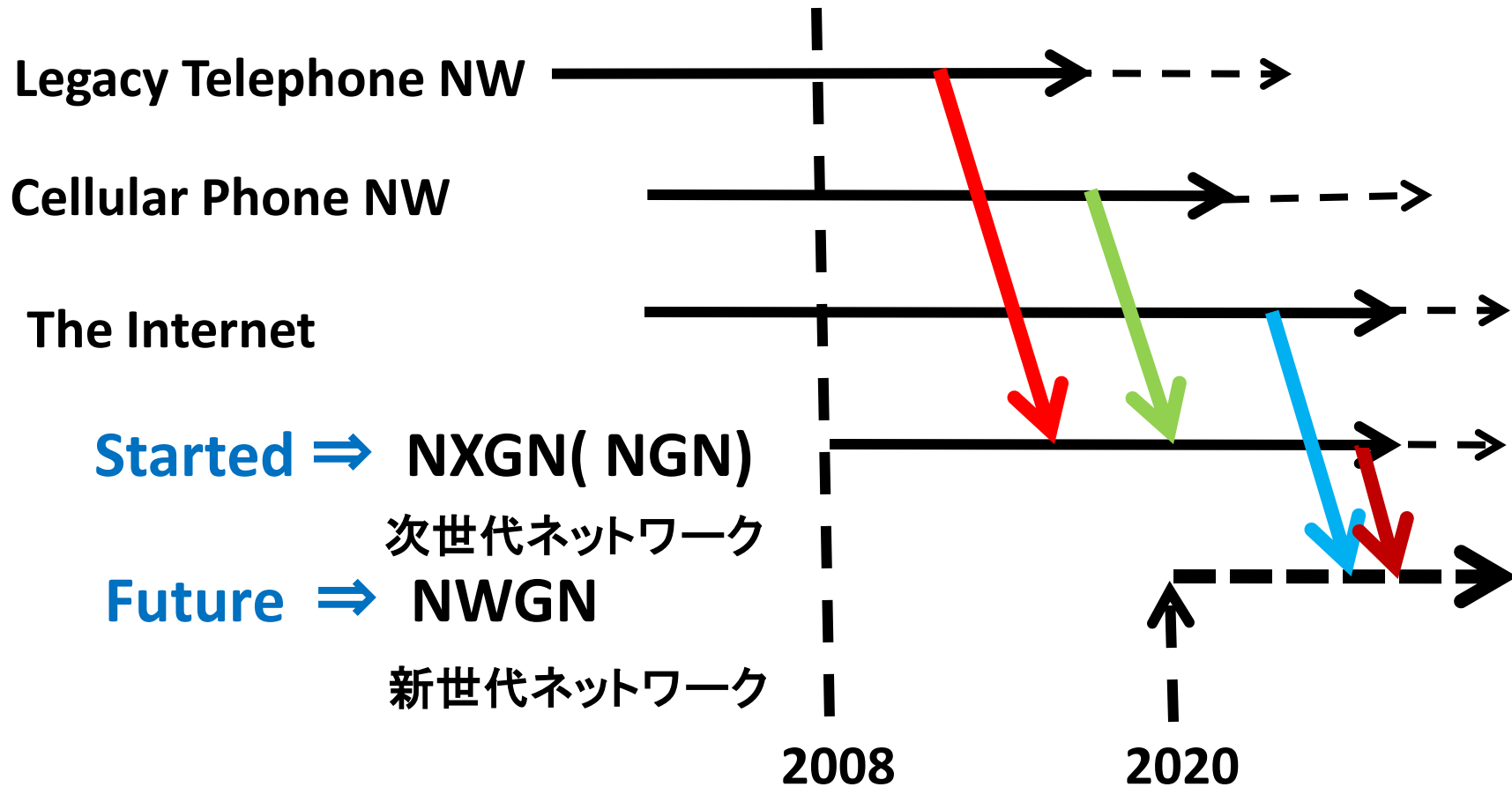
Tera b/s \longrightarrow Peta b/s



<http://www.jpix.ad.jp/jp/technical/traffic.html>

http://www.soumu.go.jp/s-news/2007/070822_2.html

An image of a network evolution



NXGN: Next Generation Network (NGN)

NWGN: New Generation Network

NXGN and NWGN

(次世代)

(新世代)

- NXGN (**Ne**X**t **G**eneration **N**etwork**): NGN

Replacement of legacy telephone

networks using **IP-based** networks to provide triple-play/quadruple-play services

Industry is investing their resources to NXGN deployment.

- NWGN (**Ne**W** **G**eneration **N**etwork**)

Clean-slate designed network architectures and main protocols different from IP-based networks , which can be **post-Internet/NGN**

NICT contributes to promote R&D on NWGN.

Research on New Generation Networks started in the world !

新世代「ネットワーク」の研究が日米欧で一斉にスタート

The United States

FIND

- NSF's ambitious program to develop the future Internet architecture through a clean slate approach.
- make a small scale, but a large number of projects converge into a fewer number of full scale architectures, and to verify using GENI
- A total of 1,200 million dollars to 26 projects by 2006

GENI

- Aimed at developing a testbed organization to succeed Planet Lab's development. programmable
- Aimed at a large scale facility development's budget in NSF. International cooperation is also included as a target.
- Project Bureau (GPO) is BBN. Planning to offer prototype, 1,500 million dollars in December 2007 over a two year period.
- A scale of construction budget is 367 million dollars.

E.C.

FP7

- EC's Funding structure towards the total fields of science and technology
- Begin by selected 133's new projects in Call 1
- Call 2 is investigating

<main individual programs>

-Network of the Future
(Call 1, D bureau) 2 billion Euros)

-FIRE
(Call2, F bureau) 4,000 million Euros

GÉANT2

- EC's research network
- The E.C. Budget for GÉANT was 9,300 million Euros over 4 years since 2004.
- It is in the middle of preparations for upgrading and for greater capacity by transforming it into GEANT3 from 2008.

Japan

NWGN development projects

- NWGN AKARI architecture development project
(Official announcement of concept's specification in April 2007)
- R&D on evaluation and establishment in the structure of NWGN) (NICT commitment, up to 20 million Yen times 2 years, plural cases)
- R&D for dynamic network technology (NICT commitment, 4 years, plural cases)

NWGN research development promoting structure

- "The head quarter of NWGN research development strategy" in October, 2007, NICT.
- "NWGN promoting forum," established in November, 2007 Working in 4 WGs
Ministry of International Affairs and Communications and NICT are a co-secretariat.

JGN2plus Testbed

- NICT's Testbed network for research development
- To provide "JGN2plus" from 2008 – 2010.

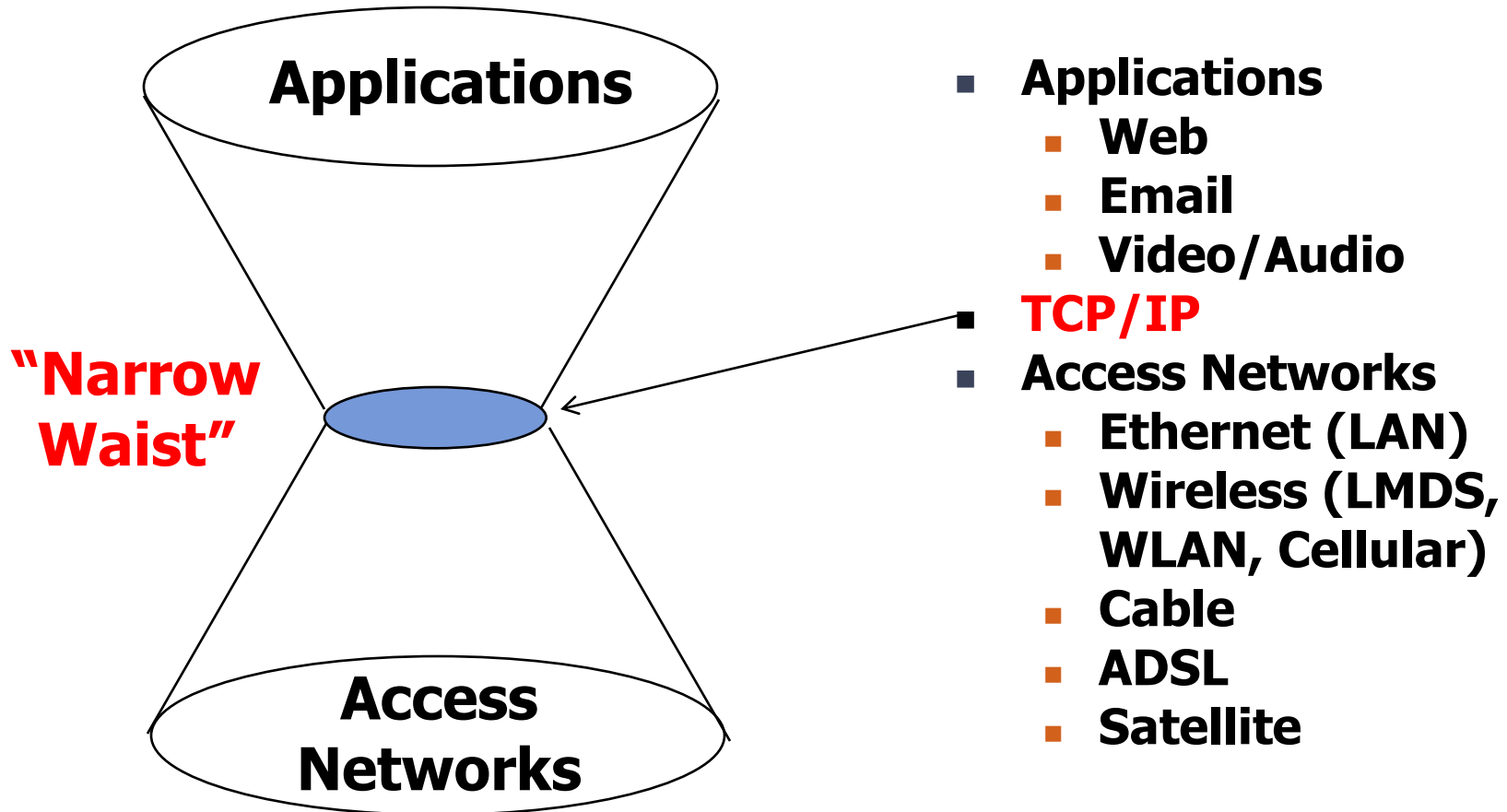
To realize NWGN, close collaboration among the E.C., U.S., and Japan is important.



Building up a framework to endorse collaboration of research organizations with each other.

Can IP Protocol handle the explosion of information in 2020s ?

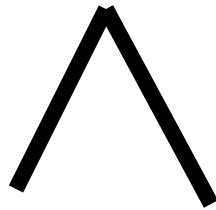
IPプロトコルは2020年代の爆発するデジタル情報を流通させられるのか？



Shortage of Storage

ストレージ容量不足

Total Storage Capacity: 246EB



In 2007

Total Digital Data Capacity: 281EB

In 2011, total capacity will be 1.8ZB

1.6 times increase per year

EB = 10^{21} Byte エクサバイト

ZB = 1000EB ゼッタバイト

Quality: High Human Perception
High definition of picture
High fidelity of sound
3 Dimension
Virtual Reality
High Utility & High Integrity
Meta Data
Naming of Content

A Vision for the Next Decade

4K
Streaming Video

Gigapixel
Wall Paper

Augmented Reality
No Glasses

1 GigaPixel x 3 Bytes/pixel x 8 bits/byte x 30 frames/sec ~ 1 Terabit/sec!

Source: Jason Leigh, EVL

OptIPuter 100 MegaPixel Displays

55-Panel Display

100 Megapixels

1億画素／システム

30 x 10GE interfaces

1/3 Tera bit/sec

Driven by 30 unit Cluster c
64 bit Dual Opteron

60 TB Disk

Linked to OptIPuter

Working with NASA ARC
Hyperwall Team to
Unify Software



Source: Jason Leigh, Tom DeFanti, EVL@UIC

Digital Entertainment with Super High Quality

Cinema  **Digital Cinema**

Musical

Opera

Concert

Game

Sports

ODS

(Other Digital Stuff)

2K vs 4K: Beyond HDTV for Digital Cinema

K : 1K=1024 Pixel

2K=2048

4K=4096

30 frames/s Interlace

【Digital TV】

TV



Digital HDTV



=1920 × 1080

24 frames/s Progressive

【Digital Cinema】



=2048 × 1080 (2K)



=4096 × 2160 (4K)



Digital Cinema standard was made by **DCI** and SMPTE is proceeding with the detailed specifications

DIGITAL CINEMA INITIATIVES, LLC, SIGNS LICENSING AGREEMENTS FOR COMPLIANCE TESTING

DCI 標準準拠の国際認証機関 ー世界で3機関

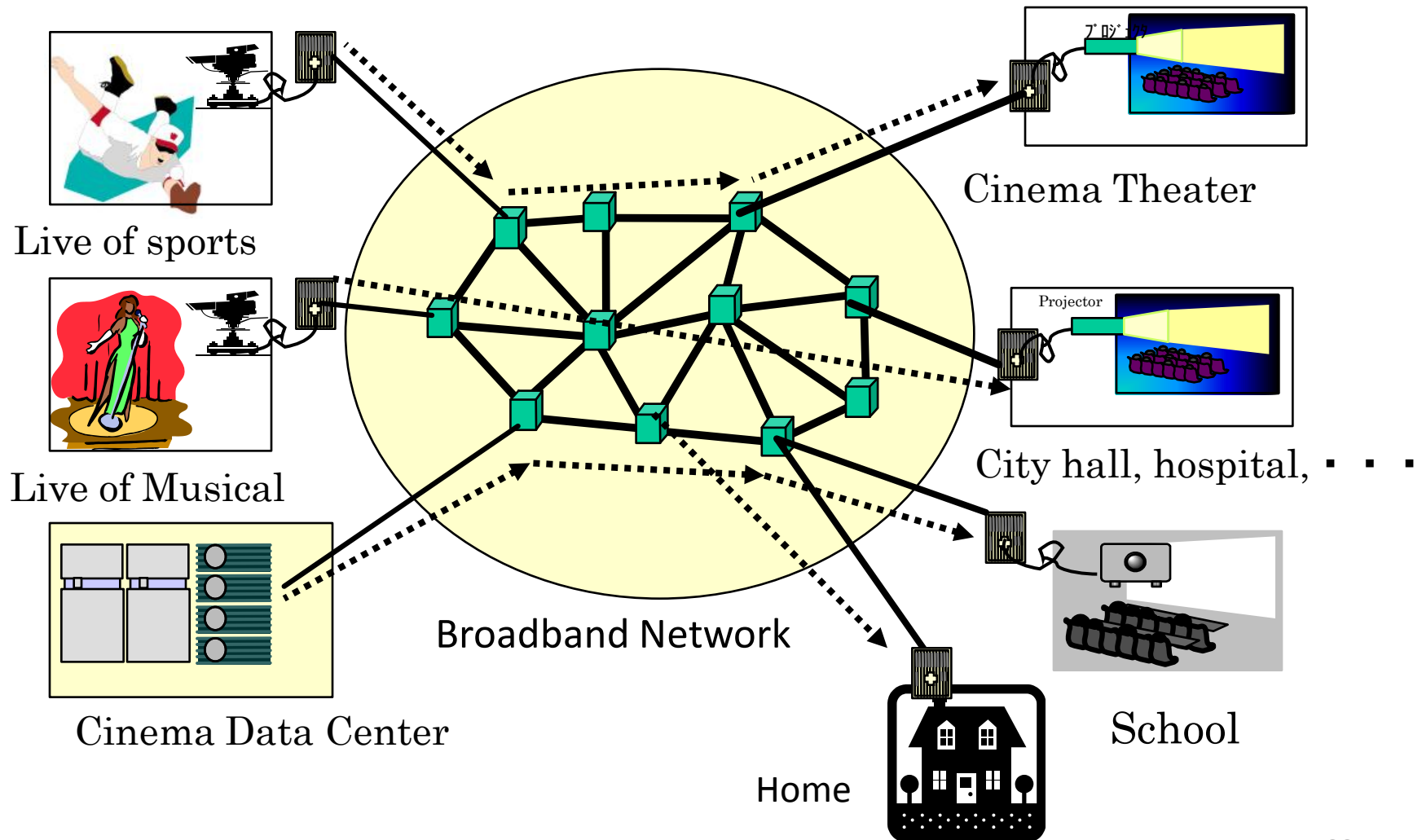
CineCert, DMC/Keio University and Media Innovation Center to Provide
DCI Specification Compliance Testing for Digital Cinema Equipment

(October 13, 2008 - Hollywood, California) Digital Cinema Initiatives, LLC (DCI) announced today that it has signed licensing agreements for compliance testing with CineCert, LLC in the United States, DMC/Keio University in Japan and Media Innovation Center in Italy. These entities will perform testing to determine whether manufactured digital cinema equipment and products are compliant with DCI's Digital Cinema System Specification (the DCI Specification).

In October 2007, DCI published its Compliance Test Plan (CTP), which includes validated test procedures for the DCI Specification, including all referenced standards of the Society for Motion Picture and Television Engineers (SMPTE).

In a joint statement, the member studios of DCI said, “These licensing agreements represent an important step in the maturation of the digital cinema marketplace. Through compliance testing, distributors, exhibitors, manufacturers and technology providers will have the assurance that equipment and products have been rigorously reviewed and comply with DCI requirements.”

Image of digital cinema and ODS distribution



Requirement for Networking

2-hour 4K digital cinema contents

Non-compressed : **5TB**

JPEG2000 Compressed : **250GB** (1/20 compressed ratio)

File Transfer

10 hours over 1Gb/s link

30 minutes over 1Gb/s link

Non-compressed

1/20 compressed

Real time streaming

6Gb/s Non-compressed

300Mb/s 1/20 compressed

Multicast function

Distribution of contents to theaters, halls and home theaters

QoS Requirements

Packet Loss

Latency

Synchronization

Ultra-Realistic Communications Forum (URCF)

超臨場感コミュニケーション産学官フォーラム

<http://www.scat.or.jp/urcf/>

立体映像、高臨場感音場再生、五感通信などの研究開発の促進を産学間連携で推進する

Time: Sustainability of Digital Content

Digital Dilemma !

Archives with long lifetime
Memory Devices
Archives Systems
Hierarchical Structure of Archive

Availability regardless of renewal
Structure of Content

Sustainability of Digital Content

Migration: $M(t_i) = \sum A(t_i) + \sum D(t_i)$ 破綻 !

Dark Archive: A collection of materials preserved for future use but with no current access.

Long Lifetime Memory Device

Classification of Digital Content

Naming and Discovery of Digital Content

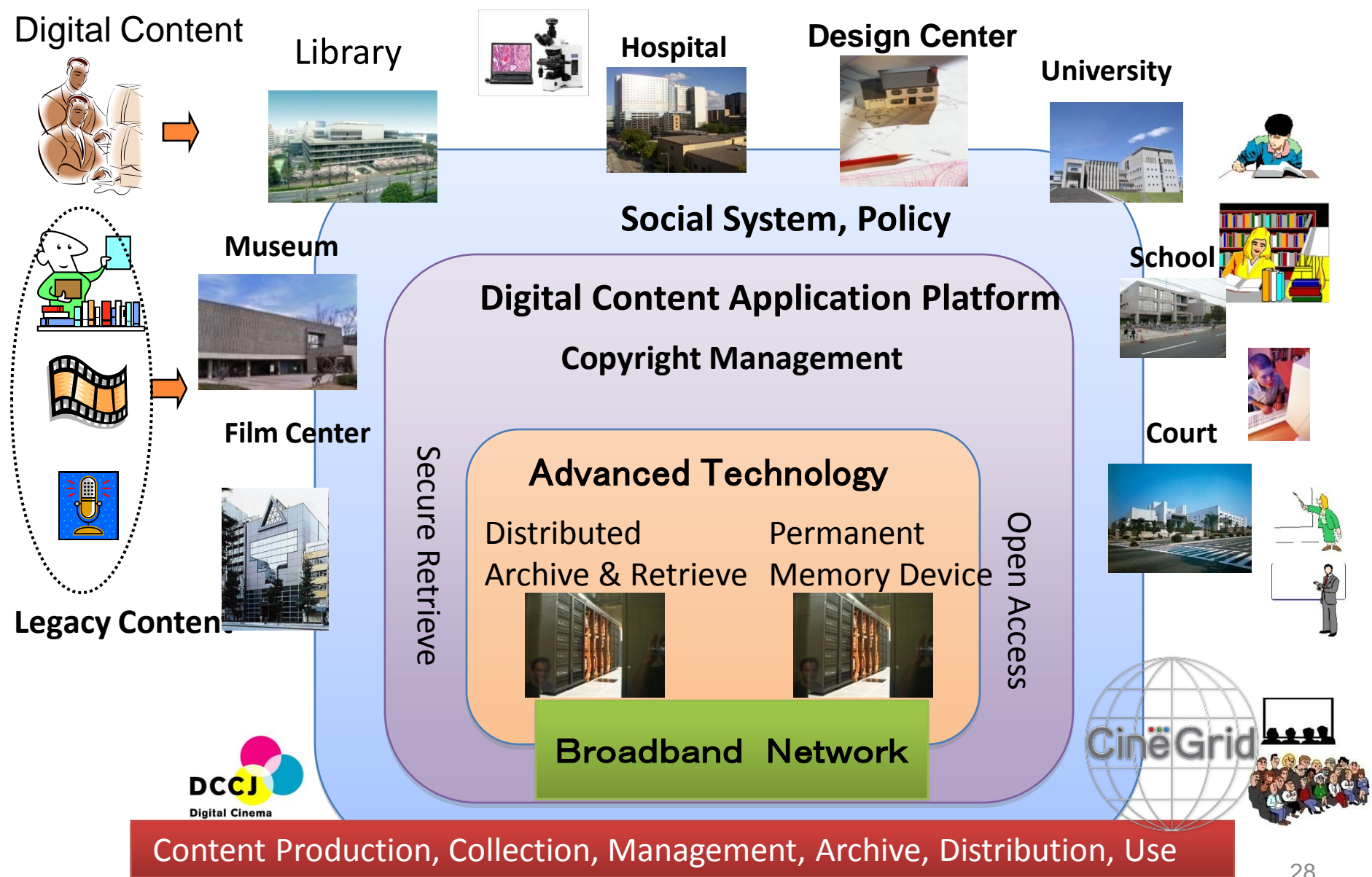
Search Engine for Long Life Content

Digital Infotheque ?

**Digital Knowledge Accumulation
Platform which enables to evolve
along digital 3 Axes**

**デジタルの3軸方向への発展を可能と
するデジタル知の集積 所**

Research on Digital Infotheque



Structure of Digital Infotheque

Knowledge Accumulation

Knowledge Usage

(デジタル知の社会システム・制度設計)
Social System Design for Digital Knowledge

Taxonomic
Function

Concierge
Function

(分散ファイルユーティリティシステム)
Digital Knowledge Application Platform

(恒久データ保存プラットフォーム)
Distributed Archives with Long Lifetime

- Model of Sustainability
- Law System
- Social System Design
- Copy Right

- Classification of digital content
- Retrieve of digital content
- Authentication PF
- Thesaurus of Digital Content
- Addition & Elimination of digital Content
- Naming & Discovery of Digital Content PF
- Media Transform PF

- Long Life Preservation
- Distributed Archive System
- Sustainable Data Structure

A Proposal of Digital Infotheque Project

デジタルインフォテーク研究プロジェクトの提案

- The working group with members from academia, public organizations and industry will be set up within this fiscal year to investigate a goal of the project, a roadmap to the goal and research themes.**
- The report made by the WG will be proposed to a relevant ministry and the Council for Science and Technology Policy(CSTP).**
- A forum for promoting Digital Infotheque R&D will be established in the next fiscal year to support the Digital Infotheque project.**

Summary

- Evolution of Digital Content has 3 Axes; Volume, Quality and Time.
- Time axis, that is, “Sustainability of digital content” is facing “**The Digital Dilemma**”.
- In order to overcome “Digital Dilemma”, federation of advanced technologies on each axis, that is, **Digital Infotheque** is required.
- Collaborative R&D project supported by the government is required to tackle “**The Digital Dilemma**” .

Thank you !

