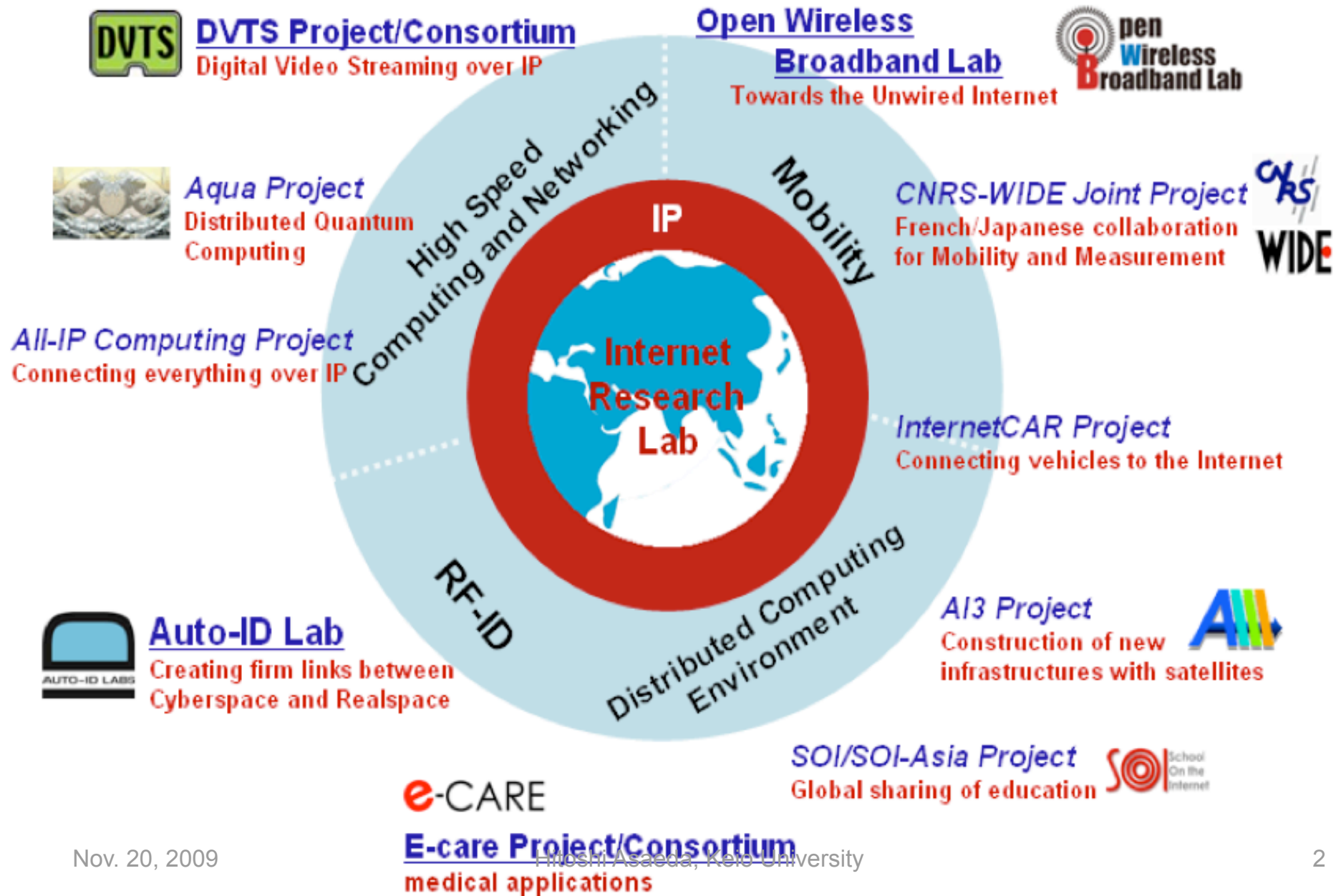


ANR-JST Workshop, Nov. 20, 2009.

Adaptive Multimedia Streaming for the Future Internet

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Overview of IRL, Keio Univ.



Faculty

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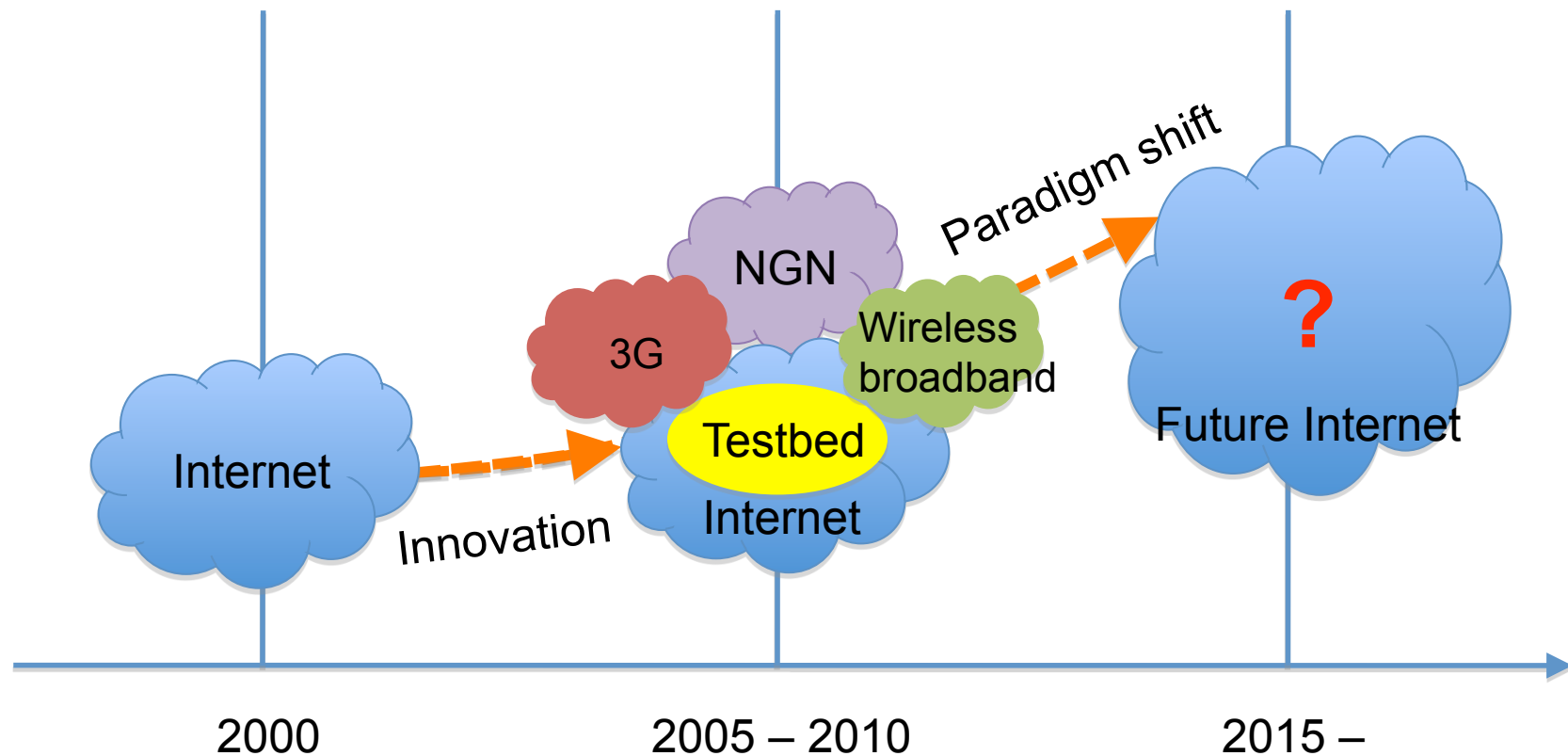
Assistant Professors

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Research Associates

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Tatsuya Inaba
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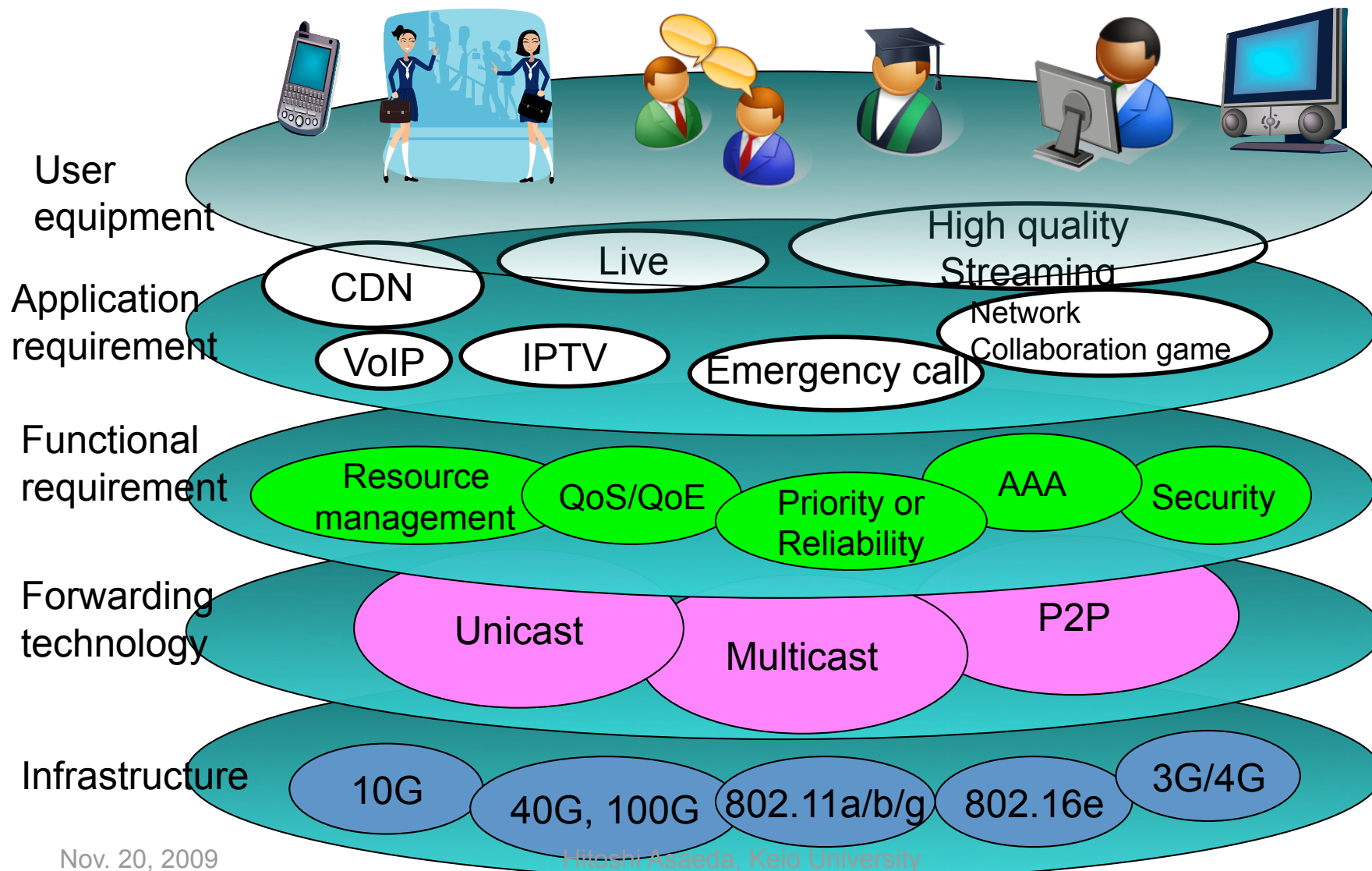
Toward the Future Internet



Top-Down Approach for Designing the Future Internet

- Multimedia streaming is one of the most important key technologies and the most attractive application for the future Internet
- Research target
 - High quality streaming
 - Maximum quality for available link capability and condition
 - Immediate and effective rate control mechanism is necessary
 - Real time streaming
 - High interactive streaming with small buffer
 - Transmission quality affected by delay, packet loss, jitter etc. is sensitive
 - Heterogeneity
 - From mobile terminals to high-spec computers or electronics
 - From low bandwidth (or lossy) link to high-broadband link
 - Wired link and wireless link (WiFi, WiMAX, 3G, LTE)

Heterogeneity and Various Requirements



Keyword: Adaptation

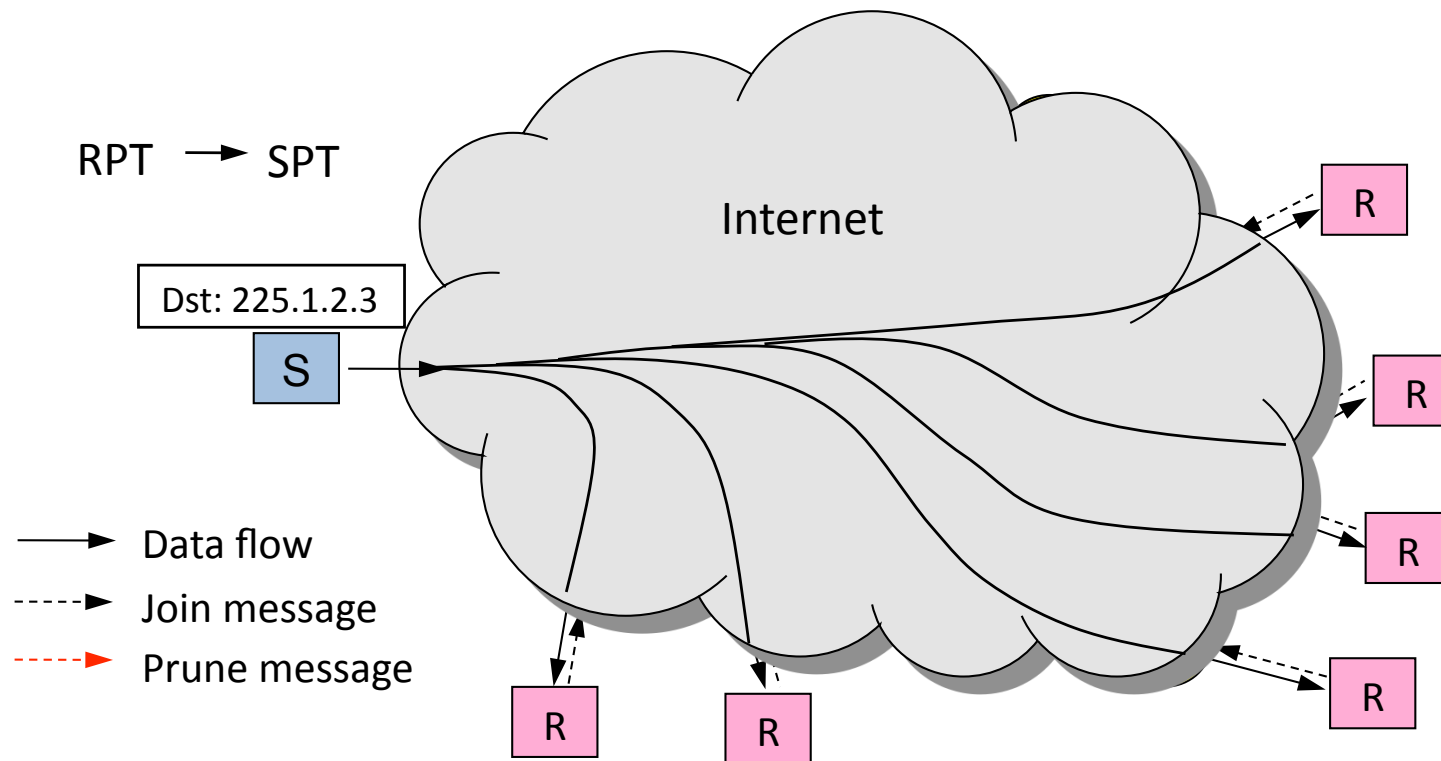
- Discussion
 - What is the best way to send and receive data?
 - How to select the path to receive data?
 - (Discussion may include security/privacy/authentication in future)
- Contradiction
 - Applications define transmission (unicast/multicast/p2p)
 - Different requirements and conditions
 - Delay tolerant vs. delay sensitive (or constraint)
 - Data loss tolerant vs. sensitive
- Strategy
 - Adaptive communications
 - Adaptive rate control mechanism
 - Unicast/multicast/P2P integration
 - Not easy as the name implies

Quality Adaptation

- Approaches
 - Unicast streaming
 - Adaptive Rate Control with Dynamic FEC
 - Not only for real-time streaming
 - Multicast streaming
 - Estimated condition based transmission (combined with Layered Multicast)
 - P2P streaming
 - Effective path (or node) selection and data recovery
 - Effective tree and/or mesh topologies
 - Chunk retrieval and node discovery

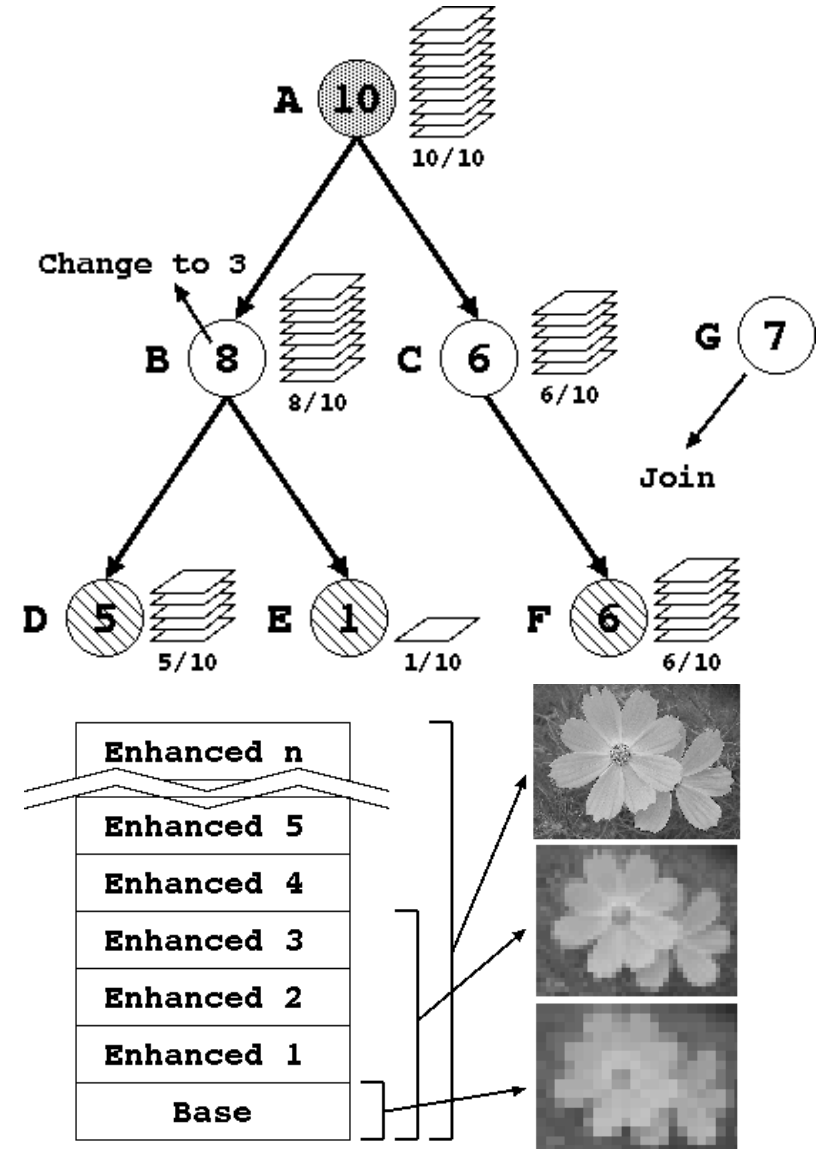
Multicast Tree Coordination

- Multicast routing tree coordination is complex and not scalable. Why?



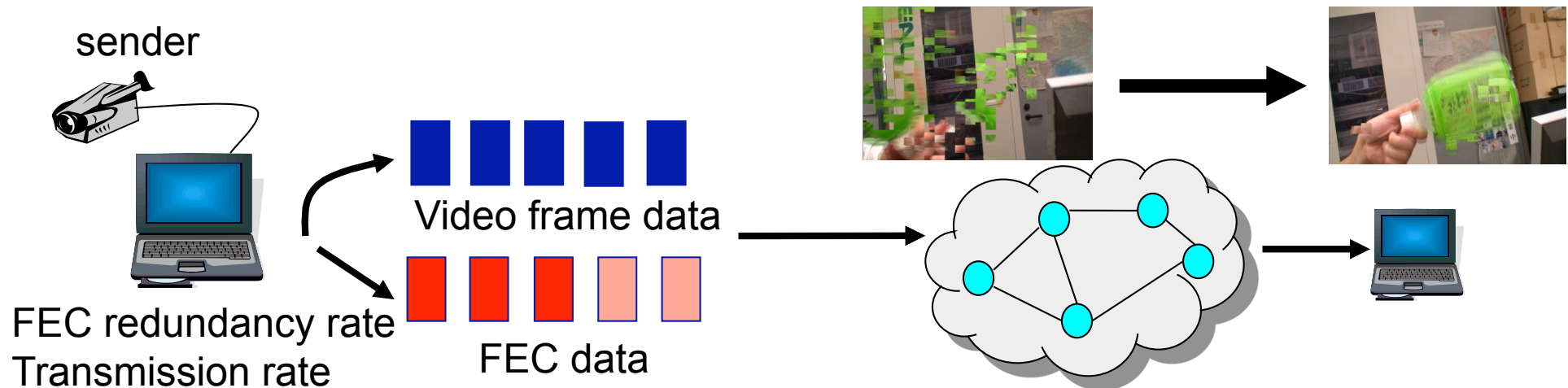
Layered Multicast

- Hierarchical data structure
 - Data are divided into several “Layers”
 - Layer is a multimedia data unit
 - Video quality is controlled by the number of collected layers
 - Layer
 - Base Layer
 - Enhanced Layer
- Multicast tree structure
 - Senders provide maximum quality data
 - Intermediate nodes decrease layers to adapt to the network resource



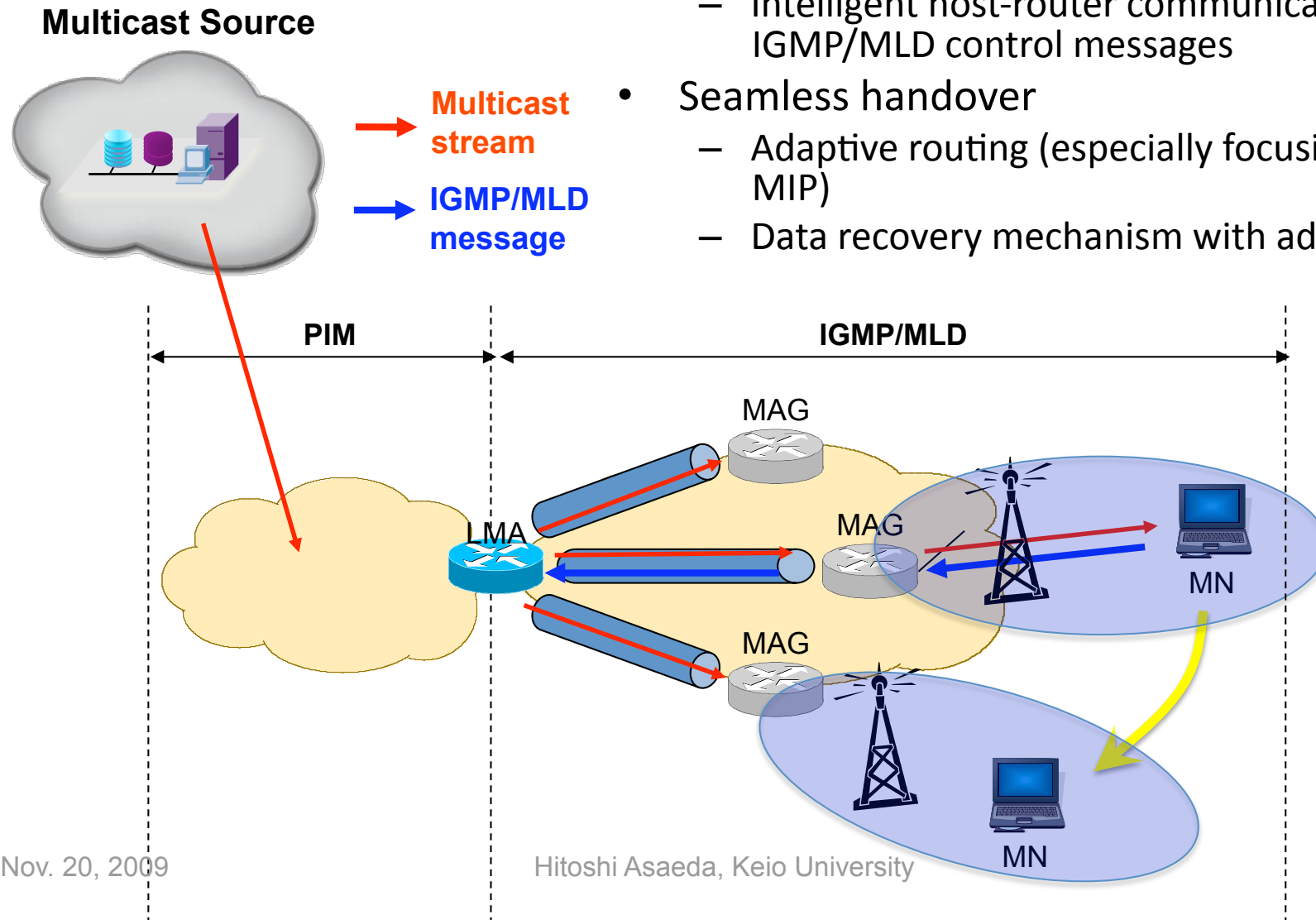
Adaptive Rate Control with Dynamic FEC

- FEC (Forward Error Correction)
 - Error recovery for lost packets
 - Approach: Useful for network condition measurement
- Dynamic FEC
 - Based on the network condition, both data transmission rate and FEC encoding rate are adjusted
 - Measurement factors: Packet loss pattern, FEC recovery rate, Duration
- Fairness and congestion control
 - Aggressive rate control vs. conservative rate control
 - Break TFRC limitation

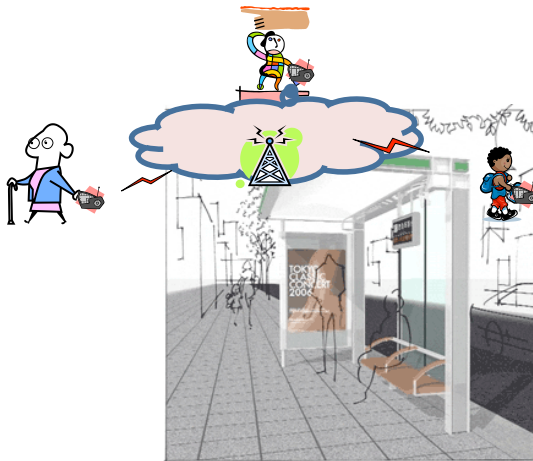
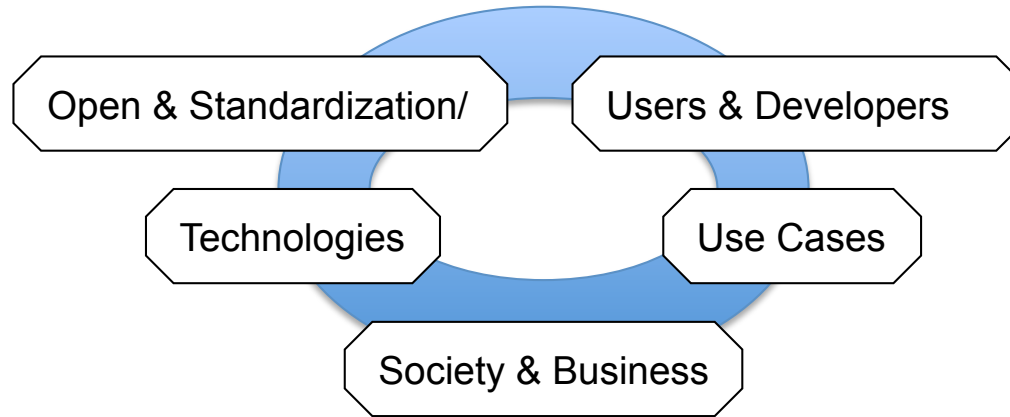


Wireless Multicast

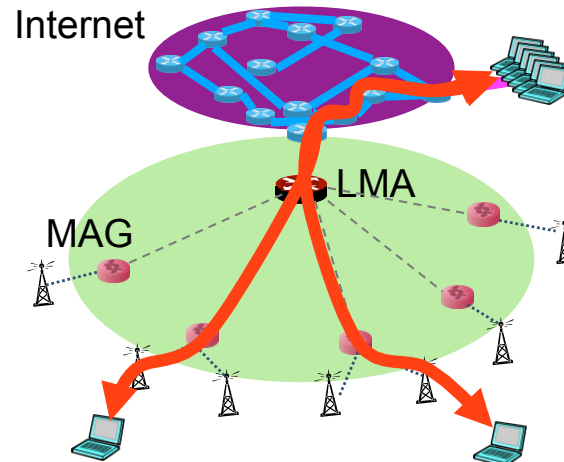
- Adaptive membership management
 - Intelligent host-router communication with IGMP/MLD control messages
- Seamless handover
 - Adaptive routing (especially focusing on Proxy MIP)
 - Data recovery mechanism with adaptive FEC



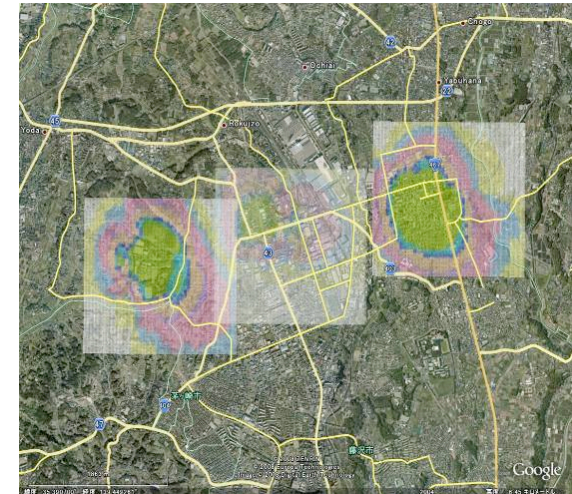
Open Wireless Platform



Social communication,
regional development



Proxy MIPv6 (PMIPv6)
based mobility



Wireless (WiMAX) testbed

Recent Activities with French Members

- Framework
 - JFLI (Japanese-French Laboratory for Informatics)
 - CNRS / UPMC & Keio Univ. / U. Tokyo / NII
 - <http://jfli.nii.ac.jp/>
- Collaboration
 - JSPS – CNRS
 - 二国間交流 for OneLab extension (since 04/2009)
 - CNRS – WIDE
 - Mobility and measurement (successfully terminated)
- Cooperation
 - Dynamic Network Project (funded by NICT (JP)) (since 04/2008)
 - With INRIA for developing FEC algorithm and its standardization
 - NS-3 development
 - With INRIA members and our Ph.D. students

Possible Research Proposals

- Toward future Internet architecture
 - Designing network model for high quality streaming
 - Streaming architecture with multicast-unicast-P2P integration
- Rate control mechanism (to replace TFRC) for new generation applications
 - Congestion control or adaptive rate control with Dynamic FEC
- High quality streaming for a large number of users
 - Robust and scalable routing architecture with testbed experiment
 - Layered multicast with quality estimation and reliable transmission
 - High performance hybrid P2P architecture
- Wireless multicast and/or streaming
 - High quality (but controllable and scalable) architecture
 - Location-based (or geographical) application

Conclusion

- Top-down approach for designing the future Internet technology
 - Adaptive multimedia streaming architecture
 - Theoretical and practical approach
- French – Japanese research collaboration
 - CNRS / LIP6
 - INRIA
- Framework and cooperation
 - JFLI
 - WIDE (including many (mainly Japanese) industrial partners)

Thank you