ITU Workshop on "TV and content delivery on Integrated Broadband Cable Networks"

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Future Cable Services: Communication and Recognition

Tomoyuki Shimizu
Research Engineer, KDDI Research, Inc.
tm-shimizu@kddi.com

Services over Cable Networks

“Hybrid” Cable Services

Broadcasting

Internet

ITU-T Recommendations for Hybrid Cable Services

- J.205, J.206 – Integrated Broadcast and Broadband (IBB)
- J.296 – hybrid set-top box
- J.230 – STB and companion devices (e.g. tablets)

Many connected devices in home

Integrated Services with Connected Devices

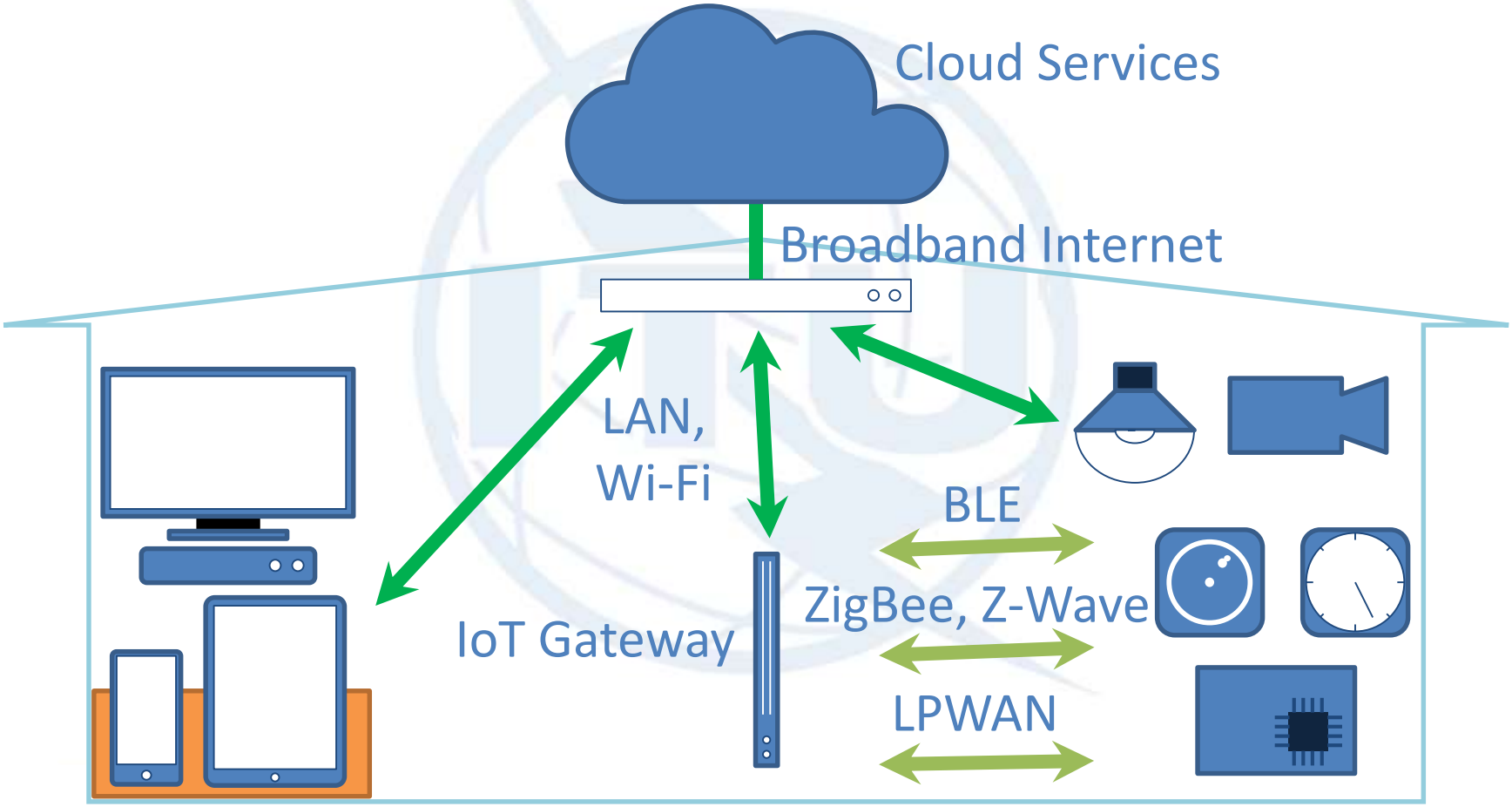
We are always with connected devices

Connected services will ultimately be able to know:

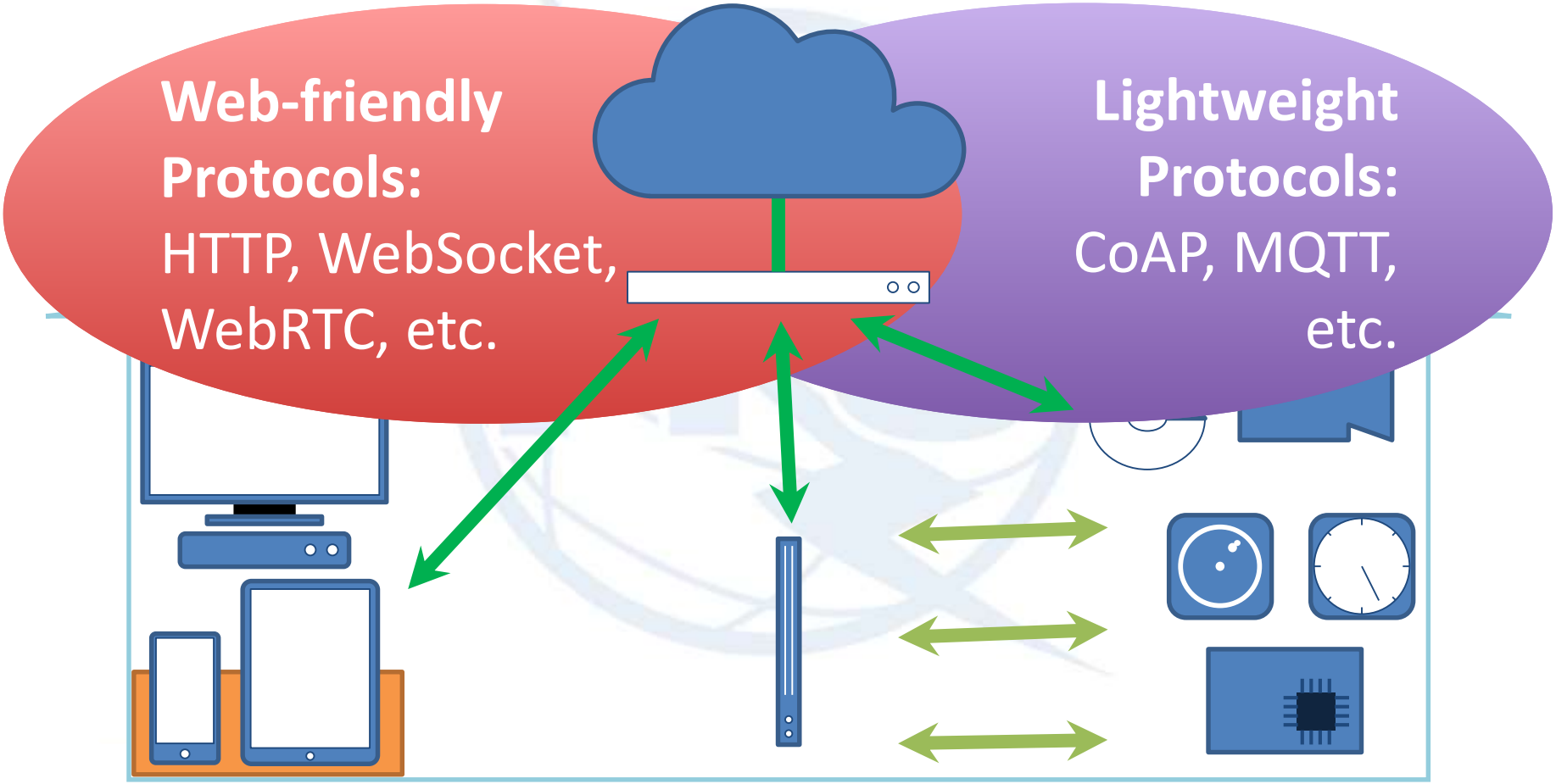
- How we feel
- What we want
- What we should do now
- What will be helpful for us
- …etc.

Communication – Connected Devices and Cloud Services

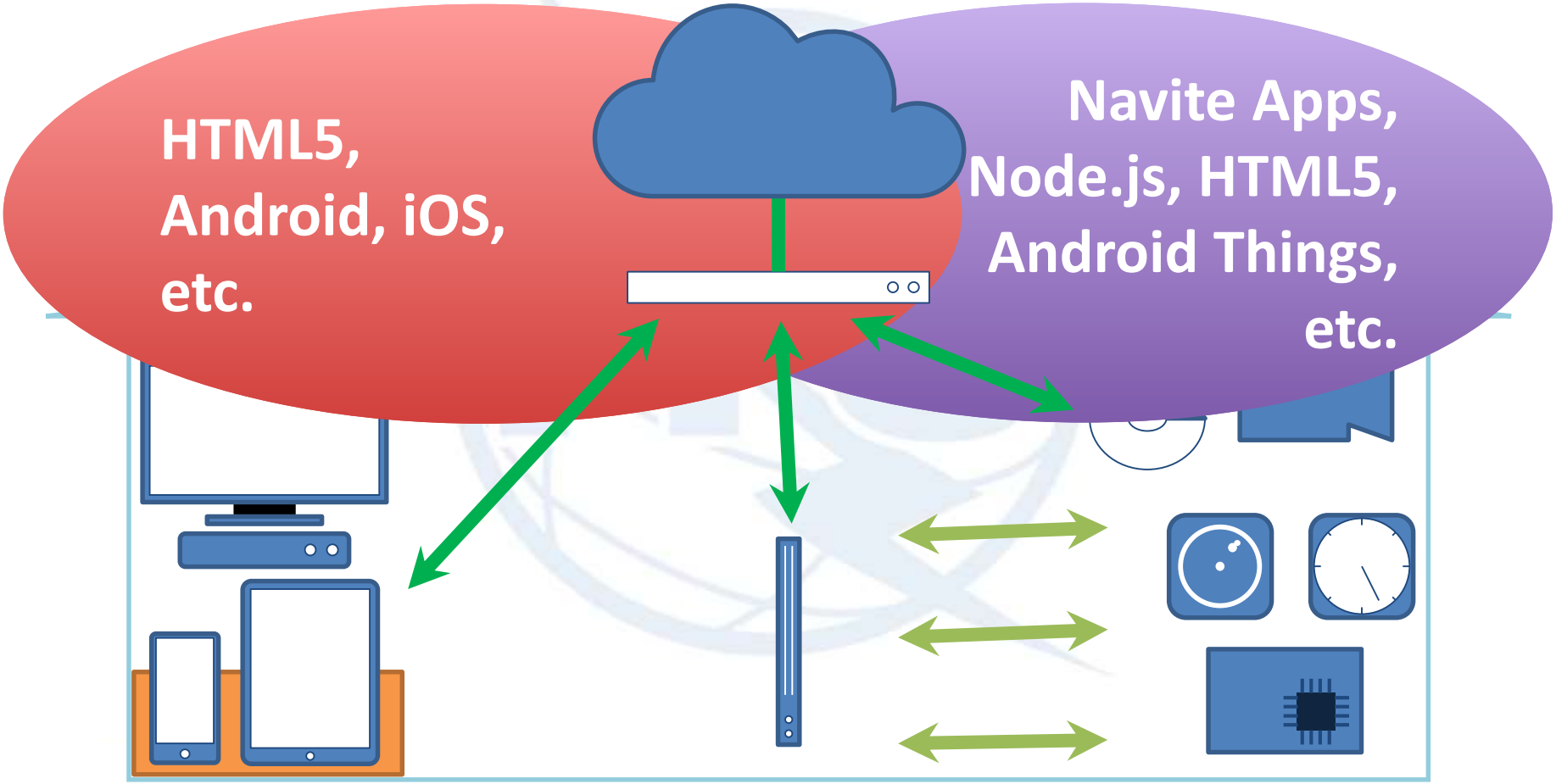
Devices and Cloud Services



Application Layer Protocols



Application Runtime Environment



IoT Hardware Platform

https://www.raspberrypi.org/

https://chirimen.org/

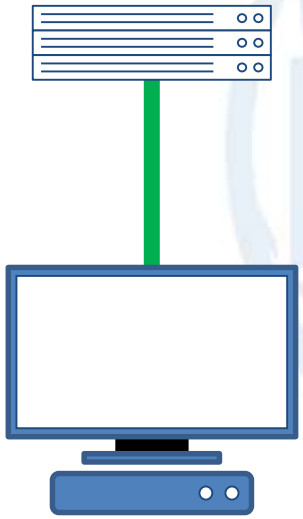
- Powerful like smartphones
- Modern runtime environment
  - Linux + Node.js
  - Android
  - Web Runtime (HTML5)
- Device connectivity
  - USB, GPIO, I2C, etc.

Interoperability is being improved

- Connectivity with Cloud Services
- Common Application Protocol
- Common Runtime Environment
- Intelligent Low-Power Chips

Recognition – Learning Users through Device Communications

Conventional broadcasting services can analyse…



- Favorite video content
- Favorite actresses/actors
- Favorite categories of news
- Interesting products and goods

Integrated services will be able to recognise…

- Lifestyle
- Activities in home
- Health condition
- Interests
- Concerns

…etc.

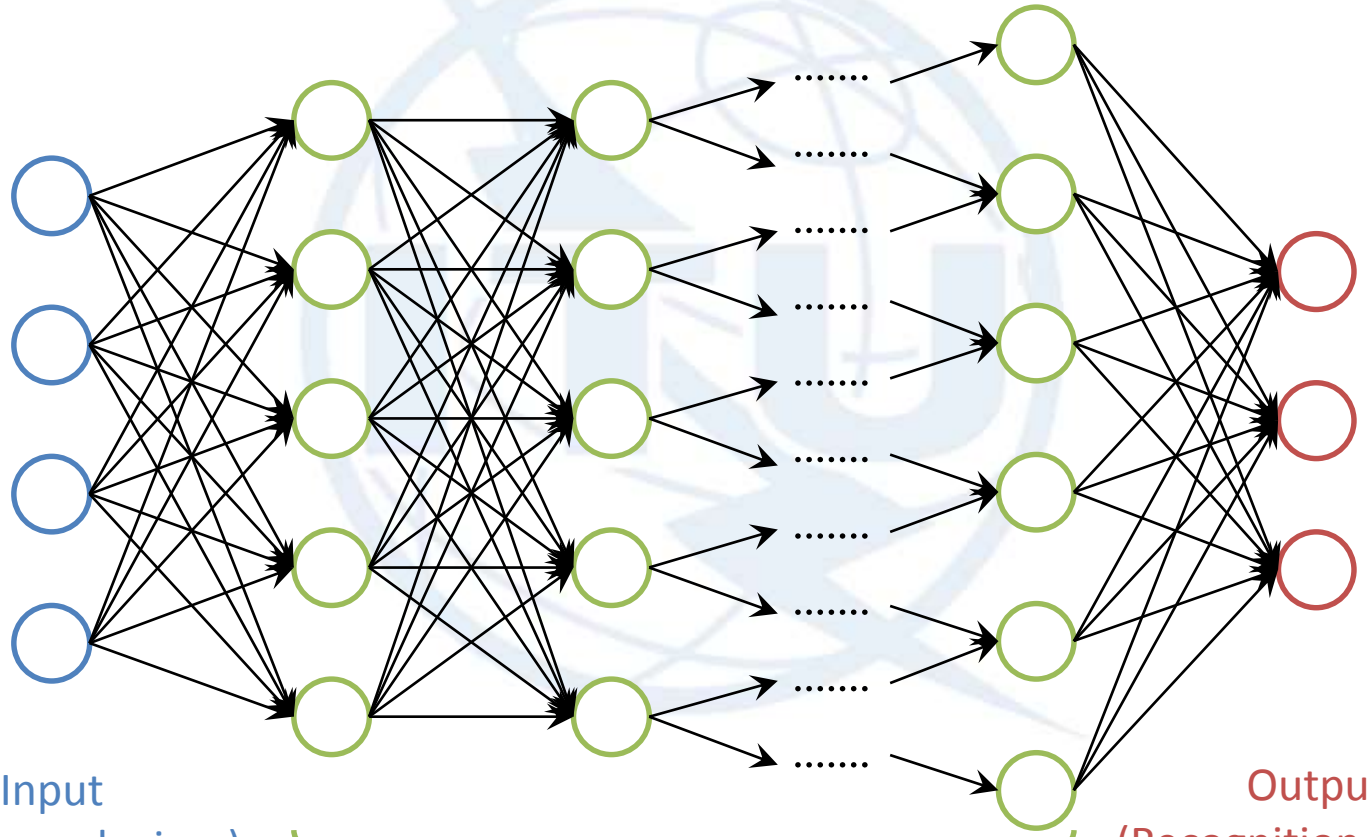
Data from connected devices may represent some user context

User behavior	Home environment
• Set-top box, Smart TV • Smartphone, Tablet • Lighting • Home security (camera, etc.)	• Sensors (temperature, humidity, etc.) • Smart grid (power consumption)

Recognise user's context: Recent machine learning

- Huge improvement in nonlinear regression analysis
  - Large amount of learning data from devices as input
  - Deep Neural Network (DNN): deep-layered structure with multiple hidden layer
  - Recognition results as output
- Image recognition, context analysis, etc.
- A huge amount of computational resources (e.g. multiple GPUs) are necessary

Deep Neural Network (DNN)



Input
(Data from devices)

Hidden Layer(s)

Output
(Recognition results)

Machine learning is widely deployed

- Handwriting recognition
- Image search
- Face and emotion recognition
- Medical image analysis (e.g. cancer diagnosis)
- Economic analysis

…etc.

Conclusions

Prospect: Future Cable Services

connect everything

recognise users

Pros and Cons

	Users	Operators
Pros	Personalized information and services • Better home environment • Energy saving • Healthcare • …etc.	Understanding users' preference and trends in an implicit manner (not limited to video content) • Housekeeping • Products and goods • …etc.
Cons	Security and privacy concerns • Home network security • Fear of device scanning	Architecture (too much flexible) Authentication and authorization

Potential Studies in SG9

- Security and privacy guidelines
- Service architecture
  - Servers, home network and devices
- Authentication and authorization model
  - Identifying both users and devices

Note: set-top box and smart TV can be regarded as a “device”

Thank you!