New Generation TV platform API and Privacy Protection

- Study from Broadcasting Extended Functionalities API in BML -

September 2, 2010

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Background

- User’s way of watching video is changing
  - Watching Internet video sites like Youtube, Nicovideo on PC (Nicovideo: online video sharing site in Japan)
  - Searching/browsing related information on mobile handsets or PC during watching TV (multi window style)
  - Watching video using simple user interface of media-player applications on mobile handsets

TV usually has larger screen and simple user interface.
So, why don’t we enjoy these styles on TV at one stop?

New service/application requirements for TV set

- User prefer to use the following functionalities on TV set,
  - Internet Video such as Youtube
  - VOD (Video on demand)
  - Recording broadcast or user preferences etc.
  - Video phone / Address Book
  - Network games
  - Bookmarks
  - Web mail
  - Calendar
  - SNS Services
  - Etc.

Application execution environment is essential
for wide variety of requirements.

High level requirements for application execution environment on TV set

- The following functionalities are required:
  - Multiple type of media data such as Text, Video, Audio are rendered at the same time
  - Real-time user interaction (for dynamic web contents etc.)
  - Bi-directional communication between TV and service delivery server (video phone, network games, service monitoring etc.)
  - Simple user interface (e.g. conventional remote control)
  - Local storage (for recording broadcast or storing user preferences etc.)
  - Security (for privacy protection etc.)

TV platform is expected to satisfy these requirements to meet users' requirements.

Existing standards or technologies in the world

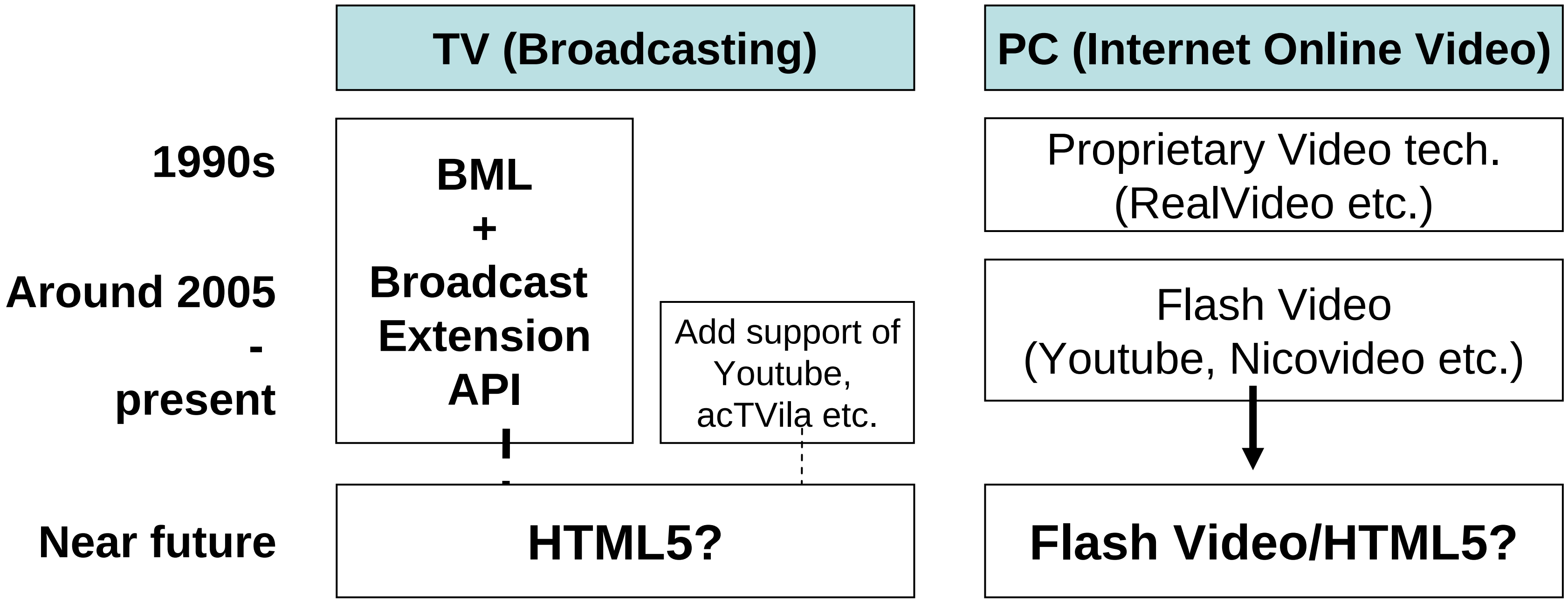
- TV platforms (just a few of examples)
  - HTML + JavaScript

    - BML, HTML5, DVB-HTML, CE-HTML etc.
  - Java-based
    - ARIB-J, DVB-J etc.
  - Other
    - Flash Video, Microsoft TV, Google TV etc.

There are many kinds of TV platforms.

Standards and technologies in Japan

- In late 1990s, Japanese broadcast industries decided to adopt XML-based standard “BML” as digital TV platform.
- Since around 2005, Youtube and Nicovideo started. People started to talk about web-broadcast convergence. Ways of watching TV and Video contents were becoming more diversified.
- In 2010, HTML5 and related specifications are becoming as good candidates for New Generation TV platform.



TV (Broadcasting)

PC (Internet Online Video)

1990s

Around 2005 - present

Near future

BML + Broadcast Extension API

Add support of Youtube, acTVila etc.

Proprietary Video tech. (RealVideo etc.)

Flash Video (Youtube, Nicovideo etc.)

HTML5?

Flash Video/HTML5?

Users and industries call for standardized TV platform API

Some of users and industries expect that HTML5 would be one of promised platforms for Next Generation Multi-media TV set.

- There are many kinds of TV platforms in the current market. (See slide No.6-7)
- Considerations:
  - Users: bothered to choose right platform meeting their needs
  - Contents Creator/Provider: need stable contents development environment. Now, need to pay extra cost to make their contents to support multiple platforms
  - Manufacturer: Hard to reduce development cost by procurement of common components (re-inventing the wheels)

We believe that standardization activities to
HTML5 incorporating BML functionalities will solve these issues.

BML in brief

- Summary
  - XML-based standard developed by ARIB (Association of Radio Industries and Businesses)
  - Defined in ARIB STD-B24 “Data Coding and Transmission Specification for Digital Broadcasting”
  - Derived from early draft XHTML 1.0 strict (extended and modified), subset CSS 1 and 2, ECMAScript and Broadcast Extensions API
- Revision history:
  - 1999: The first version (1.0) was finalized
  - 2009: The latest version (5.4) was published
- BML Broadcasting Extensions API
  - Can be categorized as the following lines:
    - EPG API
    - VOD/Broadcasting base on Home Server API
    - Storage API
    - Interactive/Presentation API
    - Other TV set Control API

In Japan, BML is time-proven presentation technology
based on XHTML/CSS and JavaScript,
which has been tested by many commercial-grade deployments.

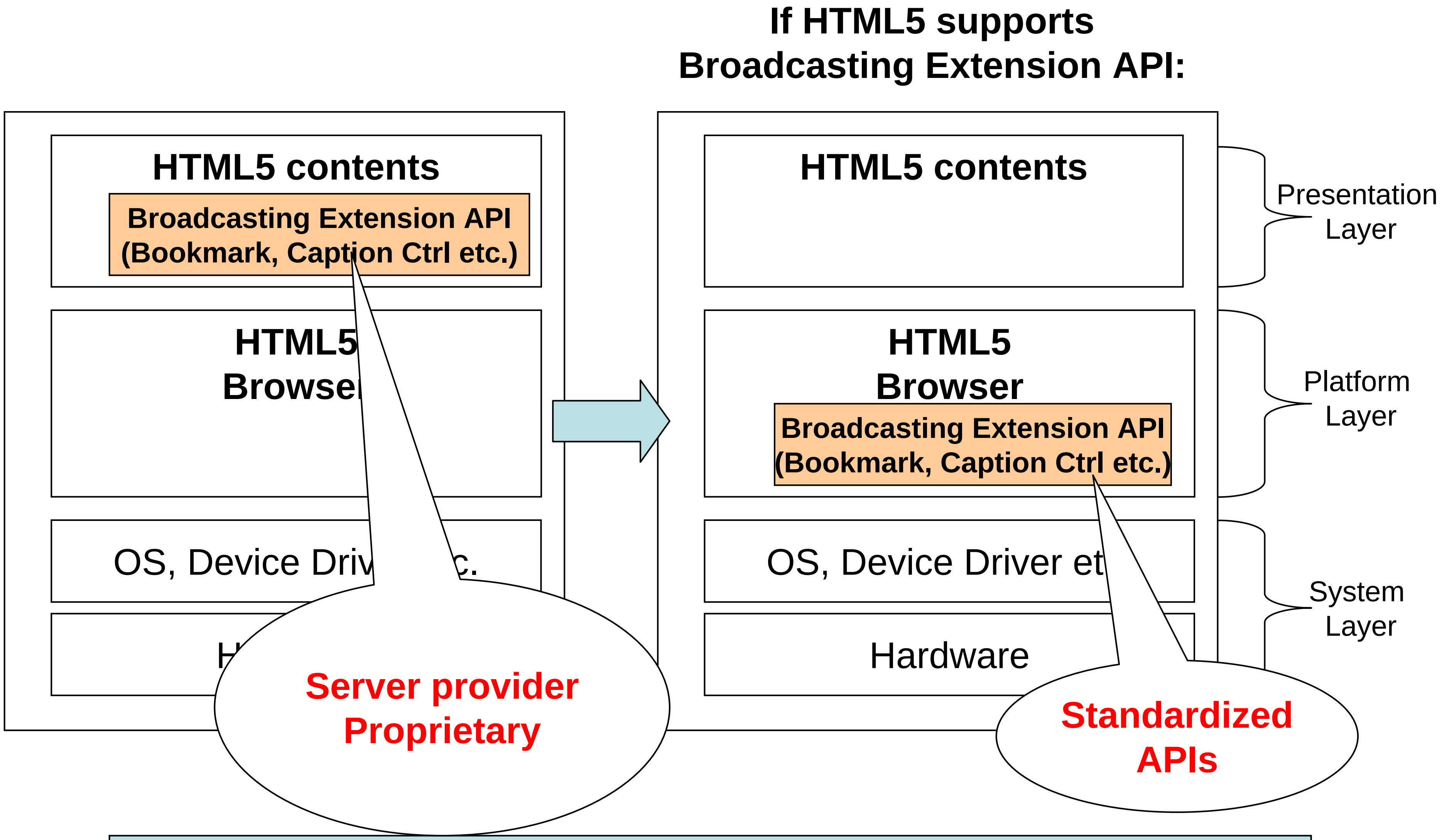
BML vs HTML5 on TV-related functionality

	BML	HTML5 + W3C DAP
Contents Text/Video/Audio	object element with remain attribute	video, audio element
Bi-directional communication	Bi-directional communication APIs	WebSockets
Storage	General-purpose Local Storage	LocalStorage
Bookmark	Bookmark API	None
Printer Control	Printing API	None
Device Control	General-purpose XML-based peripheral control API, printer	None
EPG/Reservation	EPG, Program Index, Series for recording reservation	None
Presentation	Multi-language Caption control, External Characters etc.	Limited (video overlay at WHATWG)

BML provides essential features EPG and caption control etc.
for broadcasting contents delivery.

(Yellow: differences between BML and HTML5)

Inside structure of Multi-media TV set



If HTML5 supports
Broadcasting Extension API:

HTML5 contents

Broadcasting Extension API
(Bookmark, Caption Ctrl etc.)

HTML5
Browse

OS, Device Driv c.

H

Server provider
Proprietary

HTML5 contents

HTML5
Browser

Broadcasting Extension API
(Bookmark, Caption Ctrl etc.)

OS, Device Driver et

Hardware

Standardized
APIs

Presentation
Layer

Platform
Layer

System
Layer

HTML5 contents become more stable
by standardizing Broadcasting Extension API into HTML5 Browser.

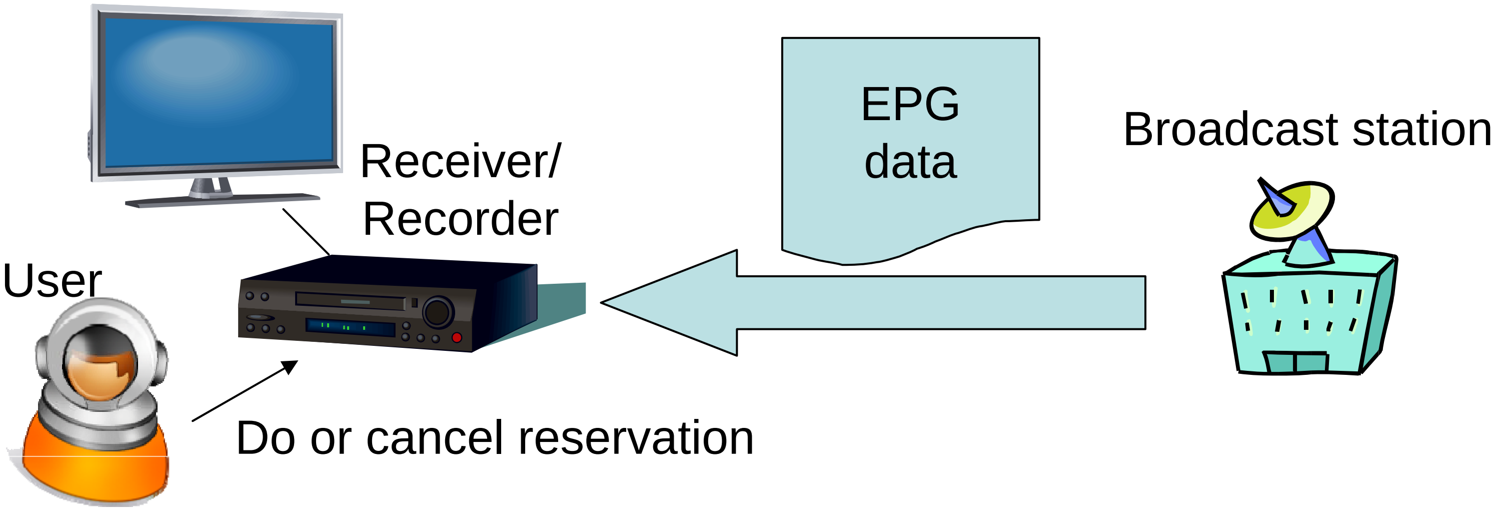
BML – Broadcasting Extensions API

- EPG API
  - EPG (Electronic Program Guide)
  - Program Index
  - Series Reservation
- VOD/Broadcasting base on Home Server API
  - Digital Broadcasting System based on Home Server (unique to Japan)
  - IPTV Control (VOD)
- Storage API
  - Persistent Storage
  - Local Storage (Directory/File System)
  - Registry (Ureg/Greg)
- Interactive/Presentation API
  - Caption Control
  - Bi-directional Communication
  - Browser Controls
  - Play Rom Sound
  - Timer
  - External Character (Gaiji)
- Other TV set Control API
  - Other Functions
  - External peripherals Control
  - Bookmark Control
  - Printing

The latest BML specification defines 229 TV-specific APIs.

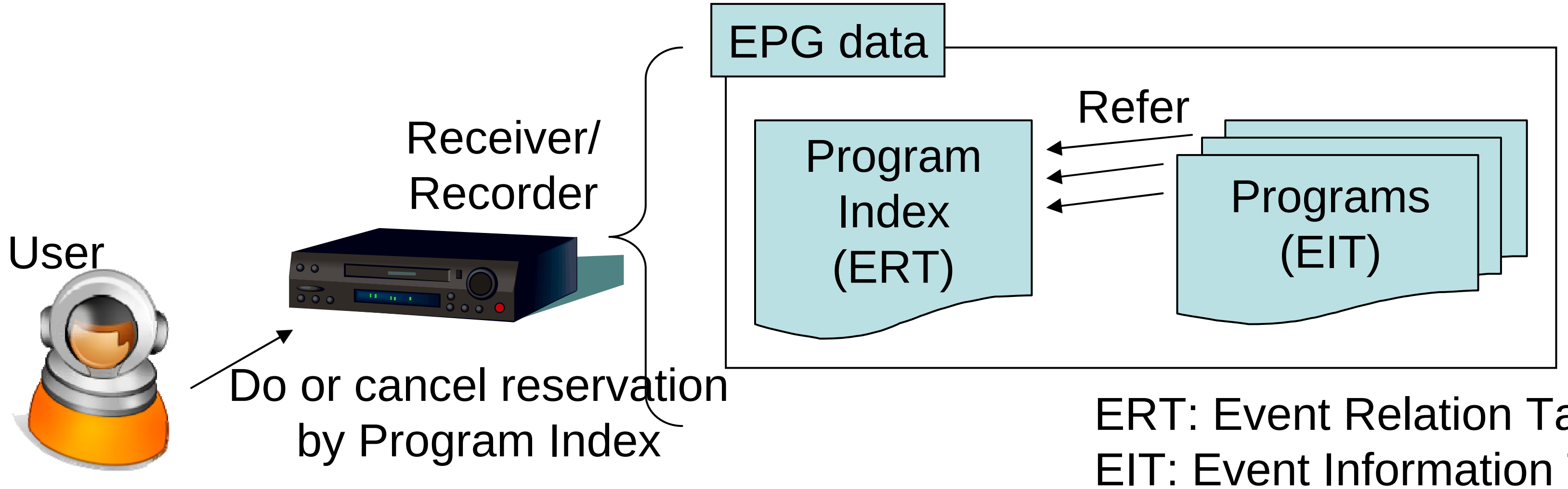
EPG (Electronic Program Guide)

- Summary
  - Do or cancel watching/recording reservation to make use of EPG information etc.
- Functions
  - Do or cancel reservation (including reservation confirmation)
  - Get program information (start time, end time, duration) from EPG data
  - Tune in service or other BML document during EPG operation


Receiver/
Recorder
User
Do or cancel reservation
EPG
data
Broadcast station

Program Index

- Summary
  - Do or cancel watching/recording reservation on program group basis. Program group is a kind of index data containing a set of program reference IDs. This feature make it simple for users to handle sets of programs.
    - Example: Original air and rerun one, a set of recommended programs etc.
- Functions
  - Do or cancel reservations on program group basis (including reservation confirmation)
  - Get program relation information from EPG data
  - Tune in EPG Display mode using a program group ID



EPG data

Refer

Program Index (ERT)

Programs (EIT)

Receiver/ Recorder

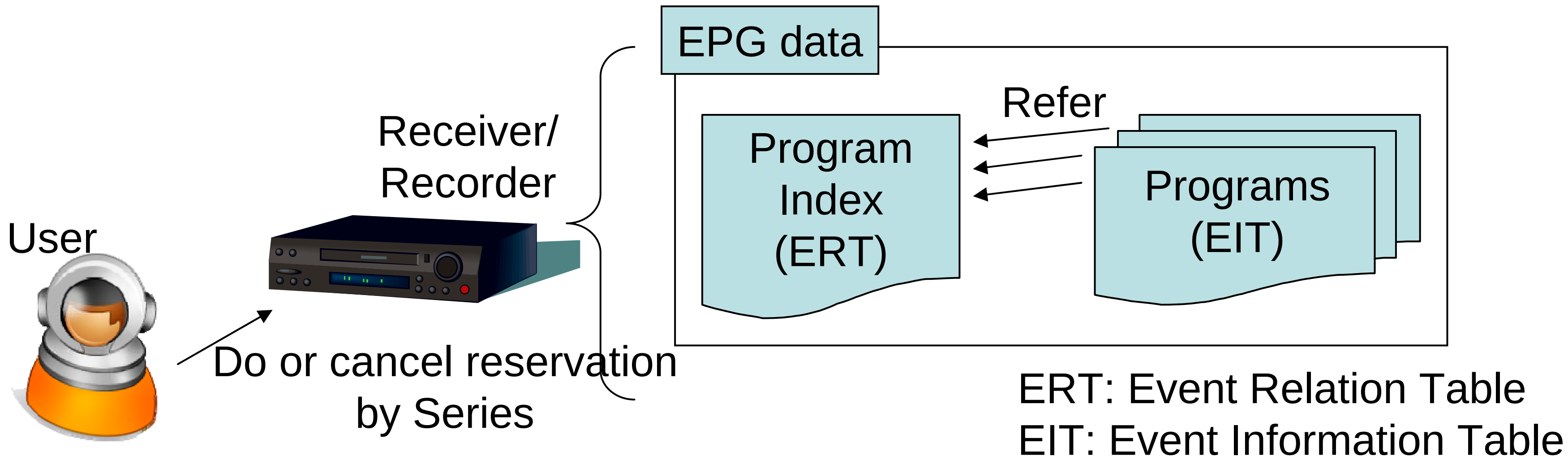
User

Do or cancel reservation by Program Index

ERT: Event Relation Table
EIT: Event Information Table

Series Reservation

- Summary
  - Do or cancel watching/recording reservation on a series basis. Series is a kind of index data containing a set of program reference IDs as a series. This feature make it simple for users to handle sets of programs.
    - Example: Drama series etc.
- Functions
  - Do or cancel watching/recording reservations on a series basis (including reservation confirmation)



User

Receiver/
Recorder

Do or cancel reservation
by Series

EPG data

Program
Index
(ERT)

Refer

Programs
(EIT)

ERT: Event Relation Table
EIT: Event Information Table

VOD/Broadcasting base on Home Server API

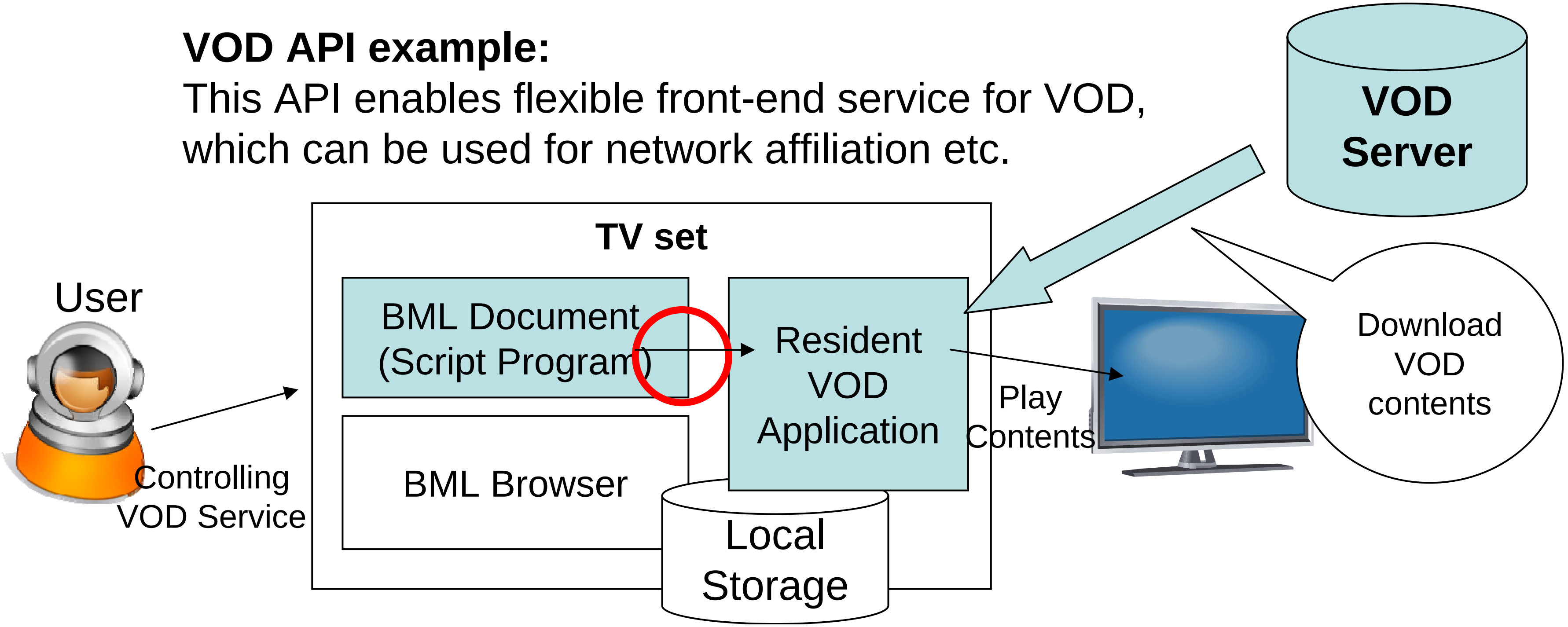
- Digital Broadcasting System based on Home Server (unique to Japan)
- IPTV Control (VOD)

VOD/Broadcasting based on Home Server API

- Summary
  - Controls VOD (Video On Demand) service from script programs in BML document.
  - In addition to ordinary VOD, supports Broadcasting based on Home Server [ARIB TR-B27] (unique to Japan)
- Functions
  - VOD API:
    - Get download-control information before starting VOD service
    - launch resident VOD application to play contents
  - Broadcasting based on Home Server:
    - Recording reservation, on-demand recording by user operation, license management of contents, CAS management, playback control, contents metadata control etc.

VOD API example:

This API enables flexible front-end service for VOD, which can be used for network affiliation etc.

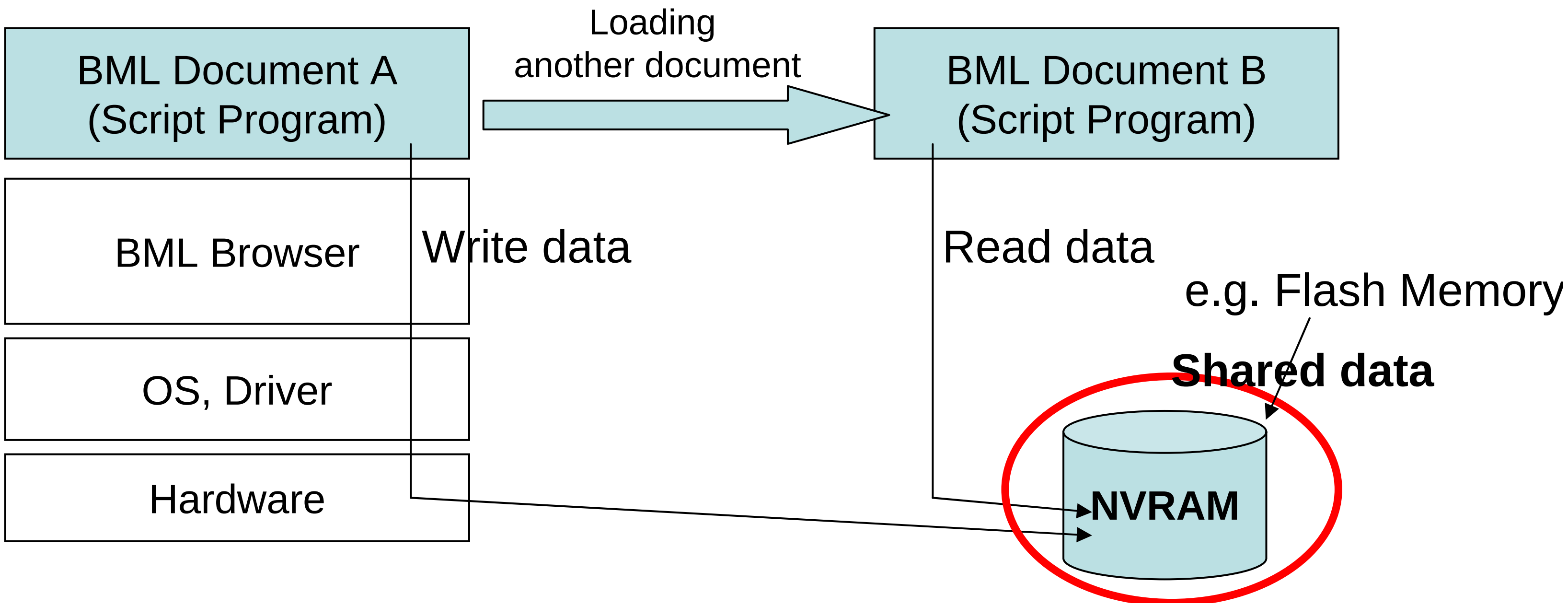

VOD Server
TV set
User
BML Document (Script Program)
Resident VOD Application
BML Browser
Local Storage
Controlling VOD Service
Play Contents
Download VOD contents

Storage API

- Persistent Storage
- Local Storage (Directory/File System)
- Registry (Ureg/Greg)

Persistent Storage

- Summary
  - Share data among different contents (BML documents) to store small chunk of data on a low-capacity storage like NVRAM (Non Volatile RAM) embedded in a receiver. For example, location, game score etc.
- Functions
  - Read/write data (String, Number, Array) on a low-capacity storage or copy/delete
  - Get the list of stored data
  - Get the total amount of free memory space in the receiver



BML Document A
(Script Program)

Loading
another document

BML Document B
(Script Program)

BML Browser

Write data

Read data

e.g. Flash Memory

OS, Driver

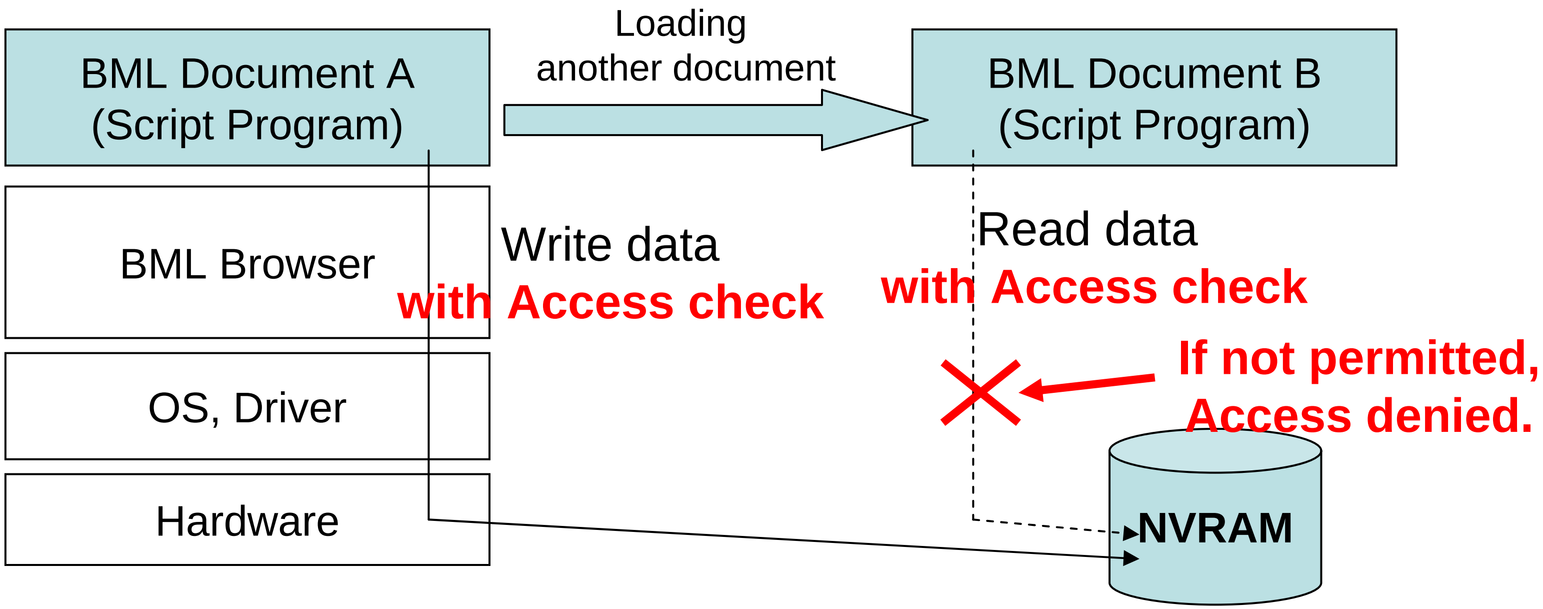
Shared data

Hardware

NVRAM

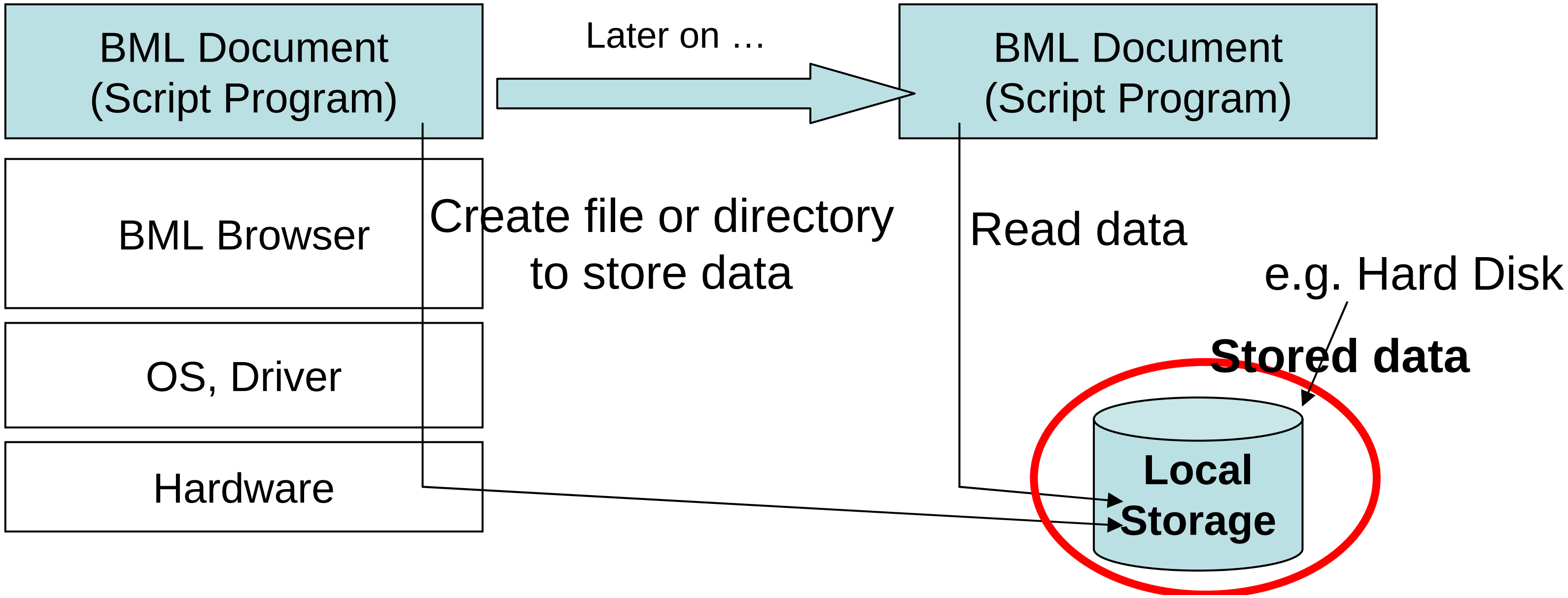
Persistent Storage with Access Control

- Summary
  - Share data with Access check among different contents (BML documents) to store small chunk of data on a low-capacity storage like NVRAM (Non Volatile RAM) embedded in a receiver. For example, location, game score etc.
- Functions
  - Read/write data (Array only) on a low-capacity storage with Access check
  - Set Access check info on stored data


BML Document A
(Script Program)
Loading
another document
BML Document B
(Script Program)
BML Browser
OS, Driver
Hardware
Write data
with Access check
Read data
with Access check
If not permitted,
Access denied.
NVRAM

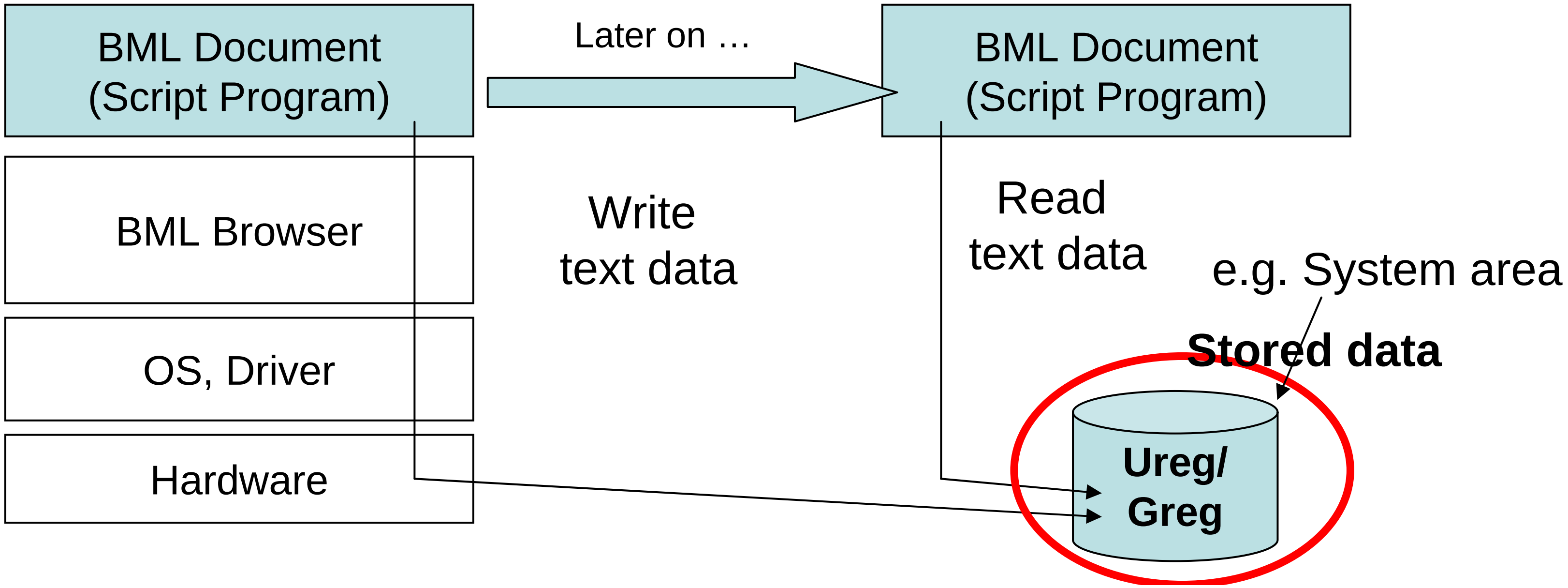
Local Storage (Directory/File System)

- Summary
  - Make contents more accessible and convenient for later-use to store broadcasting contents, BML documents and carousel data on local storage embedded in a receiver
- Functions
  - Read/write files and create directories
  - Copy directories/files and other operations
  - Get information (type, number, name, free space) about local storage
  - No delete/move operation or Access check mechanism


BML Document
(Script Program)
Later on …
BML Document
(Script Program)
BML Browser
Create file or directory
to store data
Read data
e.g. Hard Disk
OS, Driver
Stored data
Hardware
Local Storage

Registry (Ureg/Greg)

- Summary
  - Ureg/Greg are small shared memories on a TV set supporting BML. It is provided as variables directly accessed in ECMAScript code, not through API.
  - It is used for sharing temporary data (text) among multiple BML documents.
  - Ureg: keeps data until user change the channel t another.
  - Greg: keeps data until TV set is rebooted.
- Functions
  - Read/write 64 text data in array (256 Bytes for each)

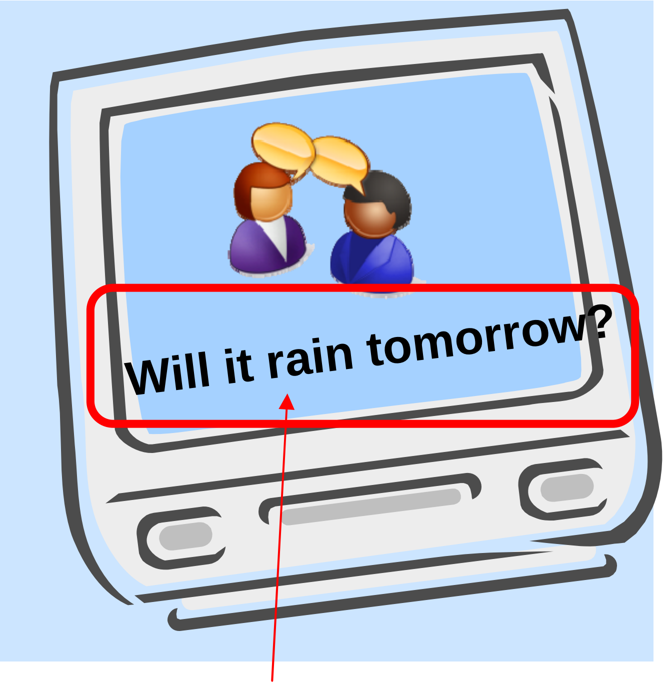

BML Document
(Script Program)
Later on …
BML Document
(Script Program)
BML Browser
Write
text data
Read
text data
e.g. System area
OS, Driver
Stored data
Hardware
Ureg/
Greg

Interactive/Presentation API

- Caption Control
- Bi-directional Communication
- Browser Controls
- Play Rom Sound
- Timer
- External Character (Gaiji)

Caption Control

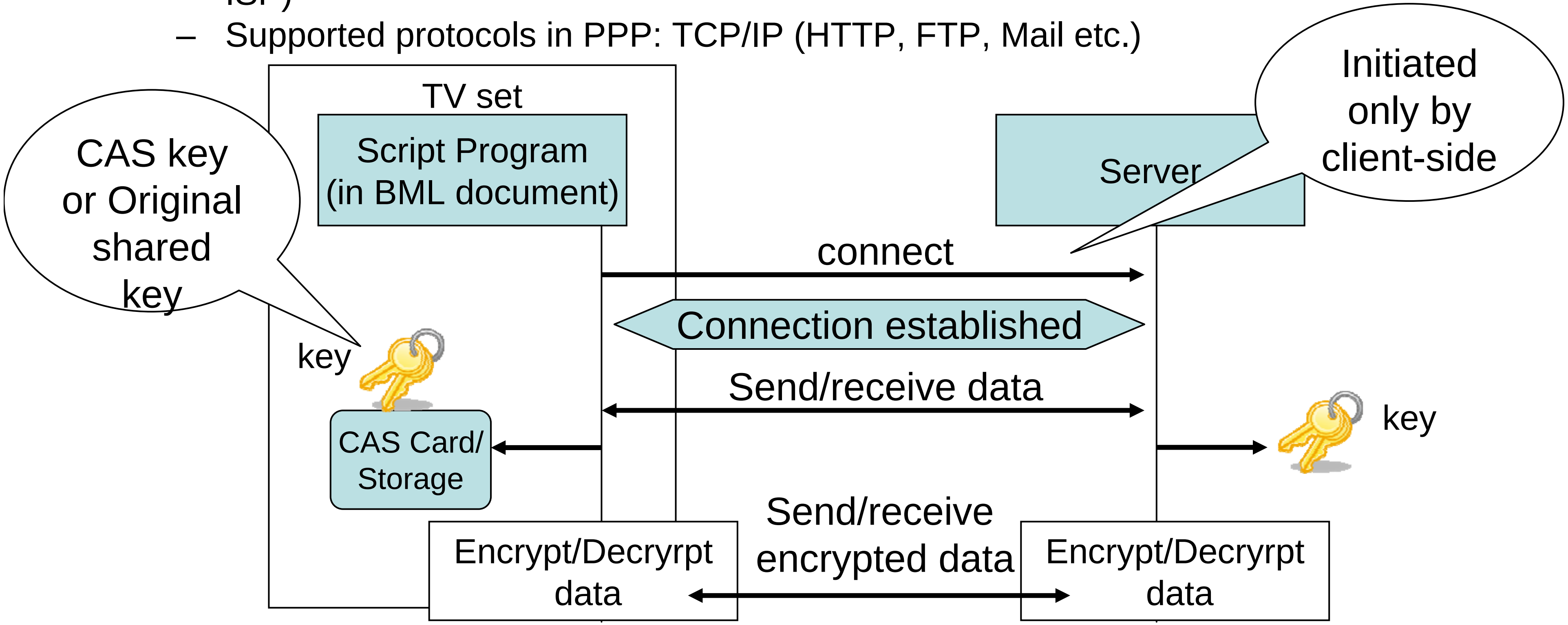
- Summary
  - Control closed caption display
- Functions
  - Select a closed caption (CC) component stream
  - Get a URI of selected CC component stream
  - Switch CC display status (On/Off) by language
  - Get the current CC display status
  - Etc.


Will it rain tomorrow?

CC display status: On
Language: Japanese

Bi-directional Communication

- Summary
  - Send and receive Text or Binary data between TV set and Server on the network. A script in the BML document can control bi-directional communication channel.
- Functions
  - Connect/Disconnect to a server/network
  - Send/receive text or binary data
  - Encryption supported (using a key registered in CAS card, or an original shared key)
  - Suuported connection types: Basic Procedure (e.g. x.28) over PSTN or PPP(via ISP)
  - Supported protocols in PPP: TCP/IP (HTTP, FTP, Mail etc.)



CAS key or Original shared key

TV set

Script Program (in BML document)

key

CAS Card/ Storage

Encrypt/Decryrpt data

Server

Initiated only by client-side

connect

Connection established

Send/receive data

key

Send/receive encrypted data

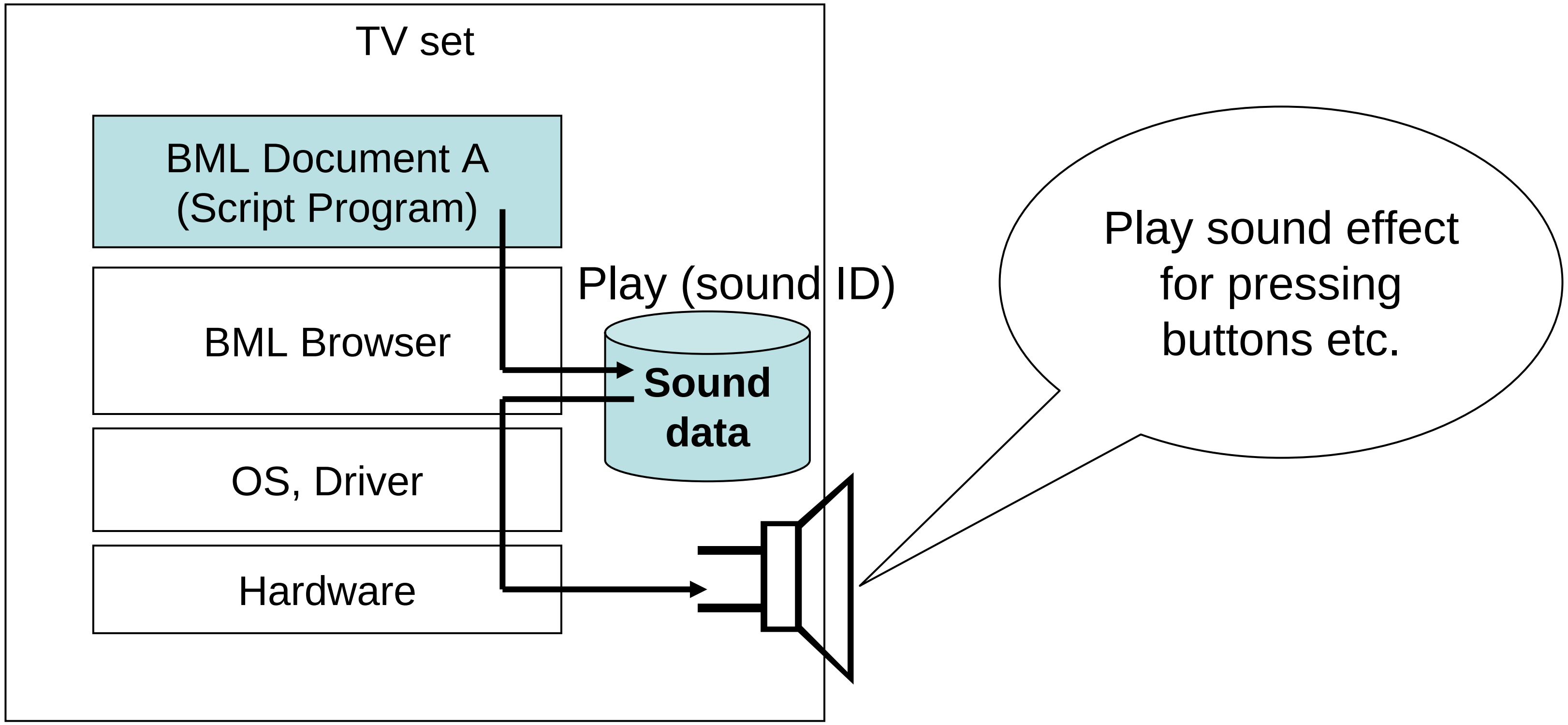
Encrypt/Decryrpt data

Browser Controls

- Summary
  - Bring some actions to browser
  - Get browser preference/status and its capabilities through the APIs.
- Functions
  - Get unique identifier of TV set, browser version, list of supported capabilities, currently executed program ID, URL of active document,
  - Change display area of browser on the full TV screen
  - Reload or quit the active document
  - Launch documents/applications or resident applications
  - Exit the current browser and launch another browser
  - Etc. (Browser Controls defines a lot of APIs except for the listed above)

Play Rom Sound

- Summary
  - Play sound data stored on TV set
- Functions
  - Star to play sound data by passing sound ID

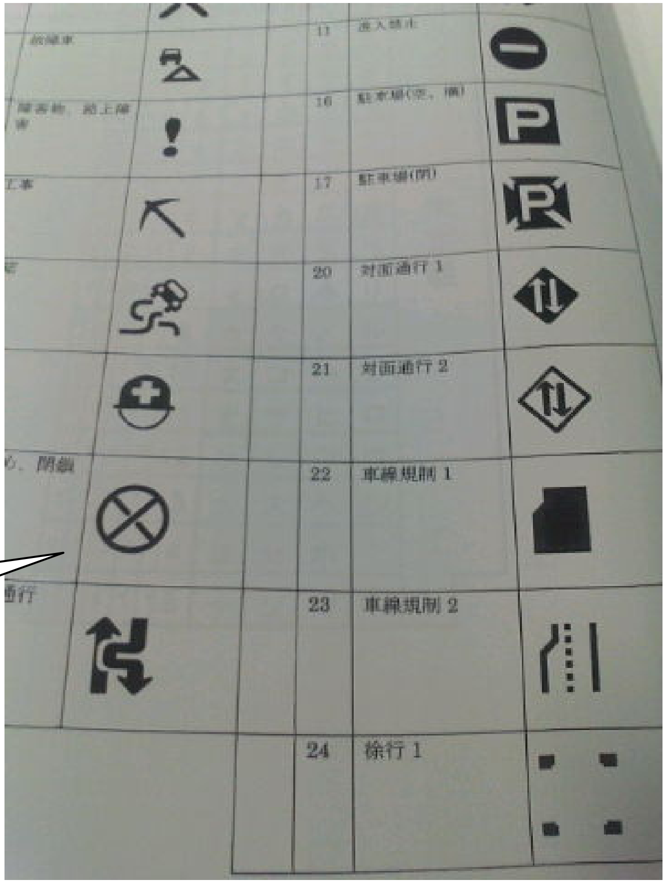

TV set
BML Document A
(Script Program)
BML Browser
OS, Driver
Hardware
Play (sound ID)
Sound
data
Play sound effect
for pressing
buttons etc.

Timer

- Summary
  - Extends the original JavaScript Timer API to provides sleep, pause, resume.
  - There are only setTimeout() and setInterval in the original JavaScript specification. So, coders usually implement their own sleep() to do a trick. This sometimes affects browser performance.
- Functions
  - Do sleep
  - Execute some code after a specified time-interval (milliseconds)
  - Keep triggering some code again and again

External Character (Gaiji)

- Summary
  - Manage external character setting on TV set to download its setting file from online server
- Functions
  - Set new external character setting by passing URL to setting file stored on the network
  - Clear the current external character settings



11	進入禁止
16	駐車場(空、満)
17	駐車場(閉)
20	対面通行 1
21	対面通行 2
22	車線規制 1
23	車線規制 2
24	徐行 1

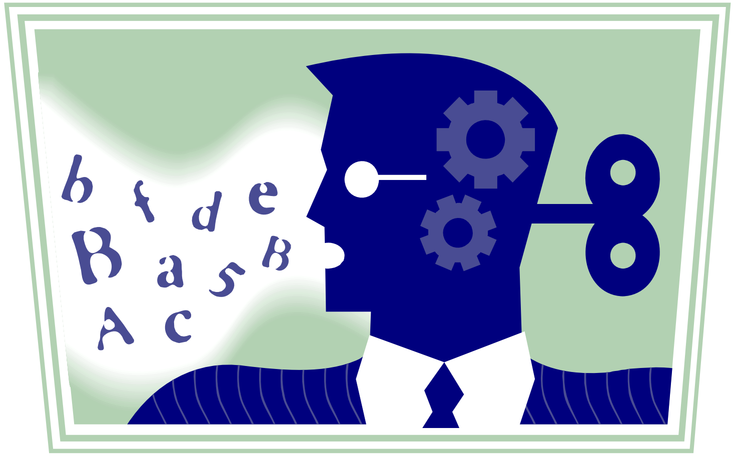
Pictorial characters etc. other than system-registered standard characters

Other TV set Control API

- Other Functions
- External peripherals Control
- Bookmark Control
- Printing

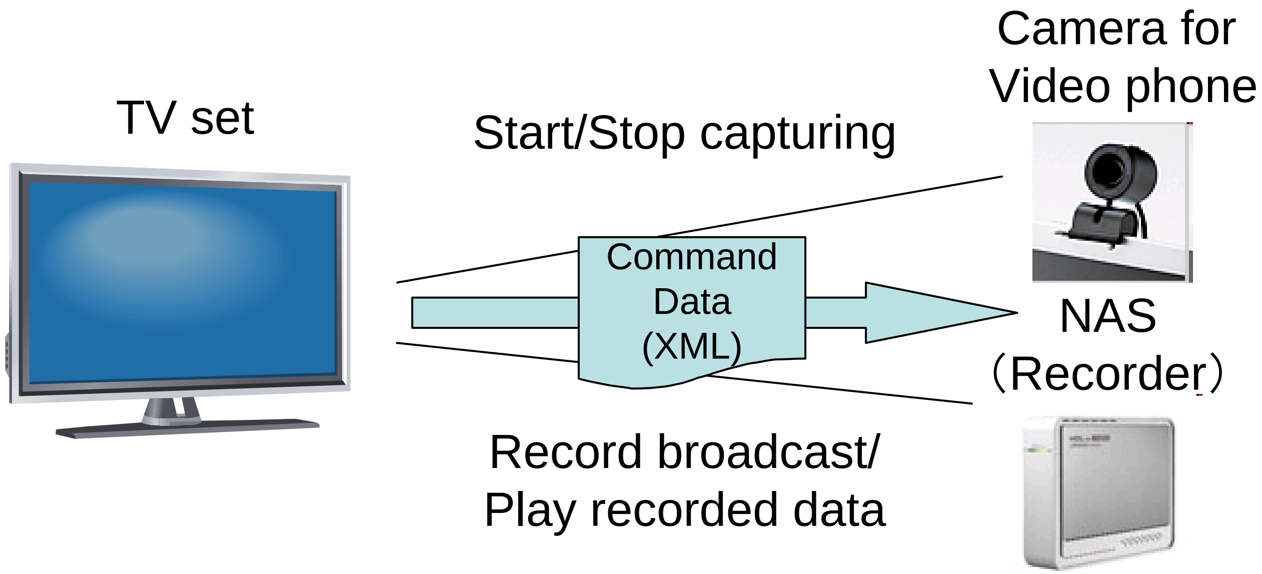
Other Functions

- Summary
  - Provides convenient tools for programmers to build their multi-media contents. For example, manipulating date, formatting number, make random number etc. These tools are not provided by the original JavaScript API.
- Functions
  - Manipulate date type variables. e.g. subdate(), adddate()
  - Format numerical type variables. e.g. insert “,” in every three digits for representing $ or Yen



External peripherals Control

- Summary
  - Communicate with external peripherals (eg. Camera, NAS) connected to TV set. It doesn’t depend on specific type of device or physical transports. This API provides general-purpose command/read data API and device-enumeration API.
- Functions
  - Enumerate currently available devices connected TV set
  - Send commands (described as an XML document) to external devices
  - Read date (formatted as an array) from external devices



TV set

Start/Stop capturing

Camera for
Video phone

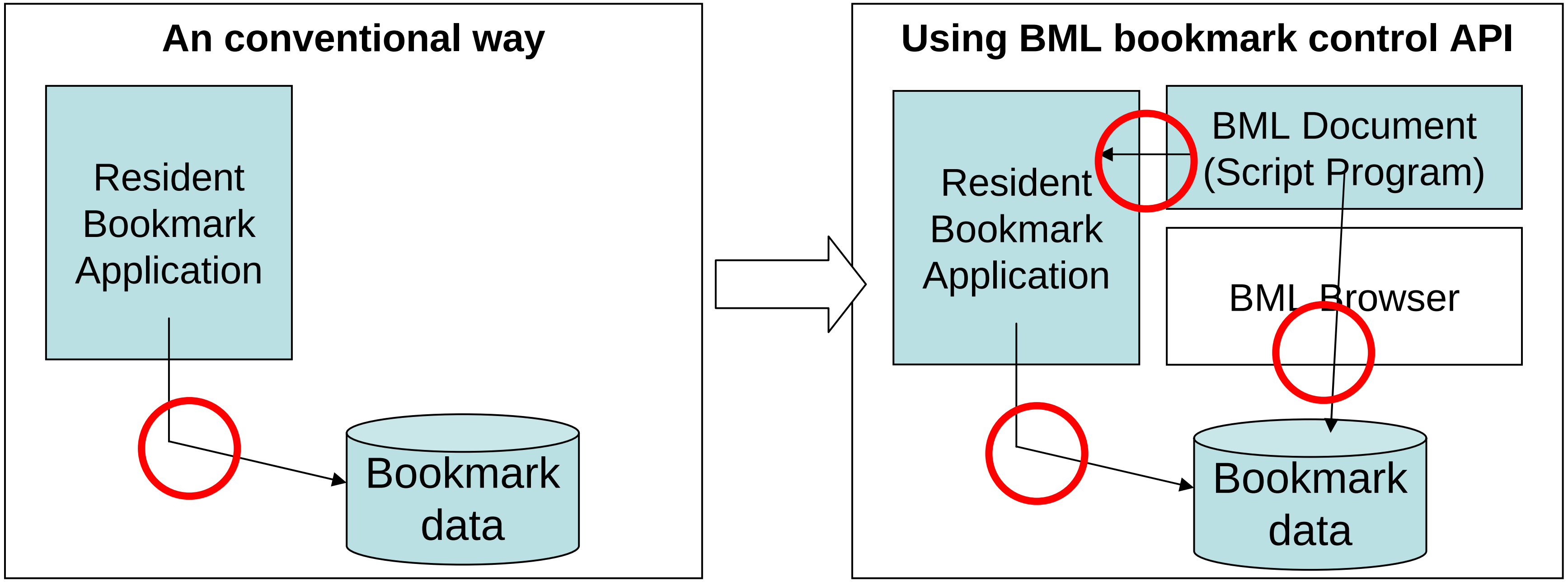
Command
Data
(XML)

NAS
（Recorder）

Record broadcast/
Play recorded data

Bookmark Control

- Summary
  - Enable script programs in BML documents to manage bookmark list with preferences. Each bookmark data can contain Expire date, Media Type etc. as well as basic information Title, URL.
- Functions
  - Read/Write bookmark data
  - Lock/unlock bookmark list to avoid unintended removal by users or programs
  - Delete bookmark data
  - Launch resident bookmark application



An conventional way

Resident Bookmark Application

Bookmark data

Using BML bookmark control API

Resident Bookmark Application

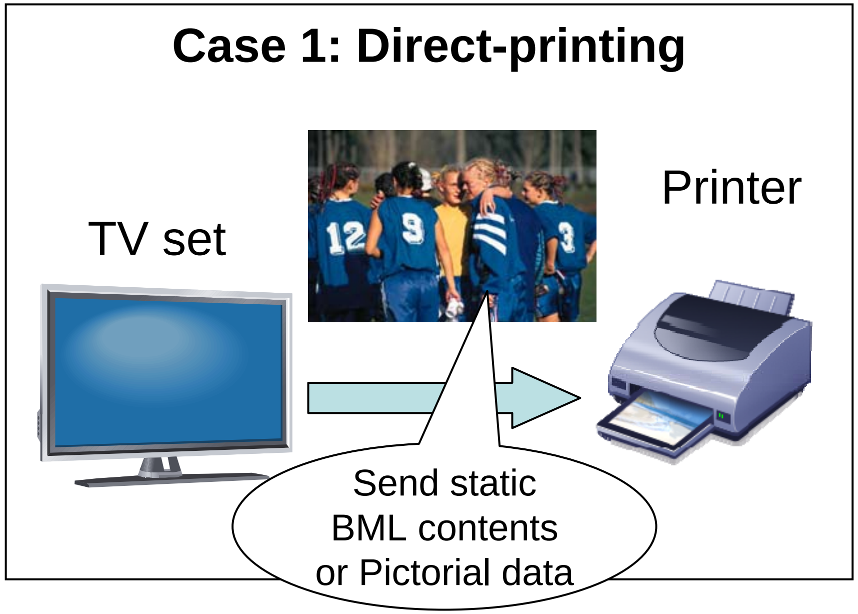
BML Document (Script Program)

BML Browser

Bookmark data

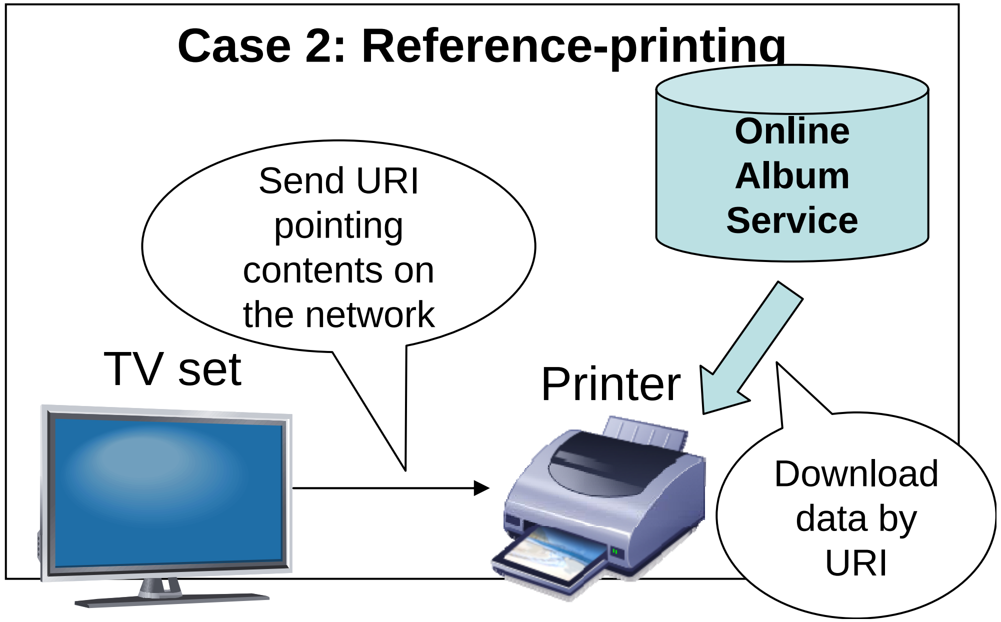
Printing

- Summary
  - Print static BML contents or images using printing device in home network.
  - This API supports both Direct-printing and Reference-printing.
  - In addition, save images on the inserted Memory Card.
- Functions
  - Send print commands to printing devices passing contents data or URIs pointing contents on the network.
  - Store image data on Memory Card



Case 1: Direct-printing

TV set
Printer
Send static BML contents or Pictorial data

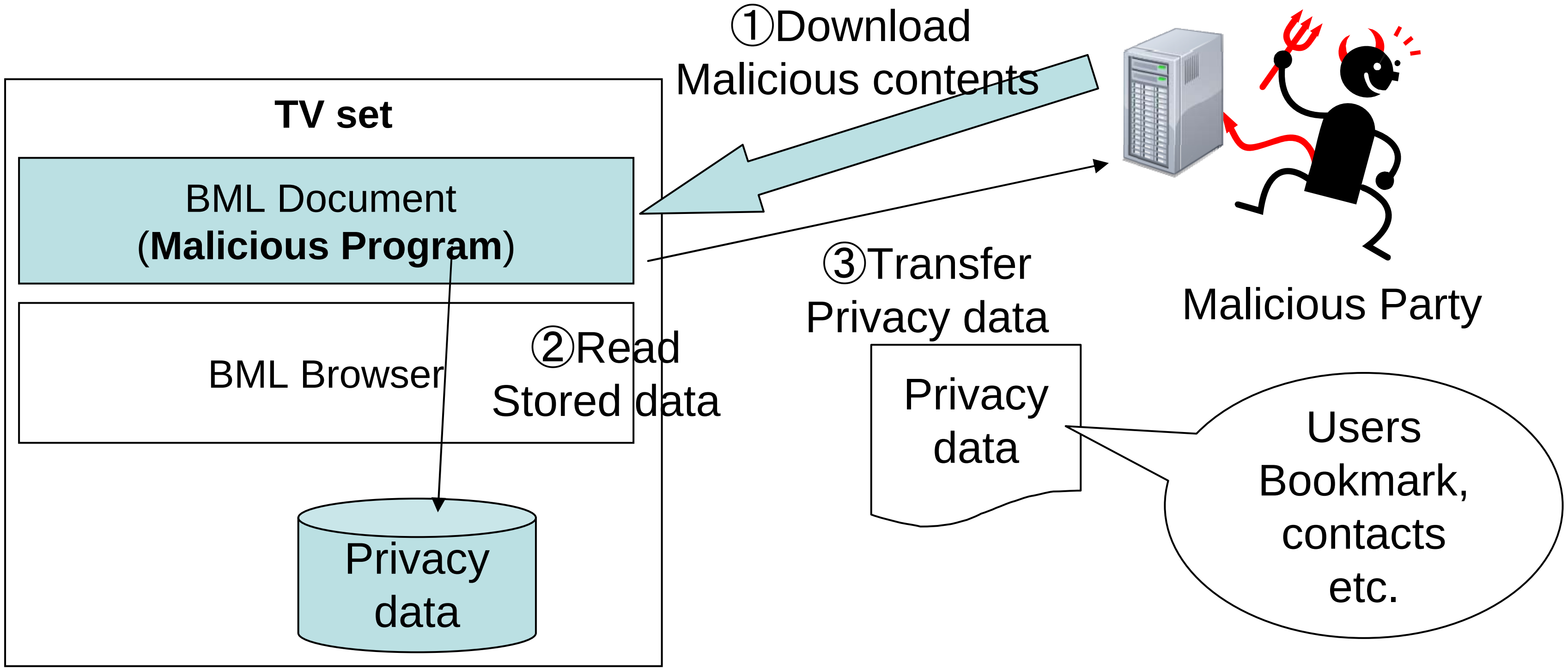


Case 2: Reference-printing

Online Album Service
Send URI pointing contents on the network
TV set
Printer
Download data by URI

Potential Privacy issues in TV platform APIs

TV platform API is useful and powerful to handle contents and data,
writing/reading and sending it through the network.
On the other hand, if security management is poor,
these APIs can also be exposed to
exploitations by malicious contents loaded on the platform.



①Download
Malicious contents

TV set

BML Document
(**Malicious Program**)

BML Browser

②Read
Stored data

Privacy
data

③Transfer
Privacy data

Privacy
data

Malicious Party

Users
Bookmark,
contacts
etc.

Privacy Information stored on TV

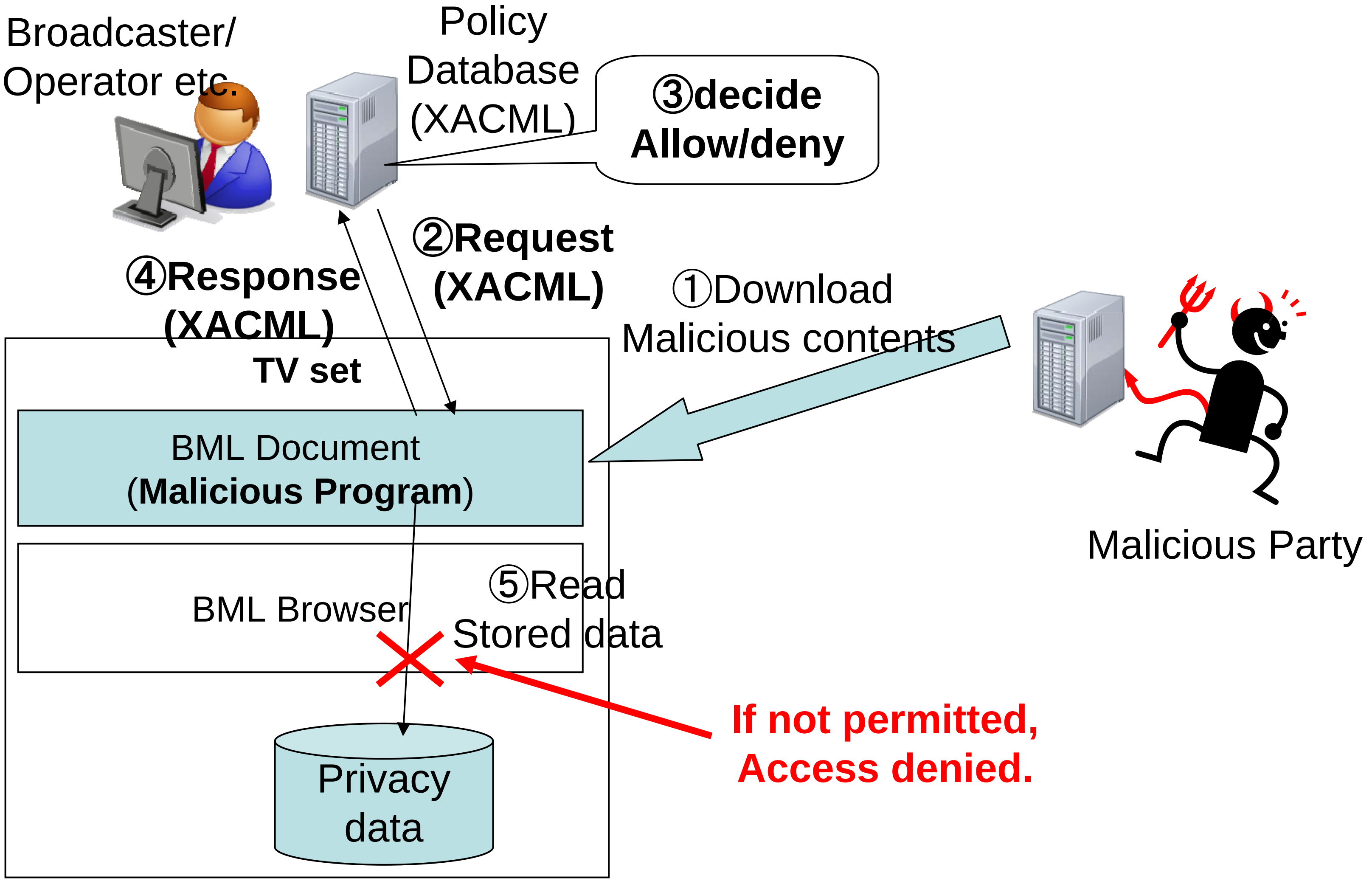
- EPG-related data selection history
- Recorded broadcast contents and its metadata
- Contacts for Video phone etc.
- Bookmarks
- Visited pages (browsing history)
- Location (postal address etc.)
- Etc.

The common privacy protection framework
is preferable to application execution environment.

Privacy protection solution

- Policy-based Access Control Framework -

Example: Applying XACML to TV platform API



Broadcaster/
Operator etc.

Policy
Database
(XACML)

③decide
Allow/deny

②Request
(XACML)

④Response
(XACML)

①Download
Malicious contents

Malicious Party

TV set

BML Document
(**Malicious Program**)

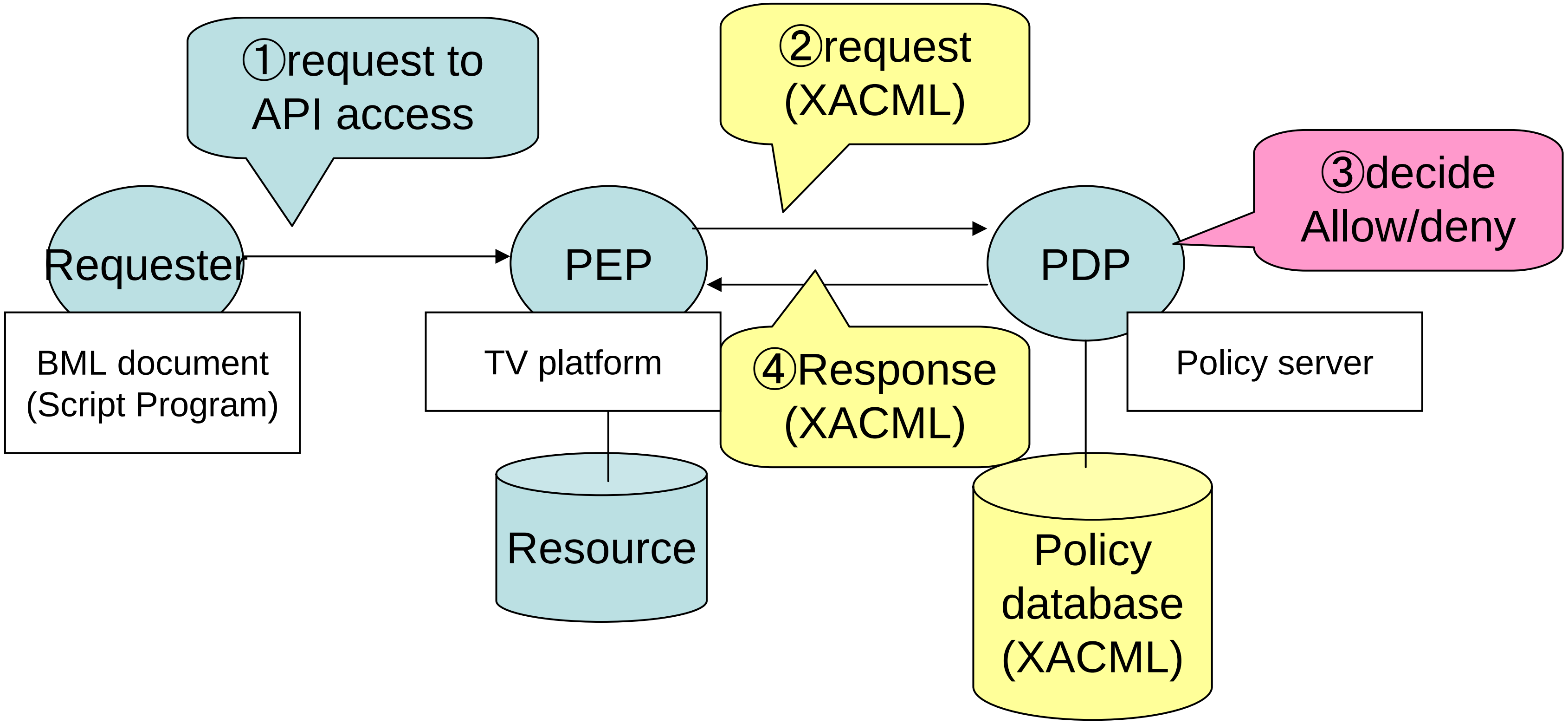
BML Browser

⑤Read
Stored data

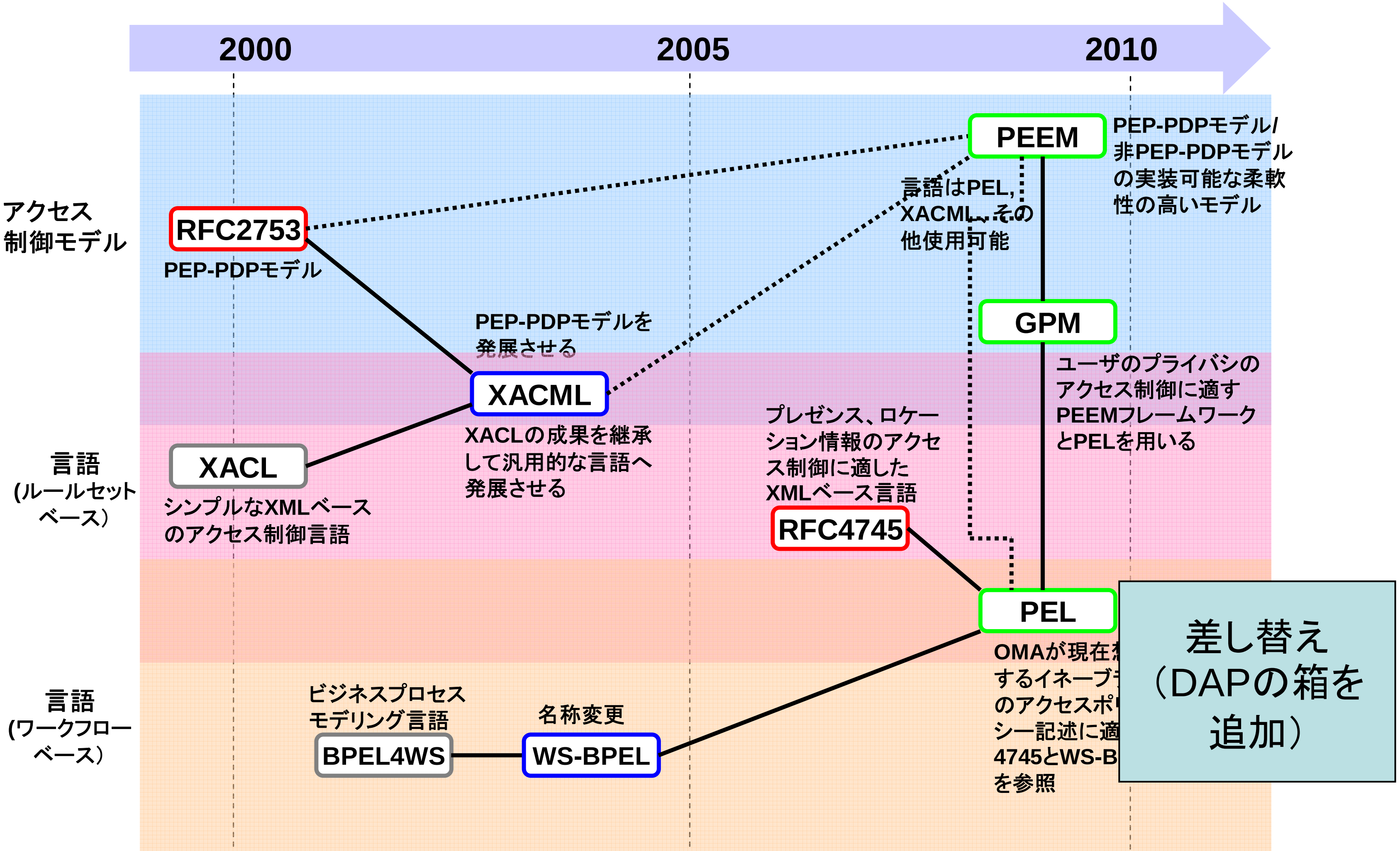
Privacy
data

If not permitted,
Access denied.

XACML Framework (For reference)


①request to API access
②request (XACML)
③decide Allow/deny
Requester
PEP
PDP
BML document (Script Program)
TV platform
④Response (XACML)
Policy server
Resource
Policy database (XACML)

Policy-based Access Control Standards



2000
2005
2010

アクセス
制御モデル

言語
(ルールセット
ベース)

言語
(ワークフロー
ベース)

RFC2753
PEP-PDPモデル

XACL
シンプルなXMLベース
のアクセス制御言語

PEP-PDPモデルを
発展させる

XACML
XACLの成果を継承
して汎用的な言語へ
発展させる

ビジネスプロセス
モデリング言語
BPEL4WS

名称変更
WS-BPEL

プレゼンス、ロケー
ション情報のアクセ
ス制御に適した
XMLベース言語
RFC4745

PEEM
PEP-PDPモデル/
非PEP-PDPモデル
の実装可能な柔軟
性の高いモデル

言語はPEL,
XACML、その
他使用可能

GPM
ユーザのプライバシの
アクセス制御に適す
PEEMフレームワーク
とPELを用いる

PEL
OMAが現在
するイネーブ
のアクセスポ
シー記述に適
4745とWS-B
を参照

差し替え
（DAPの箱を
追加）

Policy-based Access Control framework concept has
about 10-year history from XACL to DAP (based on XACML).

Conclusions and Proposal

- We propose that W3C should do the following actions in Web on TV:
  - Start from the API functionalities requirement extracting from time-proven TV platform API such as BML
  - Consider applying policy-based access control framework to TV platform API for user privacy data protection