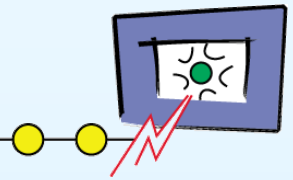

Heterogeneous Multimedia Delivery: A Terminal Approach

Terminal Middleware

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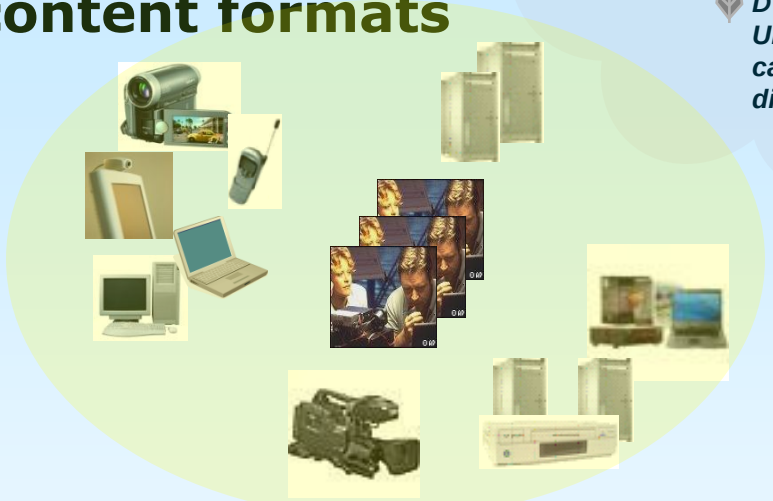
ENTHRONE WP7
EPFL LSM Multimedia Architecture Research Group
WIAMIS' 08, May 07 2008
Klagenfurt, Austria

Heterogeneity problem

different types of core and access networks

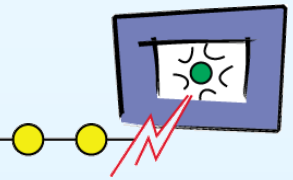
DVB-T/S/C/H
UMTS, GPRS,
cable, ADSL,
dial-up, ...

diversity of content formats



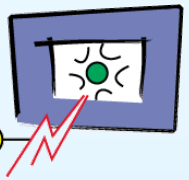
diversity in client devices

Challenges

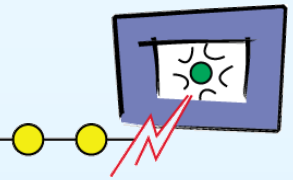


- **Universal Media Access (UMA) concept**
  - benefits from the use of open and common formats;
  - useful and complete descriptions about the context of usage;
  - new forms of presenting and allowing the consumption of the content.
- **MPEG-21**
  - a complex and complete open framework to address the UMA requirements, among which
    - Digital Item “model” (DID, DIDL, DII)
    - Digital Item Adaptation tools (DIA)
    - Rights Expression Language (REL)
- Still, many decisions to take on how to use and combine available tools

WP-7 Review: ENTHRONE 1 Achievements



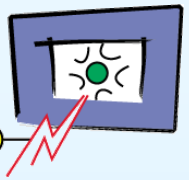
- **First version of a user terminal architecture supporting QoS management based on MPEG-21 tools:**
  - Content management through MPEG-21 Digital Items handling;
  - Implementation of MPEG-4 Scalable Video Decoding (SVC);
  - Licenses management through MPEG-21 REL;
  - Content protection through ISMA/MPEG-4 IPMPX support
  - QoS management through local perceived QoS metric and alerts management;
  - Terminal and Network description through MPEG-21 DI Adaptation descriptors.



ENTHRONE 2 Goals and Achievements:

- Redesign of WP7 User Terminal Architecture for enabling:
  - **Portability** on all classes of terminals (PC, Set-Top Boxes, Pocket PC, Smart phones, etc ...);
  - **Wider content and distribution scenario support:** streaming of DI (MPEG-2, MPEG-4 AVC, MPEG-4 SVC), streaming of LASeR content, streaming of ESG content;
  - **Support of different (and new) classes of QoS Probes:** perceived QoS for video, perceived Qos for audio, RTP packet loss rate, RTP packet loss weighted statistics;
  - **Standard Modules and APIs for:** QoS Metadata Management (MPEG-21 compliant modules for UED/UCD), MPEG-21 DI content browsing, MPEG-21 QoS probe metadata handling, MPEG-21 IPMP modules;

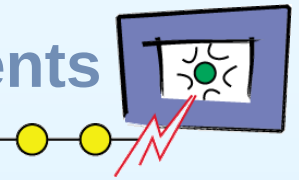
WP-7: ENTHRONE 2 Goals and Achievements



Portability:

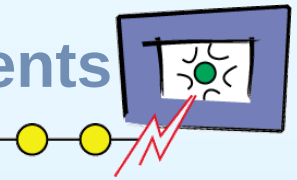
- **Module Design and Module APIs supporting portability on different OS:** (Win, WinMob, Symbian);
- **Distributed architecture (client-server) for reducing complexity on limited resource terminals (mobile terminals):**
  - Distributed DI Browser (low complexity DI browsing client side);
  - Distributed Terminal Device Manager (TDM) for the handling of all communications between EIMS and Terminal enabling reduced complexity for: User Interface, MPEG-21 IPMP processing;
- **Modular Design:**
  - Plug-in of (standard optimized) web browser;
  - Unified QoS probes APIs with different content players and TDM;

WP-7: ENTHRONE 2 Goals and achievements



Wider content and distribution scenario support:

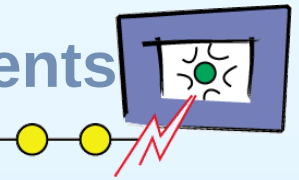
- Terminal Architecture and APIs supporting:
  - Audio-Video MPEG players (MPEG-2, MPEG-4 SP, MPEG-4 AVC, MPEG-4 SVC);
  - LASER players (PorTiVity Player);
  - ESG SVG Player (DVB-H, 3G);



Support of different (and new) classes of QoS Probes:

- 5 QoS probes currently supported implementing different QoS measures with different trade-offs between performance and complexity:
  - RTP packet level (2 probes implemented and supported, BSoft and TID approaches)
  - Perceived video quality (2 probes implemented and supported, TDF and R&S approaches)
  - Audio perceived quality (1 probe supported and implemented), UPB

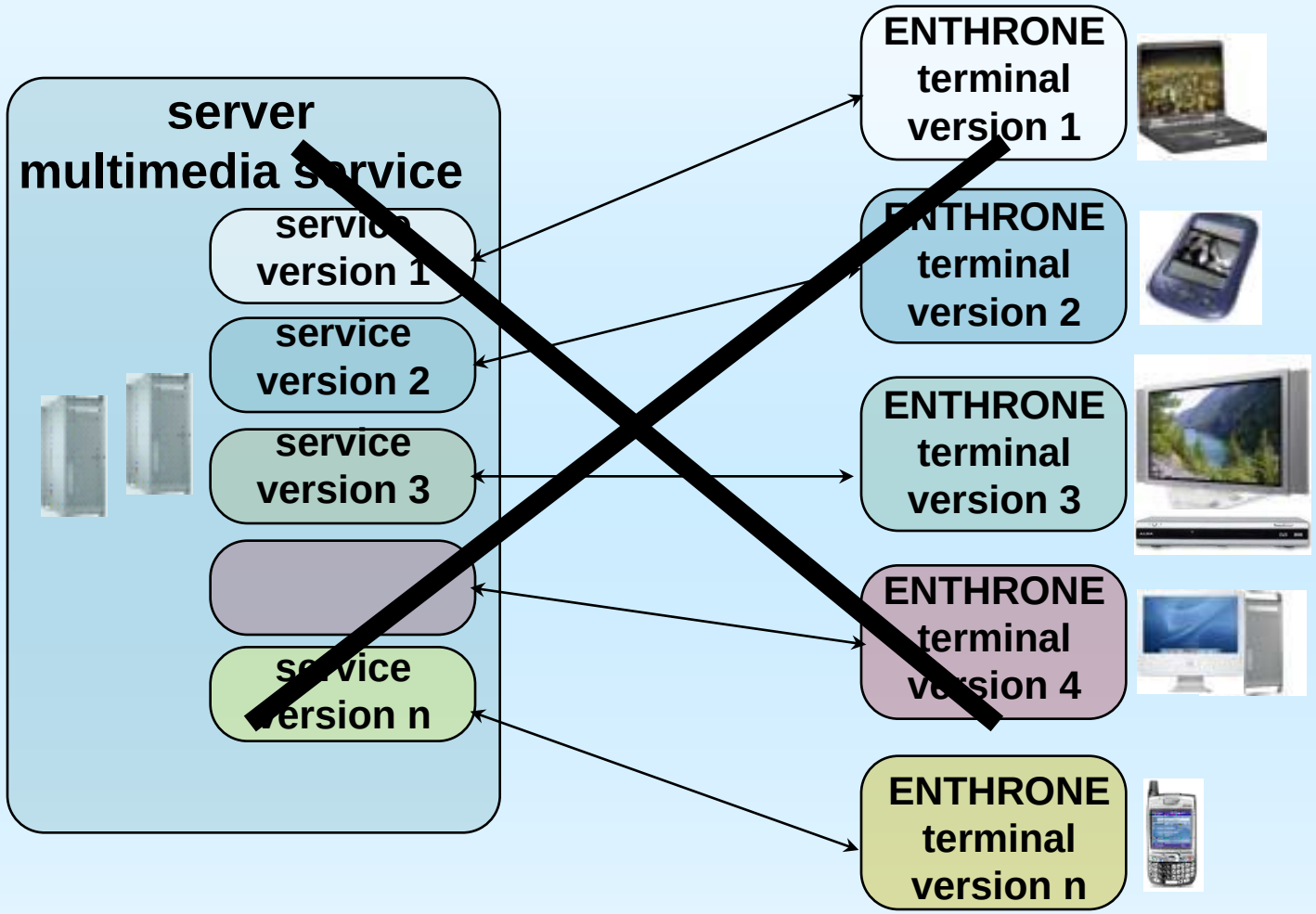
WP-7: ENTHRONE 2 Goals and Achievements



Summary of advances over the state of the art:

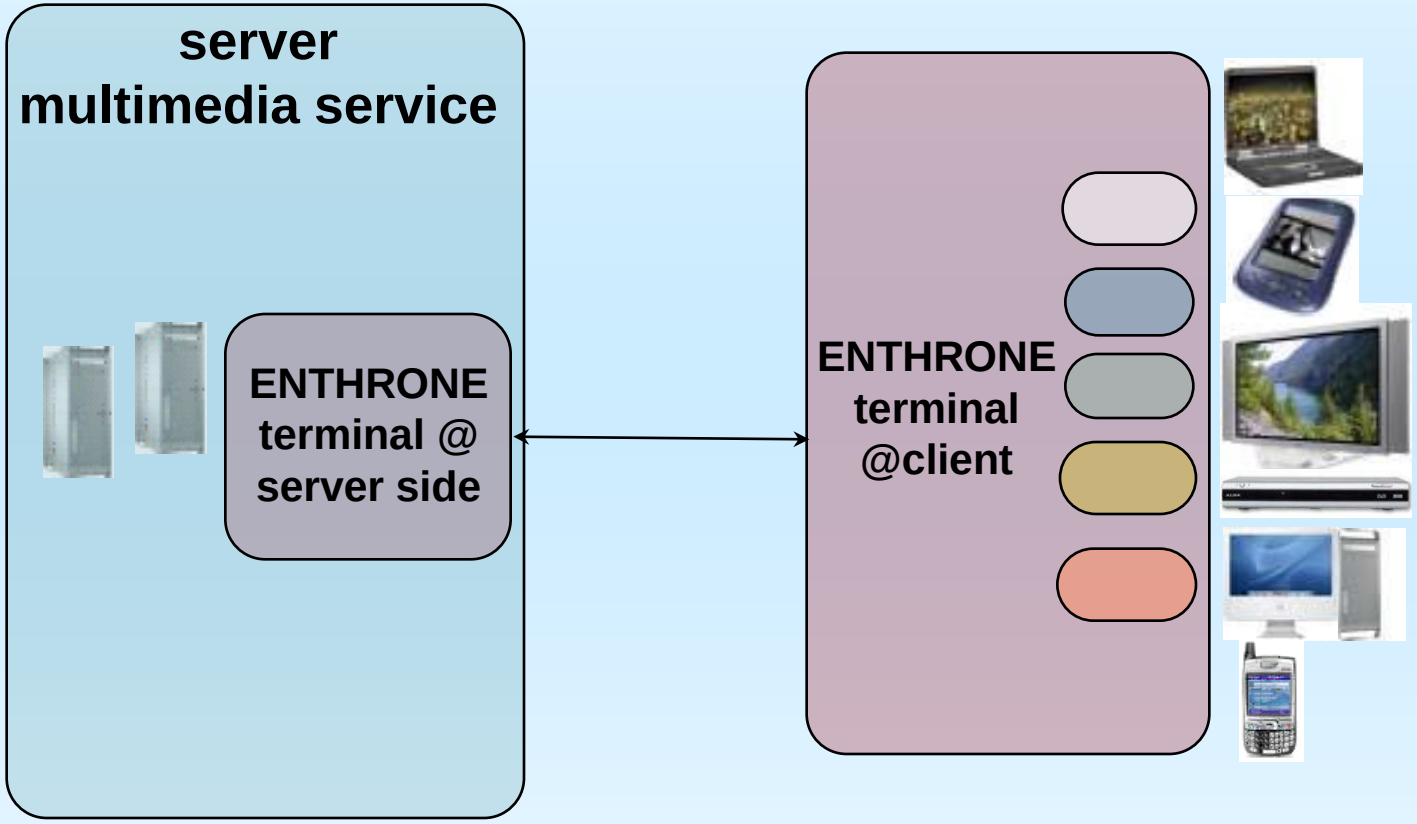
- Novel and improved approach to E2EQoS management with monitoring across the delivery chain (specifically PQoS for WP07 Terminal)
- Provide feedback information based on PQoS measurements to EIMS for dynamic adaptation purposes
- Novel approach to “Adaptation” based on Scalable Content (scalability used to provide the best possible service given the terminal & network constraints)
- Positive feedback for short term exploitation of QoS Monitoring Tools (results from Enthrone 1 already commercially exploited and further added value with R&D in Enthrone 2)

Approaches


server
multimedia service
service version 1
service version 2
service version 3
service version n
ENTHRONE terminal version 1
ENTHRONE terminal version 2
ENTHRONE terminal version 3
ENTHRONE terminal version 4
ENTHRONE terminal version n

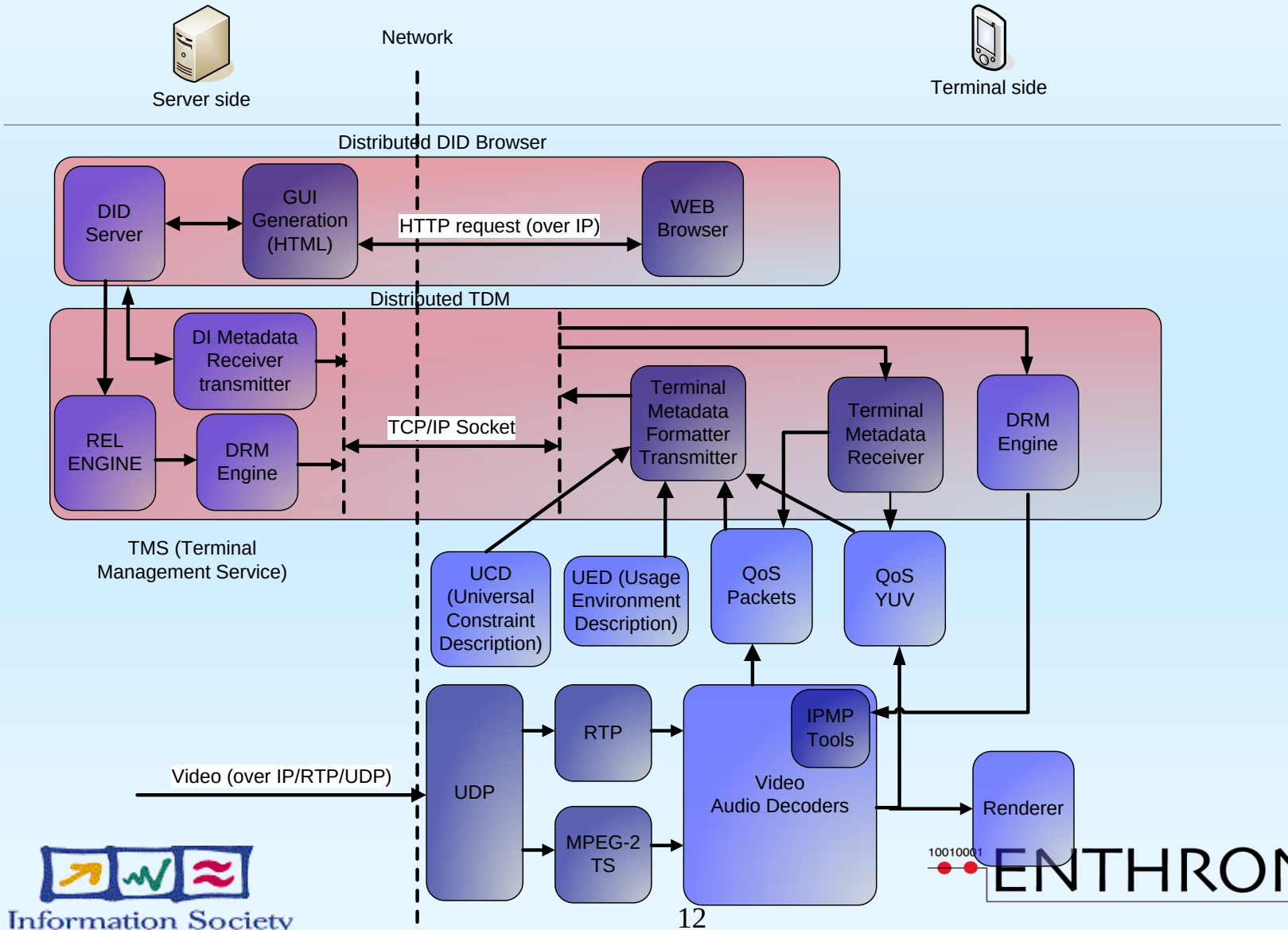
Approaches

- **Approaches**



WP-7: ENTHRONE 2 Achievements

ENTHRONE 2 Terminal Architecture



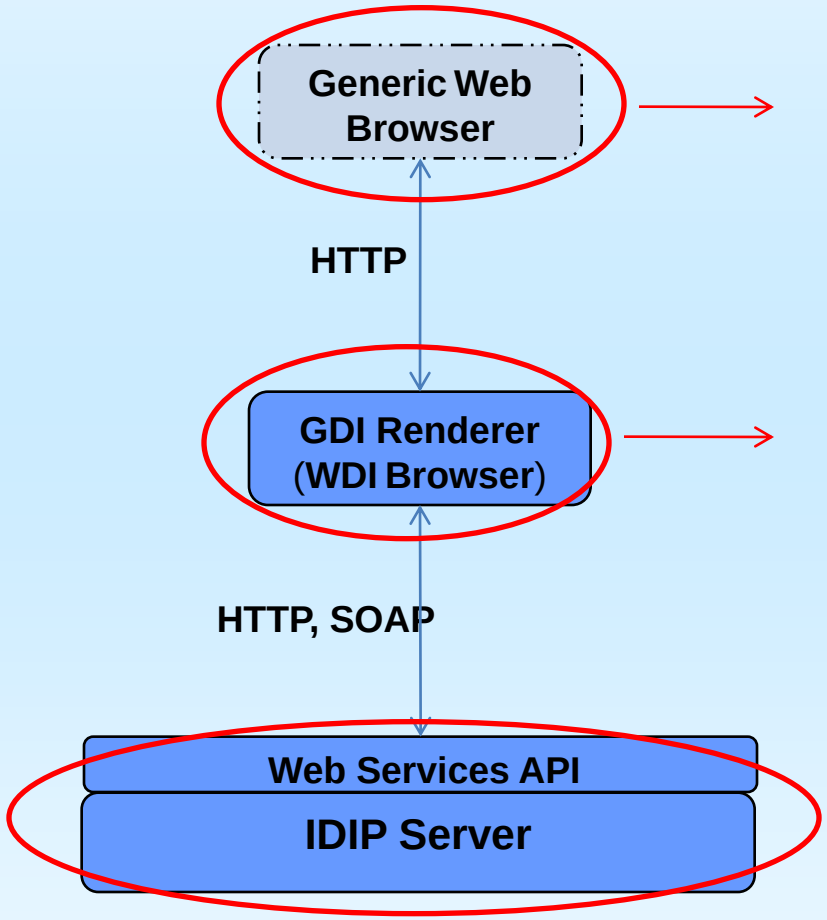
WP-7: ENTHRONE 2 Achievements

ENTHRONE Terminal Configurations

ENTHRONE TERMINAL CONFIG	OS Platform			Content Browsing		Streaming Content	QoS Probes Supported
	Win	Win Mob	Symbian	MPEG-21	ESG		
BSoft Player + DIB	YES	YES	YES	YES	NO	AVC, SVC, MPEG-2, …	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)
LABRI Player + DIB	YES	YES	NO	YES	NO	AVC, SVC, MPEG-2, …	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)
BSoft Player + SVG Renderer	YES	YES	YES	NO	YES	AVC, SVC, MPEG-2, …	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)
LABRI Player + SVG Renderer	YES	YES	NO	NO	YES	AVC, SVC, MPEG-2, …	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)
PorTiVity (GPAC) Player	YES	YES	YES	YES	NO	AVC, LASeR, MPEG-2, …	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)
DVB-H + 3G	YES	YES	YES	NO	YES	AVC, SVC	RTP (BSoft, TID), PQ (TDF, R&S) Audio PQ (UPB)

WP-7: ENTHRONE 2 Achievements

DDI Browser "distributed" architecture



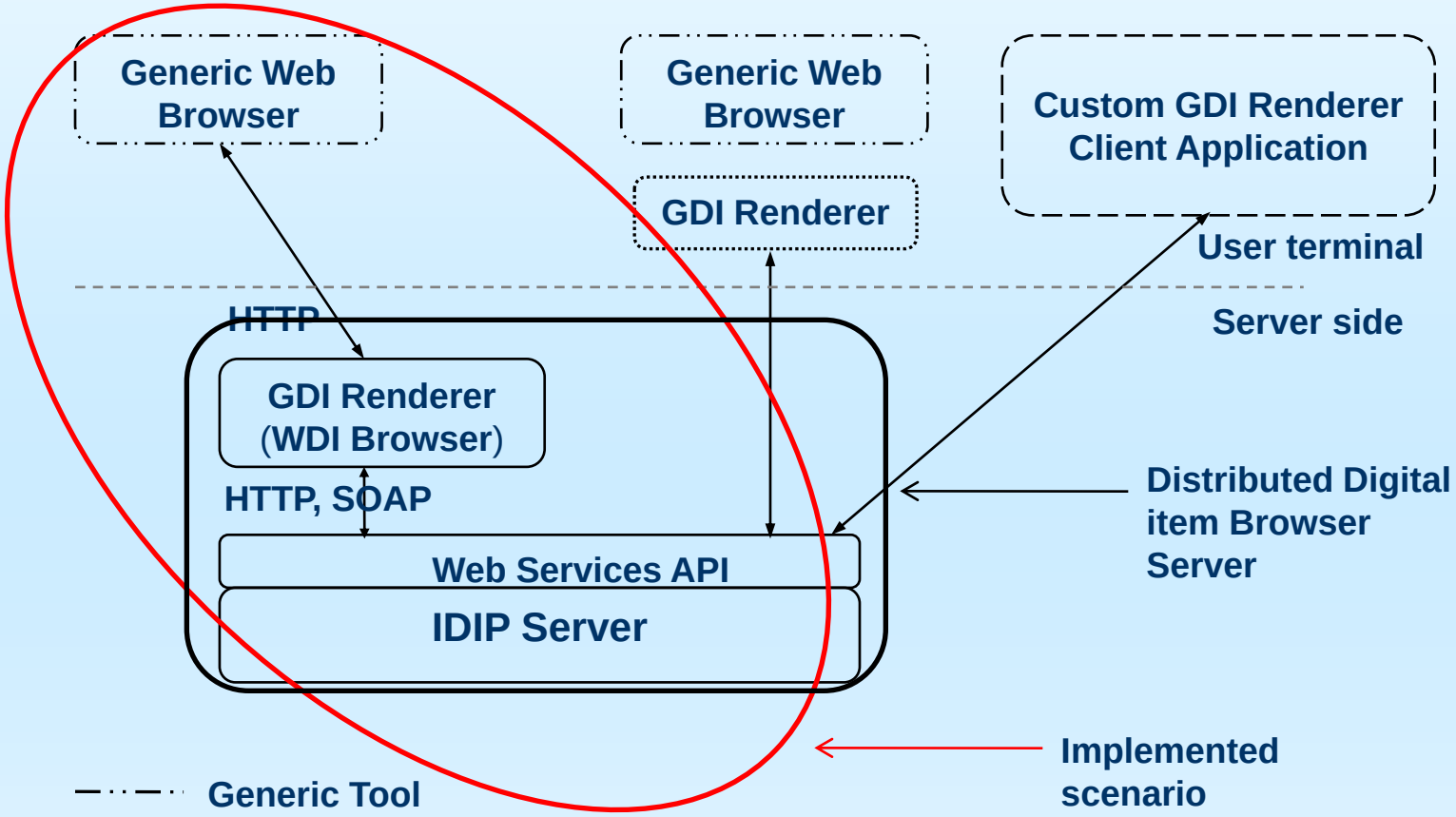
Aplication used by the end-user to access the system front-end (Off-the-shelf component)

Generates the graphic presentation to be shown to the user;
Captures end-user interactions
(ENTHRONE component)

Parses a DID and filters information for the end-user;
Processes end-user interactions
(ENTHRONE component)

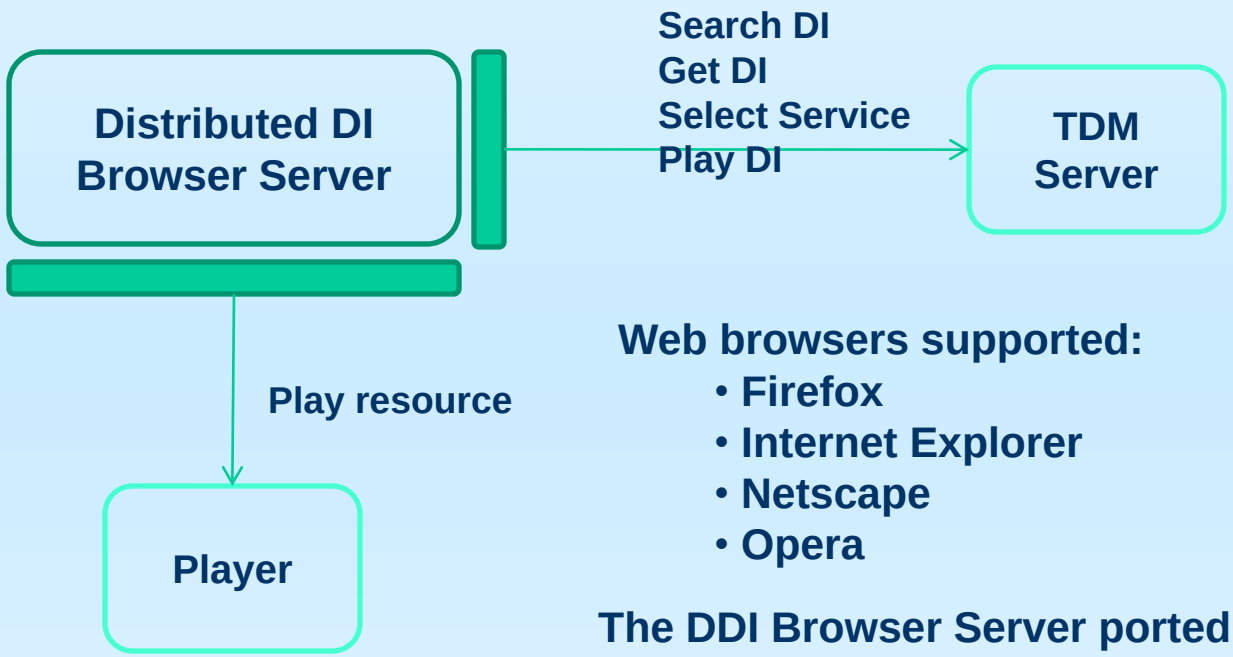
WP-7: ENTHRONE 2 Achievements

DID Browser deployment configurations



WP-7: ENTHRONE 2 Achievements

DDI Browser interaction with other ENTHRONE modules



Web browsers supported:

- Firefox
- Internet Explorer
- Netscape
- Opera

The DDI Browser Server ported so far on:

- Win
- WinMob
- Linux

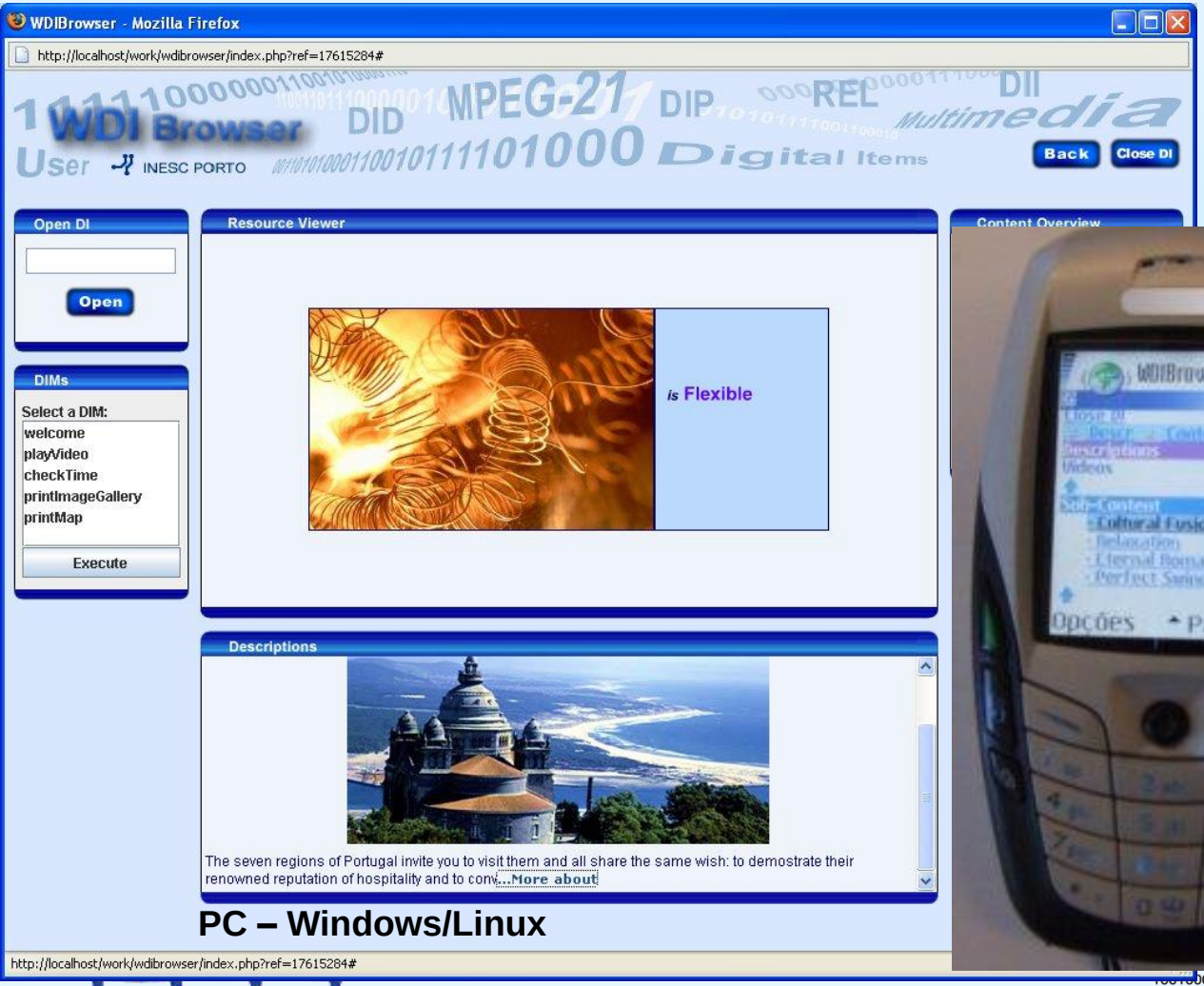
WP-7: ENTHRONE 2 Achievements

DDI Browser in ENTHRONE Terminal

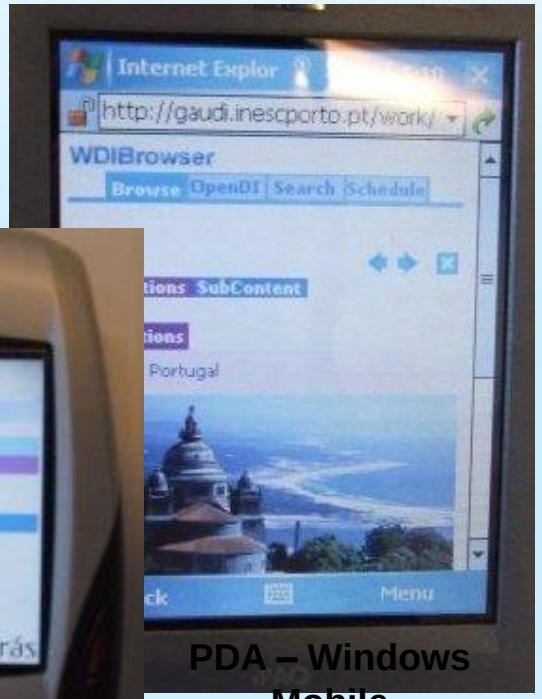
- **Achievements:**
  - Generic browsing of Digital Items
  - Integration with the Terminal Device Manager
  - Graphic integration of the Terminal Player in the DDI Browser GUI
  - OS support (Win, WinMob and Linux)
- **Next steps:**
  - Support for DRM related metadata
  - Support for different query formats (MPEG-7 query format)
  - Support for Search relevance feedback
  - Support for MPEG-21 Event Report
  - Support for MPEG-21 Digital Item Processing
  - Improved support for multiple sessions

WP-7: ENTHRONE 2 Achievements

DDI Browser in ENTHRONE Terminal



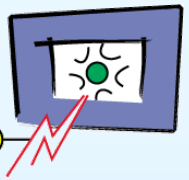
PC – Windows/Linux



PDA – Windows Mobile

Mobile Phone - Symbian

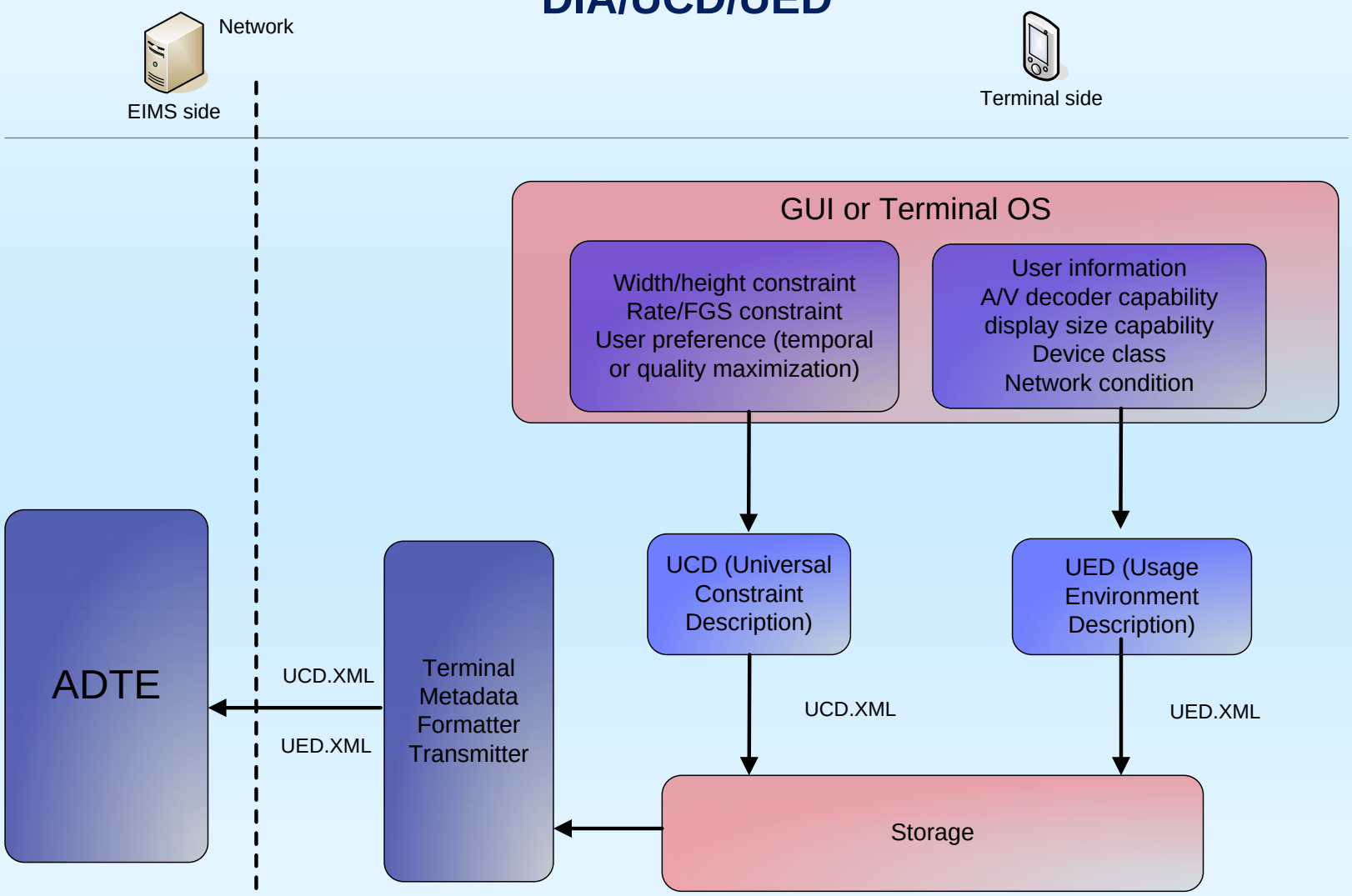
WP-7: ENTHRONE 2 Achievements



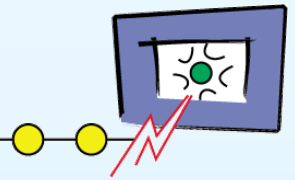
- **MPEG-21 Digital Item Adaptation Standard (DIA)**
  - Specify descriptions and metadata to support the adaptation of multimedia contents to terminal characteristics
  - Provides systematic solutions for selecting optimal adaptation strategies
  - Supports inter-operability of the adaptation process
- **MPEG-21 DIA User Environments Description (UED) tool**
  - Provides user characteristics: user info, usage preference, history, accessibility, location
  - Provides terminal capabilities: codec capabilities, device properties, I/O characteristics
  - Measure network characteristics: capabilities, conditions
- **MPEG-21 DIA Universal Constraint Description (UCD) tools**
  - Specify supplementary information to further constrain the usage environment (i.e. constrain rendering to reduced-screen modes to preserve terminal resources).

WP-7: ENTHRONE 2 Achievements

DIA/UCD/UED



WP-7: ENTHRONE 2 Achievements

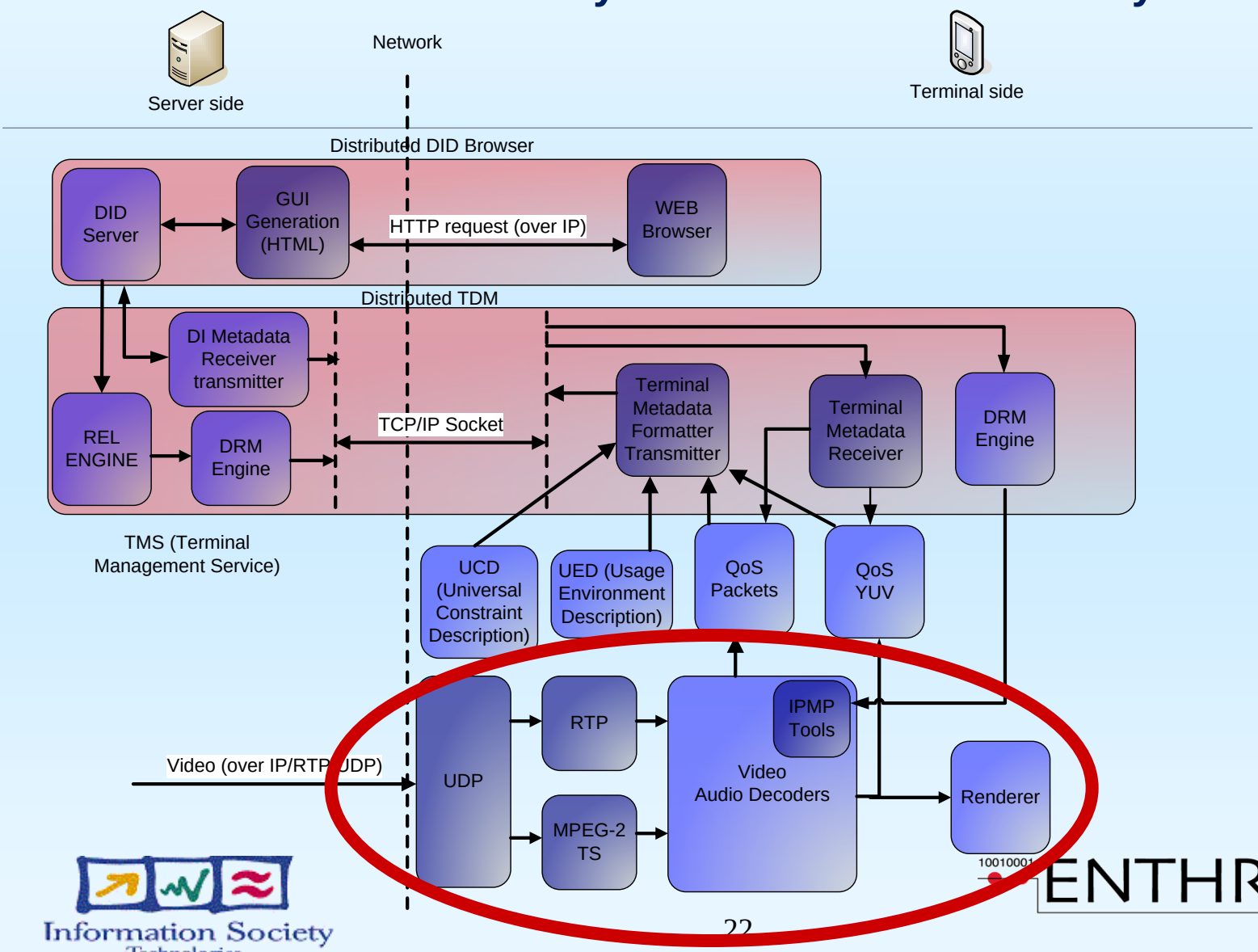


DIA/UCD/UED

- **Achievements:**
  - UED, UED module for Windows and Windows Mobile (first version)
  - API specification, and UED, UCD documentation (first version)
  - Integration with Player and TDM
- **Next Steps:**
  - UED, UED module for Windows and Windows Mobile (final version)
  - API specification, and UED, UCD documentation (final version)
  - Integration with PorTiVity Player and ESG Player

WP-7: ENTHRONE 2 Achievements

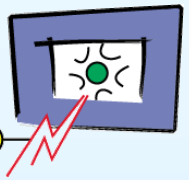
The Players: BSoft and LABRI Player



WP-7: ENTHRONE 2 Achievements

The Players: BSoft Player

- **Achievements**
  - Support of AVC, SVC decoding
  - Full integration in the ENTHRONE terminal architecture (UED/UCD, QoS Probe APIs, TDM client)
- **Next Steps**
  - Complete porting on Symbian
  - Complete integration of several complementary PQOS monitoring probes
  - Complete integration of DRM tools
  - Complete integration, testing and validation of "middleware" for QOS monitoring feedback loop
  - Complete integration and testing of DID tools
  - Harmonize the different solutions for the Terminal Player (4 solutions: bSoft Player, Labri Player based on VLC, IRT Player based on GPAC/Laser, Expway Player based on GPAC/SVG)
  - Support of HDTV

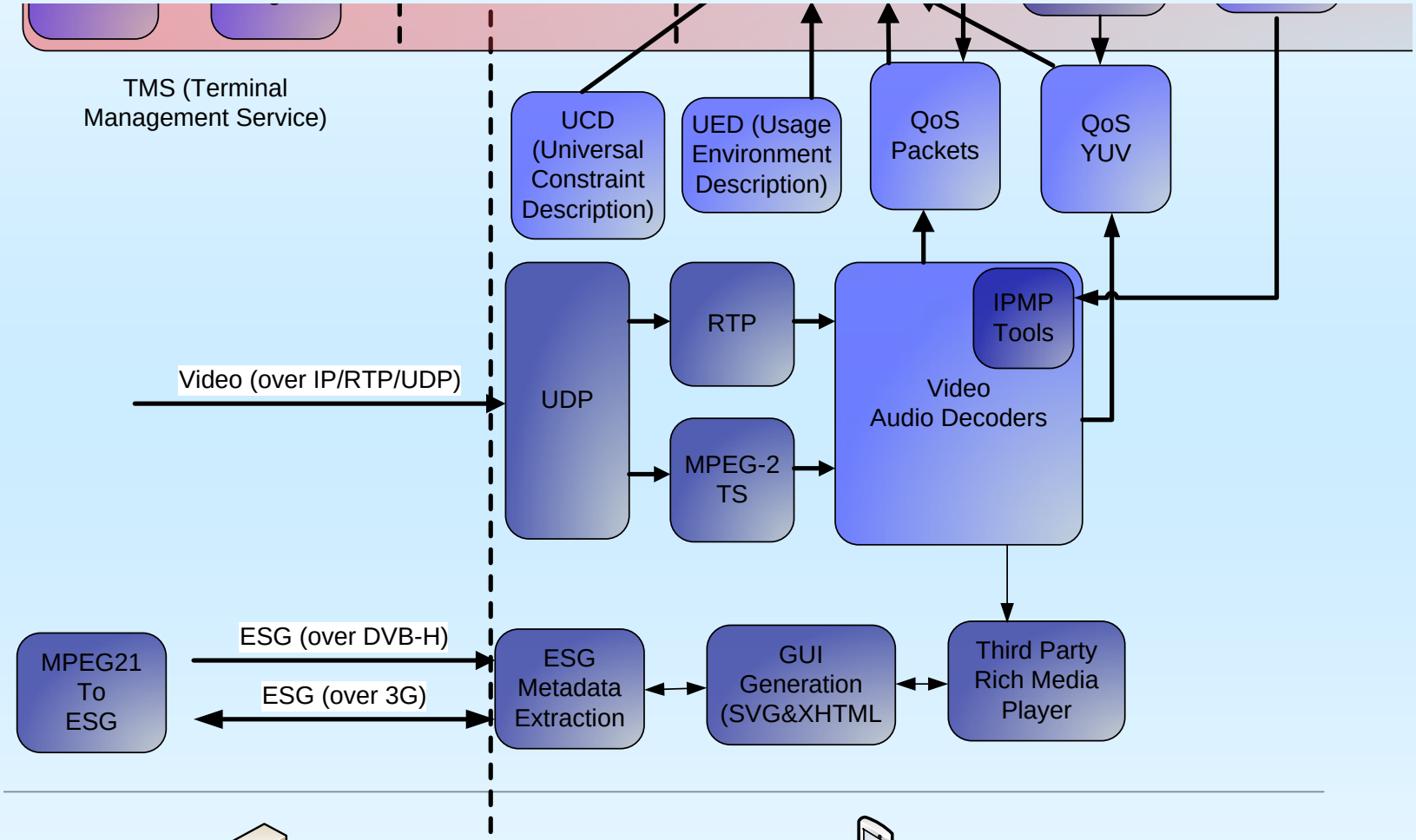


The Players: LABRI Player

- **Achievements:**
  - Standalone Terminal for: Windows, Linux, Win Mob
  - Plugins-components
  - Activex component for Internet Explorer (IE)
  - Main features implemented : RTSP with support of SDPng, HTTP session control and streaming, RTP payload format for legacy media codec, Unicast and Multicast support, Session Announcement support using SAP, DVB-T/S support
- **Next Steps:**
  - Porting the Forwarding Error Correction (FEC) to Win Mob
  - Integrating WP5 IPMP management tools
  - Integration with Enthrone terminal components (TDM, QoS Probes, UED/UCD)

WP-7: ENTHRONE 2 Achievements

The Players: ESG Player

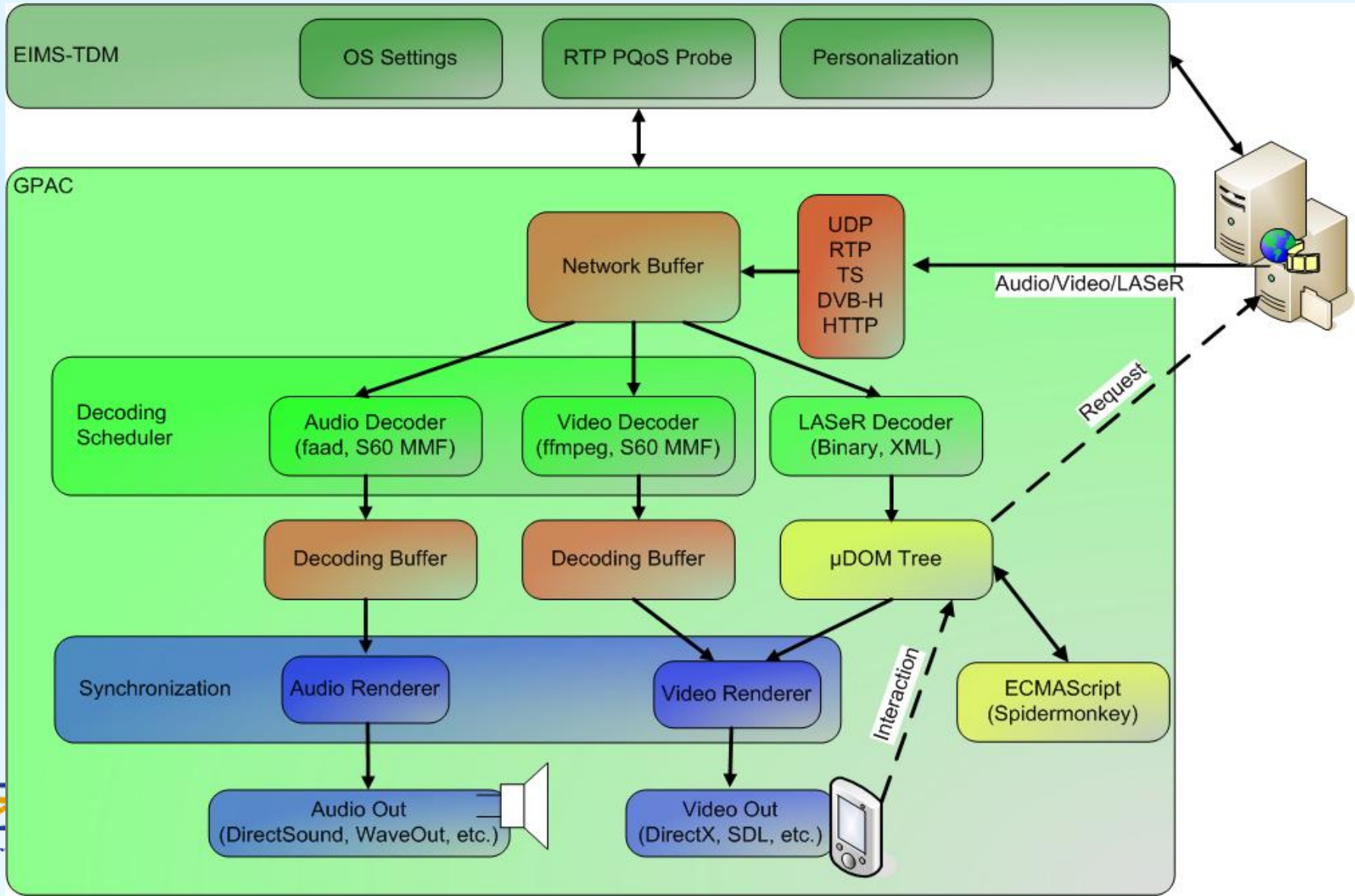


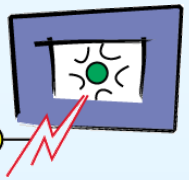
The Players: ESG Player

- **Achievements:**
  - Meta data (ESG) management on the terminal
  - SVG and DHTML GUI generation from metadata
  - Broadcast support (DVB-H)
  - DHTML player on the terminal (third party) without video
- **Next Steps:**
  - Full Video support
  - Bidirectional communication over 3G for QoS feedback to EIMS
  - Integration of QoS probes and TDM for 3G communications

WP-7: ENTHRONE 2 Achievements

The Players: GPAC PorTiVity LASeR Player

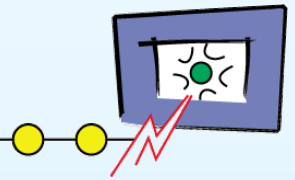




The Players: GPAC PorTiVity LASeR Player

- **GPAC - ENTHRONE Content example**
  - MultiRadio (Interactive enhanced radio service) designed by RBB
  - AAC radio stream over DVB-H
  - Additional content streamed as MPEG-LASeR (MPEG 4 Part 20)
  - Featuring news, info on current program, images, videos, games
  - Interaction between user and moderator in the studio

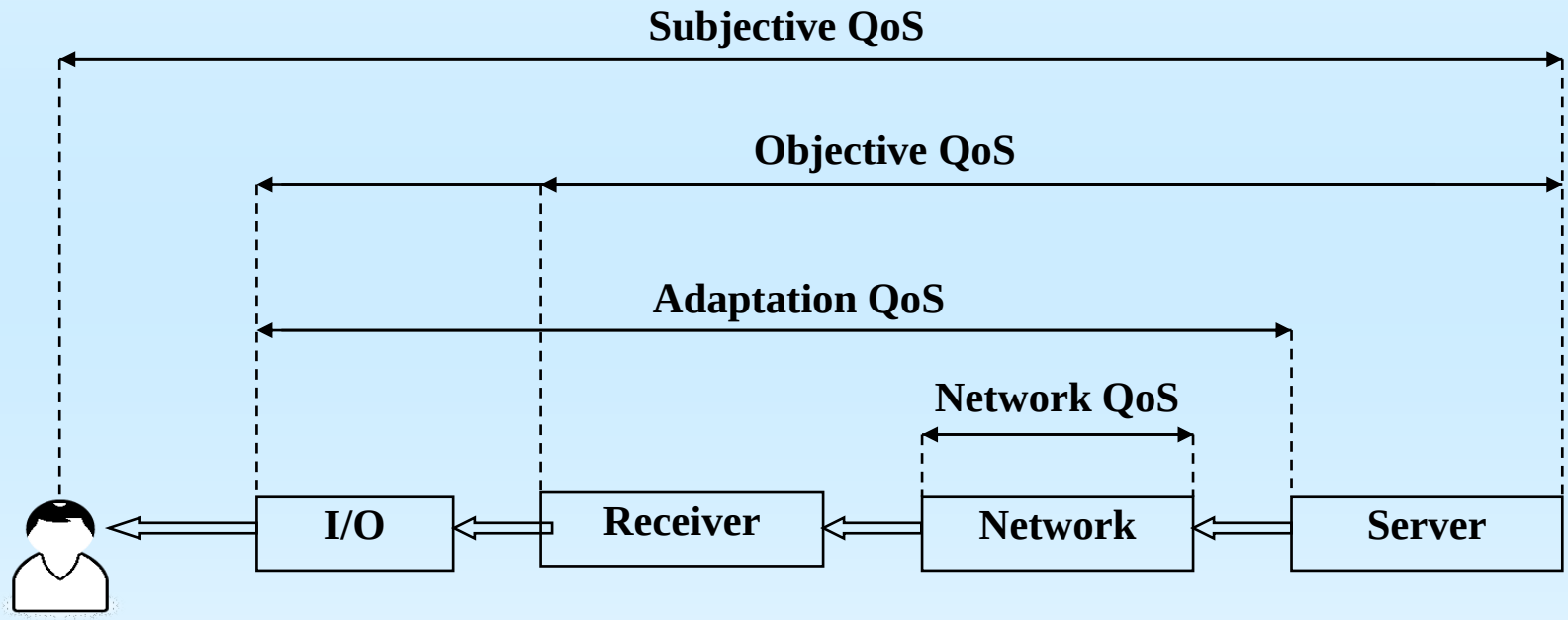
WP-7: ENTHRONE 2 Achievements



The Players: GPAC PorTiVity LASeR Player

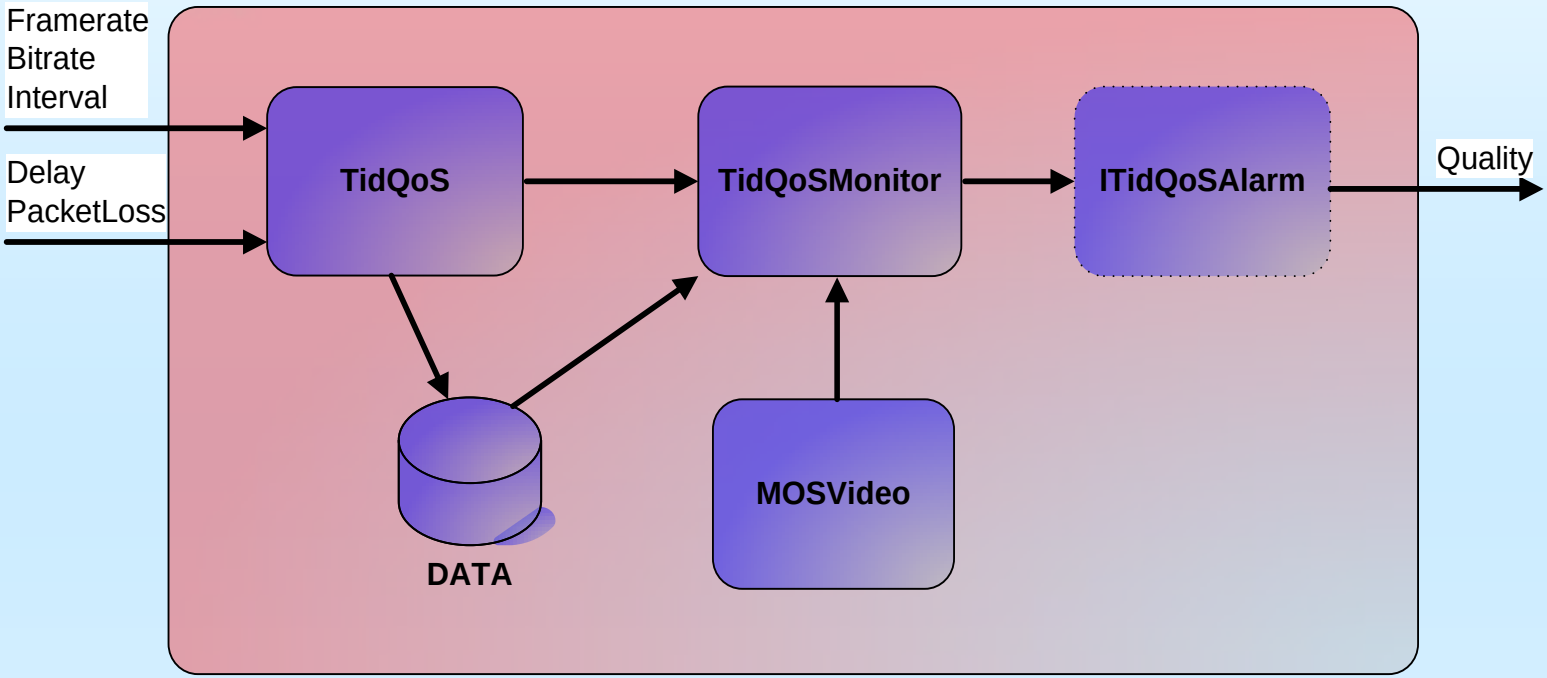
- **Achievements:**
  - Stabilised GPAC Player
  - Optimizations in Renderer, Scheduler, Output and Plugin-Architecture
  - Implementation of missing LASeR functions
  - Support for MPEG LASeR, SVG, ECMAScript content
- **Next Steps:**
  - Integration of ENTHRONE TDM and QoS-Probes
  - Symbian Porting
  - Adaptation of RBB`s MultiRadio-Service to MPEG-LASeR and testing

Subjective, Objective, Adaptation, Network QoS Mapping



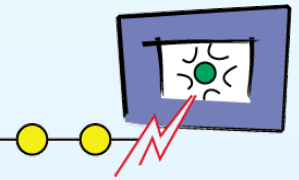
WP-7: ENTHRONE 2 Achievements

Telefónica I+D PQoS Module Architecture



TidQos:
Analyze the input data and stores this information temporally for statistics purposes.
TidQoSMonitor:
Trigger alarms when they are needed and/or communicate the QoS periodically.
MOSVideo:
Obtains the quality of service associated with the data analyzed.

WP-7: ENTHRONE 2 Achievements

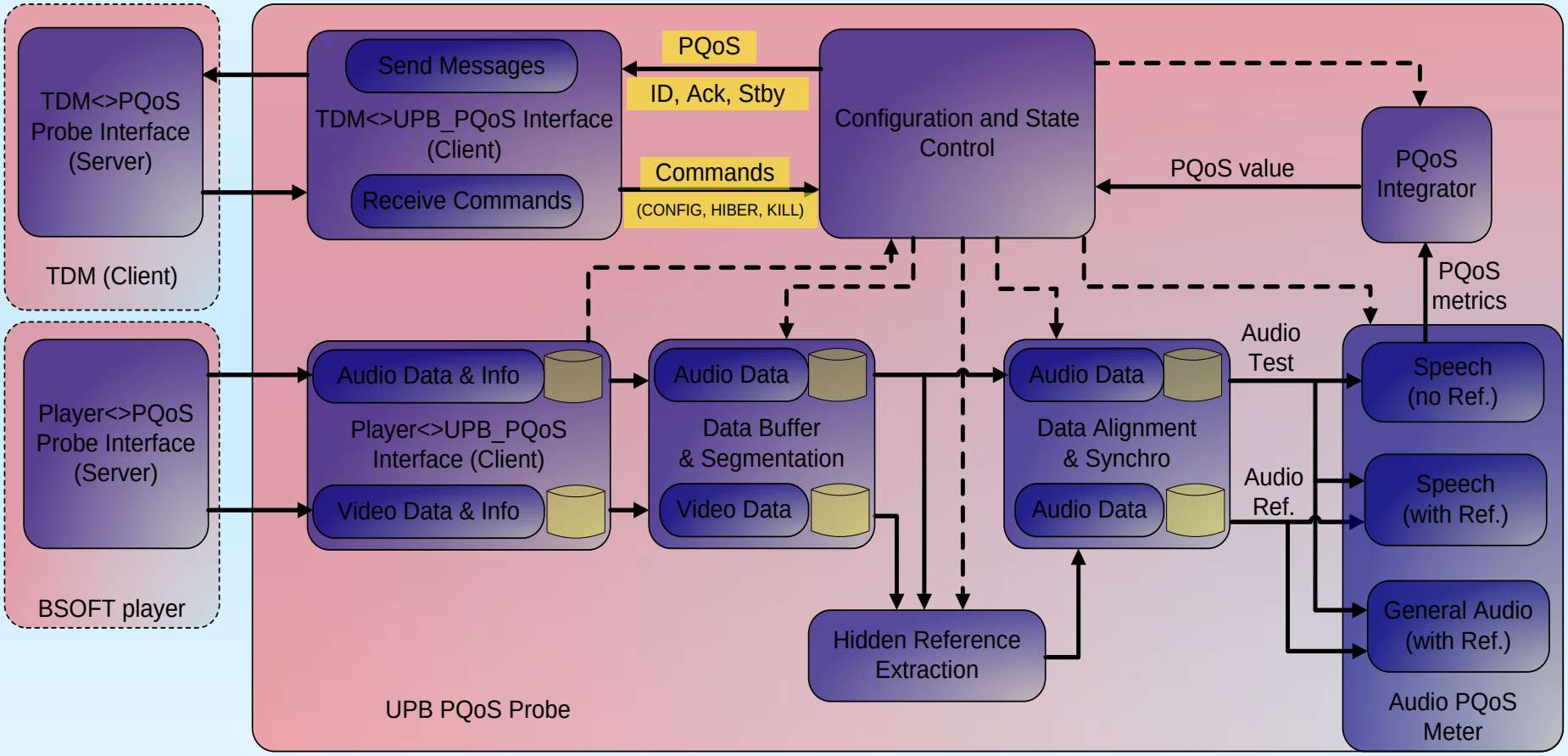


Telefónica I+D PQoS Module Architecture

- **Achievements:**
  - Implementation and integration in the ENTHRONE Terminal completed (Win and WIN Mob)
  - Issued a web public survey to collect as many subjective QoS measurements on video applications as possible, requested for a professional QoS model validation and promotion, contributing also to project dissemination activities.
- **Next Steps:**
  - To extend collection of statistical data for validation and development of TID QoS model description.
  - Build liaisons and collaborations with other European projects that are currently running and working in the Enthrone2 area and activities. Wide and heterogeneous scenarios to validate this TID PQoS Model,
  - Several levels of dissemination and exploitation of results.

WP-7: ENTHRONE 2 Achievements

UPB Audio PQoS Probe Architecture

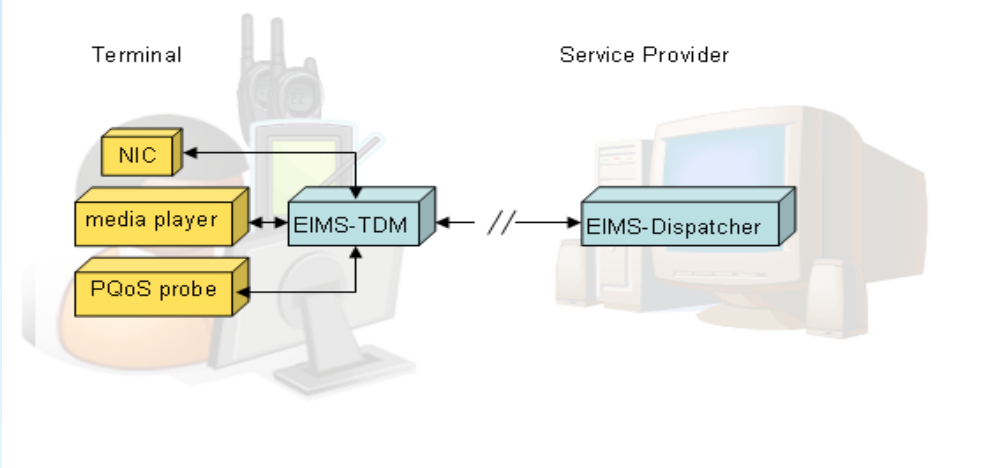


UPB Audio PQoS Probe Architecture

- **Achievements:**
  - Basic implementation and partial integration in Enthrone terminal (Win)
- **Next Steps:**
  - Complete implementation and integration (Win and WinMob)
  - Testing, validation and final tuning of the QoS metrics in different scenarios
  - QoS measuraments for speech signals for both non-referenced and referenced signals

Terminal middleware

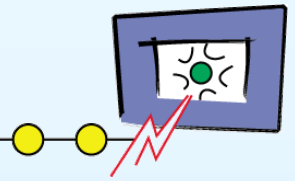
- **TDM, Terminal Device Manager**
  - providing device independence
  - binding together the different functionalities offered by the ENTHRONE terminal
  - appropriately routing the data
  - filtering the communication with the server
  - logging events



Terminal middleware

- provides to the DDI Browser the functionality for the complete presentation of MPEG-21 DIs, supporting the use cases:
  - search for Digital Items
  - get a requested Digital Item
  - select a Digital Item for consumption
  - verification and purchase of licenses
  - play the selected Digital Item

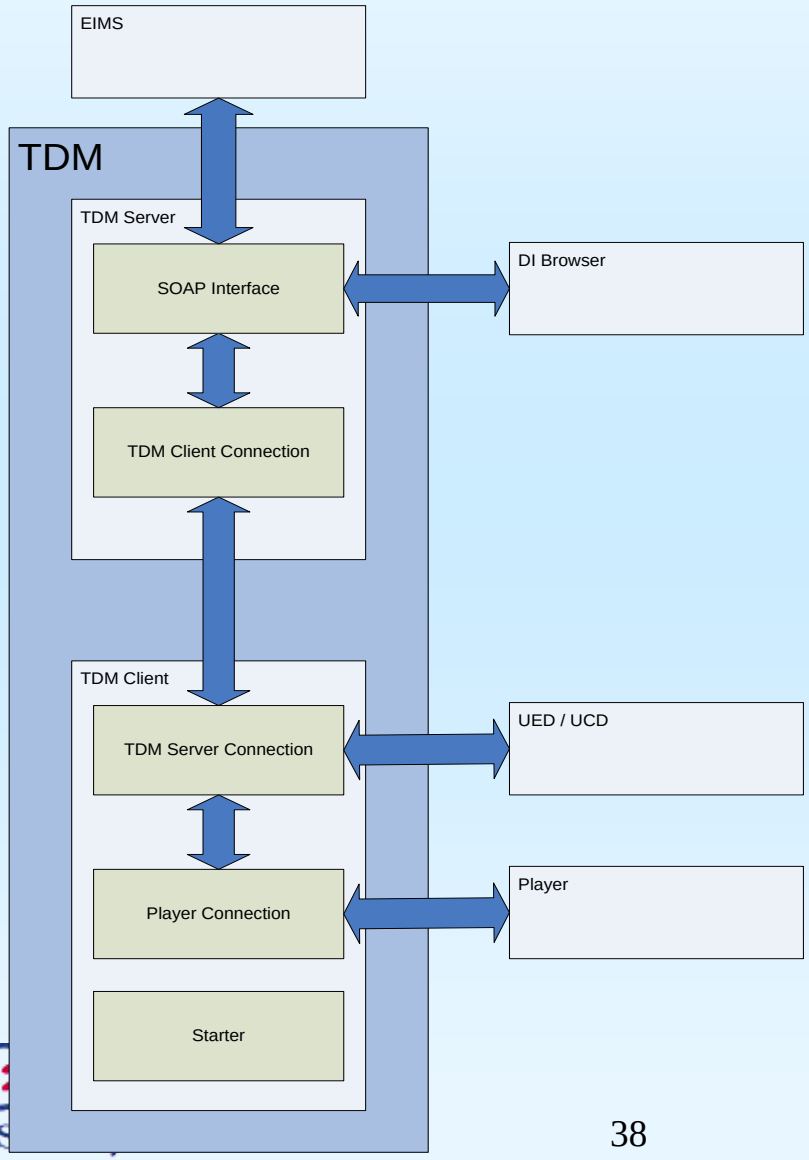
Terminal middleware



- provides to the Player and the QoS probes the functionality for the adaptation feedback, supporting the use cases:
  - QoS adaptation
- provides to the DRM system the functionality for the key management, supporting the use cases:
  - User rights management

WP-7: ENTHRONE 2 Achievements

Terminal Device Manager (TDM)



TDM Server

SOAP - DIBrowser:

• playDI, selectDI, searchDI, getDI

SOAP - EIMS:

• changeProbeConfig, Send new Probe configuration, Get UED

TDM Client

TDM Client - Server

•Get new Probe configuration, Send UED

Player Connection - Player

• Send new Probe configuration, Get Probe Alarms, Start, Start the connection to DIBrowser

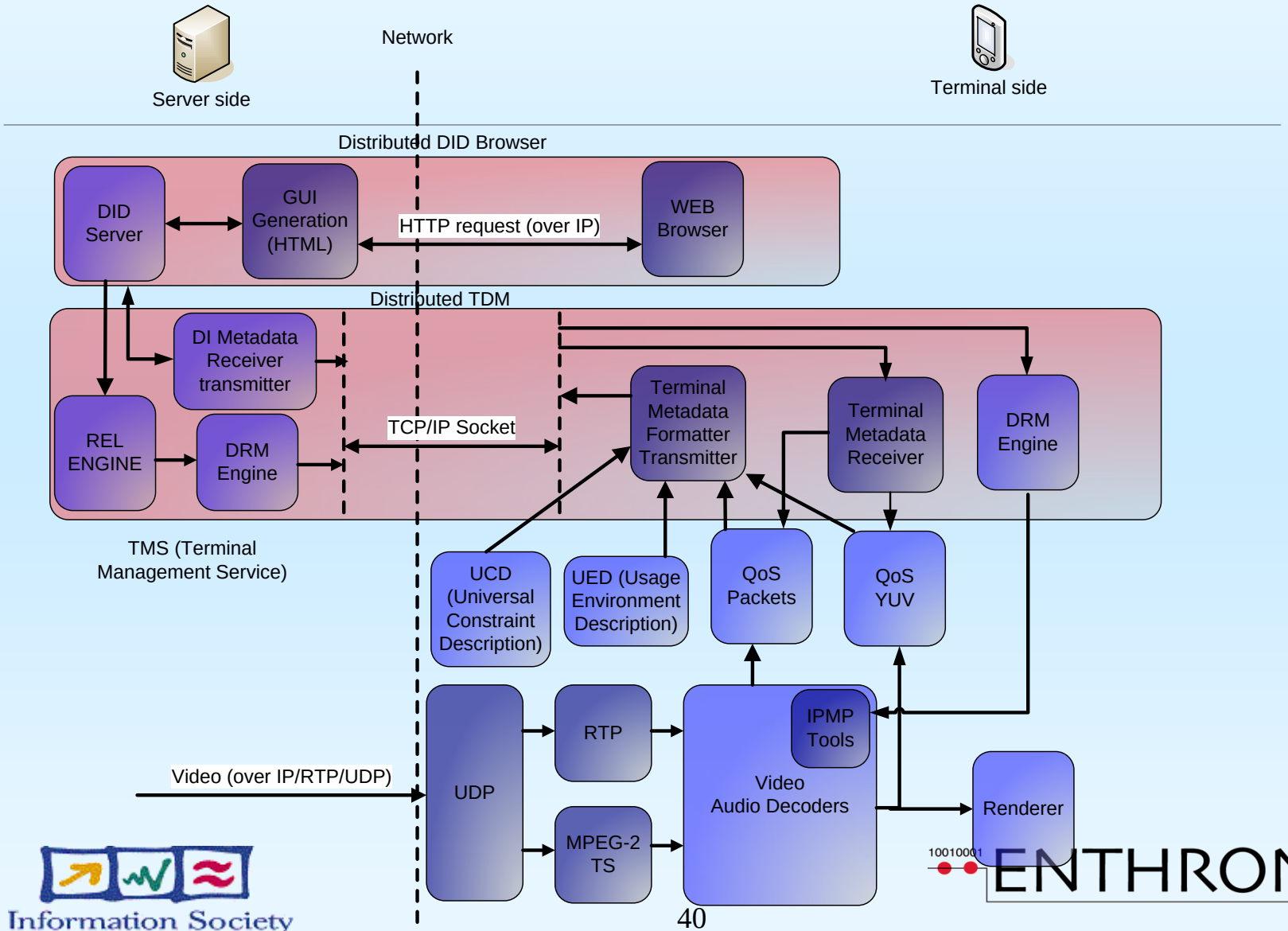
WP-7: ENTHRONE 2 Achievements

Terminal Device Manager (TDM)

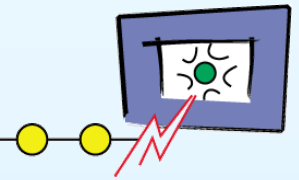
- **Achievements:**
  - Distributed architecture handling all communications between terminal components at server and client side
  - Integration with all other terminal components completed (XML MPEG-21 compliant based communications)
  - OS support (Win, WinMob)
- **Next steps:**
  - Support of IPMP WP5 modules at server and client side (minimization of complexity at client side)
  - DDI integration for extended DI Browsing methods
  - Porting on Symbian
  - Integration and support of “PorTiVity” player, ESG player and LABRI Player
  - Implementation of MPEG M3W APIs with all supported players

WP-7: ENTHRONE 2 Achievements

ENTHRONE 2 Terminal Architecture



WP-7: Conclusions



- **ENTHRONE Terminal Architecture:**
  - Support of different classes of QoS Probes in multiple configurations providing QoS feedback to EIMS (main ENTHRONE goal)
  - Main result achieved with:
    - Wide support of different standard content and distribution scenario (variety of players and seamless integration of QoS probes)
    - Portability on different OS and terminals (modularity, distributed architecture for intelligent resource saving on mobile terminals, usage of standard components and APIs).
    - Successful integration and coordination of most of the components developed by several partners thanks to the clear specification of standard interfaces.
    - Implementation of state-of-the-art and next generation standard technologies for media compression and handling (MPEG-4/7/21, EGS).
    - Integration in the QoS terminal of standard IPMP components.