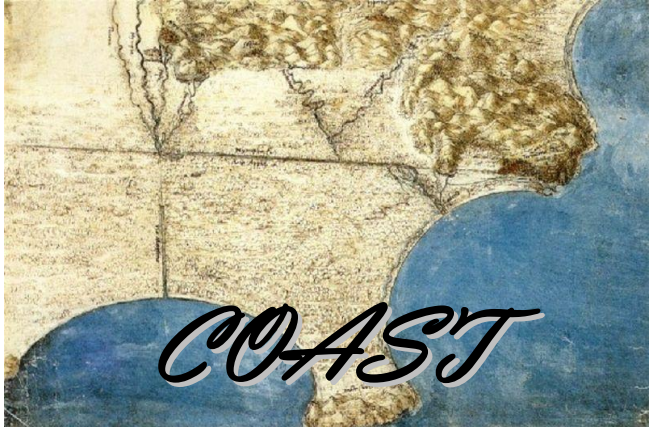

**** The COAST logo is based on the painting "Birds Eye View of Sea Coast" by Leonardo Da Vinci***

Content Aware Searching, retrieval and sTreaming in Future Internet

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NapaWine Final Workshop
Turin, January 21th, 2010

Outline

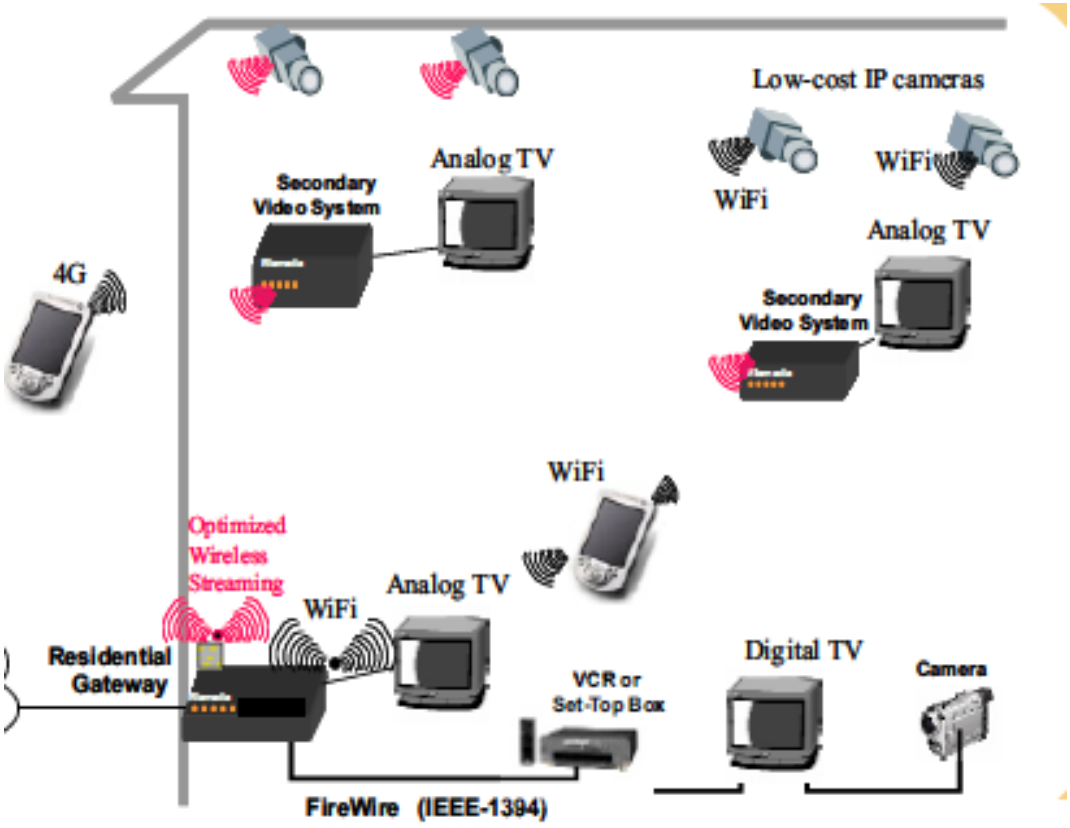
- COAST Project Consortium
- Past IST-FP6/FP7 related projects
  - ASTRALS 2006-2007
  - SEA 2008-2009
- COAST Project Summary
- COAST Network Architecture
  - Content Publishing
  - Content Search and discovery
  - Caching and Routing
  - Streaming and Adaptation

Project Consortium

Before COAST…

ASTRALS – FP6

- Audio-visual STReaming plAtform for domestic Leisure and Security
  - Home Network video distribution platform over wireless links
  - Optimized video storage, transcoding and distribution
  - Scalable video coding (SVC)
  - Video Surveillance / Event Detection



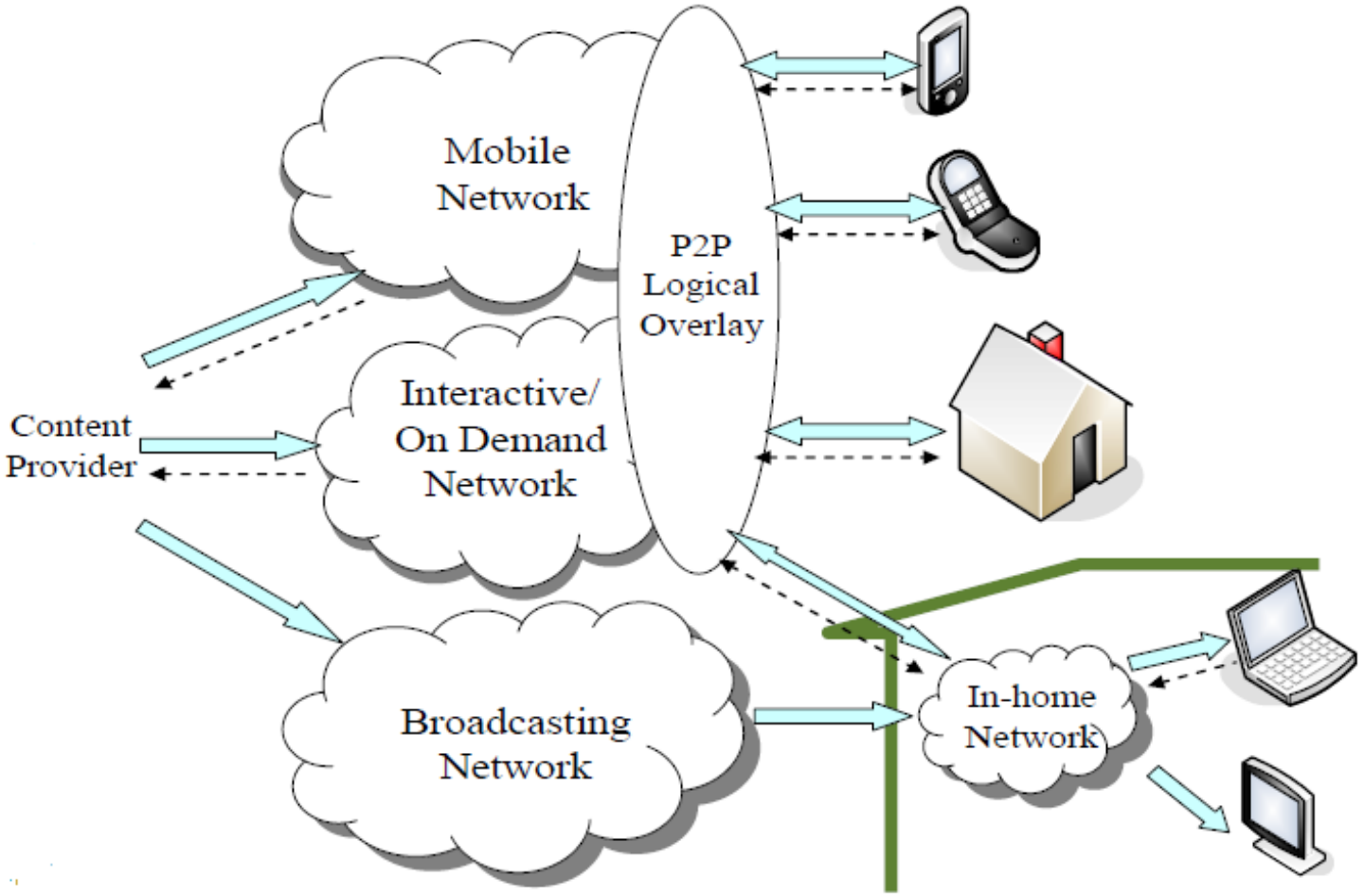
ASTRALS – Highlights

- HHI
  - MP4 File Format extension for SVC
  - IETF drafts for RTP payload format extension
- STM
  - First prototype of an adaptive streaming framework for SVC media
  - Advanced SVC enabled Home Media Gateway based on STM embedded platforms
  - Automatic adaptation to heterogeneous conneted terminals
  - Showed at CES-2007

SEA – FP7 (1/3)

- SEAmless Content Delivery
  - Adaptive video delivery
    - Through different Newtork Types (3G, WLAN, IP)
    - Targetting different devices
    - Scalable, Multiview and Multiple Description coding schemes supported
  - Each user seen as a Content Producer/Mediator
    - Optimized P2P distribution
  - Content Protection
    - C/S and P2P distribution

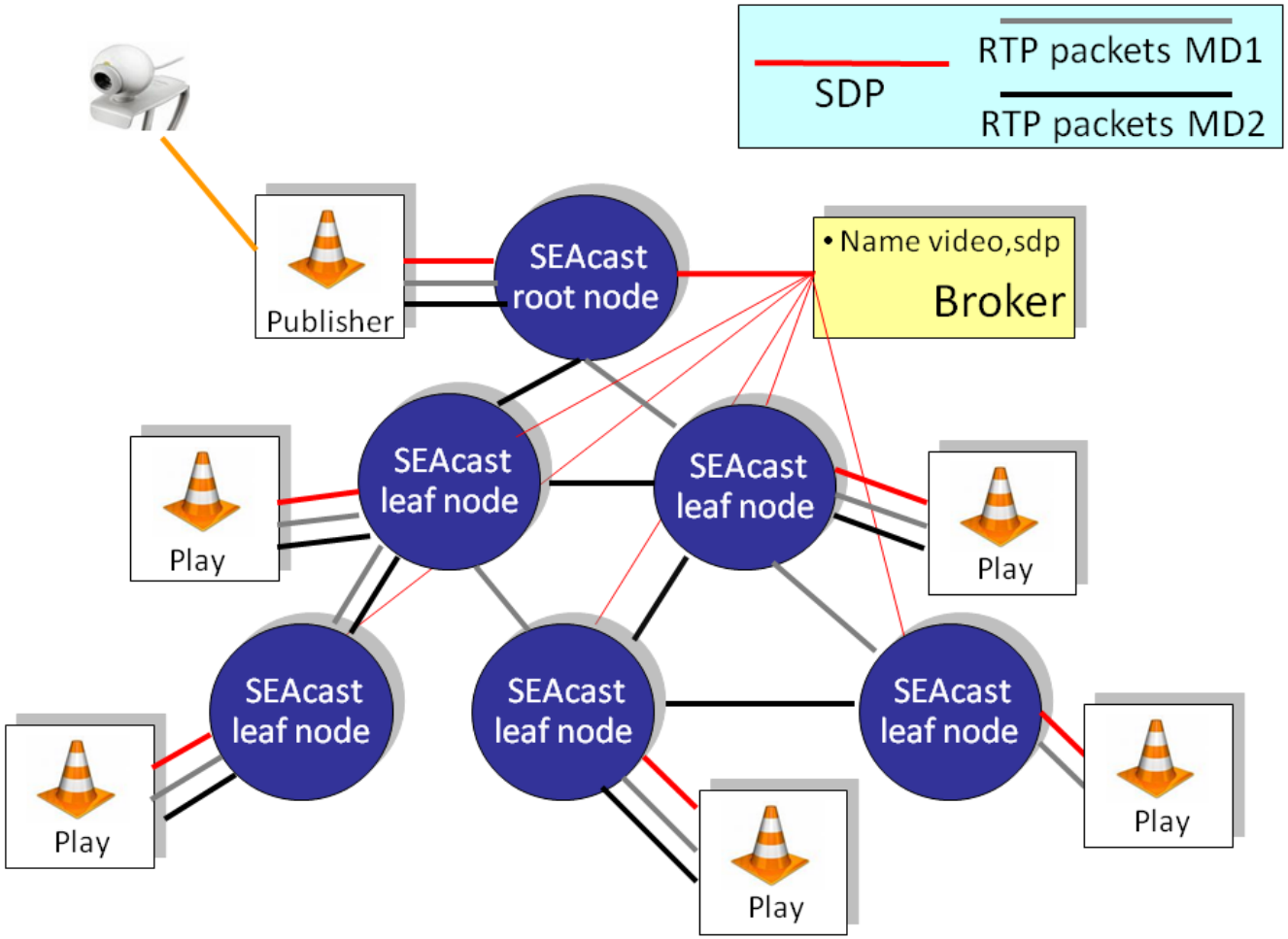
SEA – FP7 (2/3)


Mobile Network
P2P Logical Overlay
Interactive/ On Demand Network
Content Provider
Broadcasting Network
In-home Network

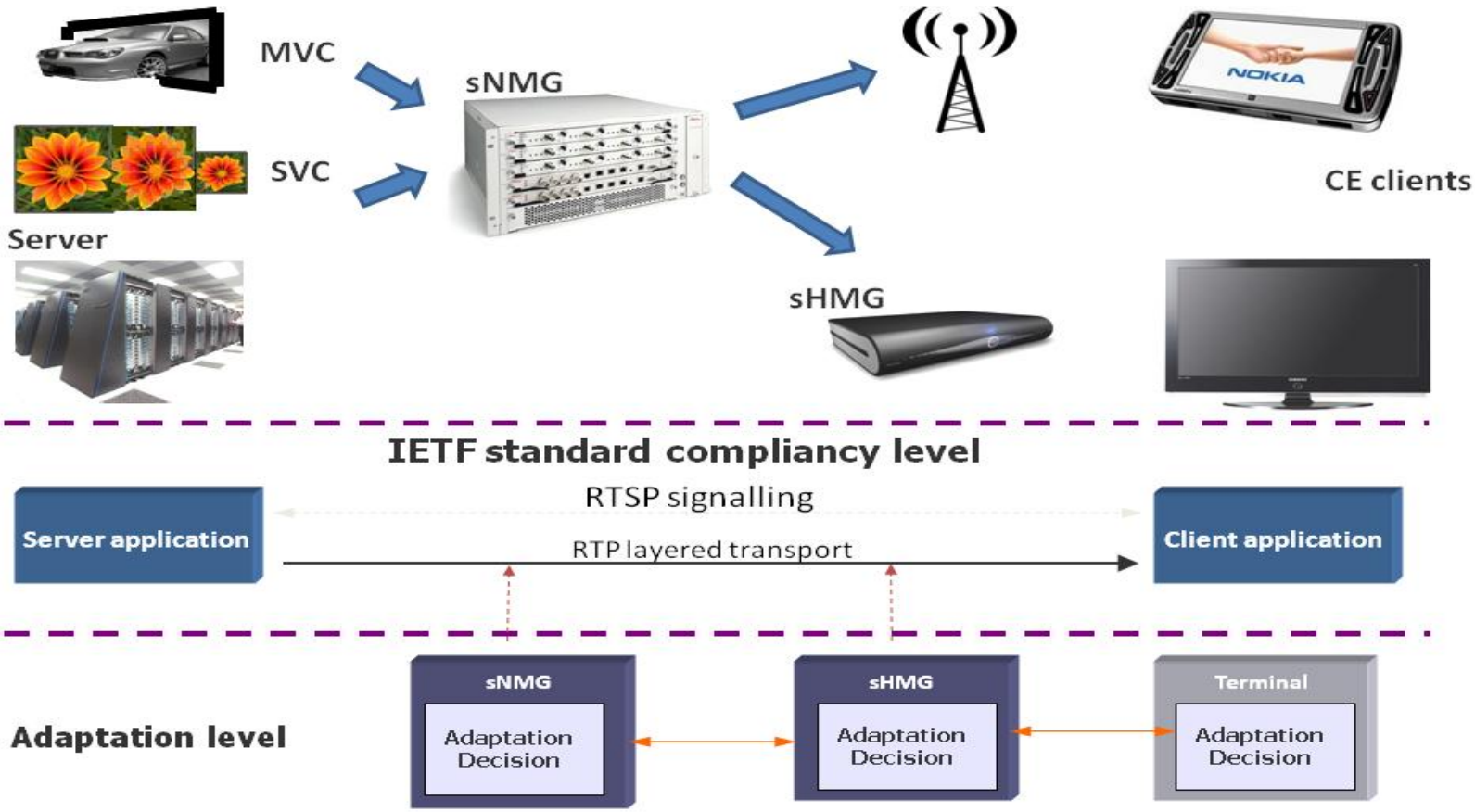
SEA – FP7 (3/3)

- Highlights
  - Multiple Description schemes applied to tree based P2P distribution schemes
  - RTSP/RTP based adaptive streaming framework
    - NAM: Network Awareness Module
    - TAM: Terminal Awareness Module
    - ADM: Adaptive Decision Module
    - AEM: Adaptive Execution Module
  - Seamless support for SVC and MVC coding formats

SEA – SEACast P2P application



SEA – SVC/MVC Adaptation



Back to COAST…

Project Summary

COntent Aware Searching, retrieval and sTreaming - COAST

- **Content & Services Searching & Indexing.**
  - Content and Web services identification and analysis via inspection of the traffic flows
  - Content and services location (Crawling)
- **Content-Aware Delivery Network Architecture**.
  - Discovery of the underlying network infrastructure, the user terminals and the user preferences
  - Protocols and network overlays for efficient content delivery
- **Future media content adaptation and enrichment.**
  - Means for rich video content formats (SVC, MVC) presentation
  - Content adaptation according to user preferences, terminals capabilities, local network conditions

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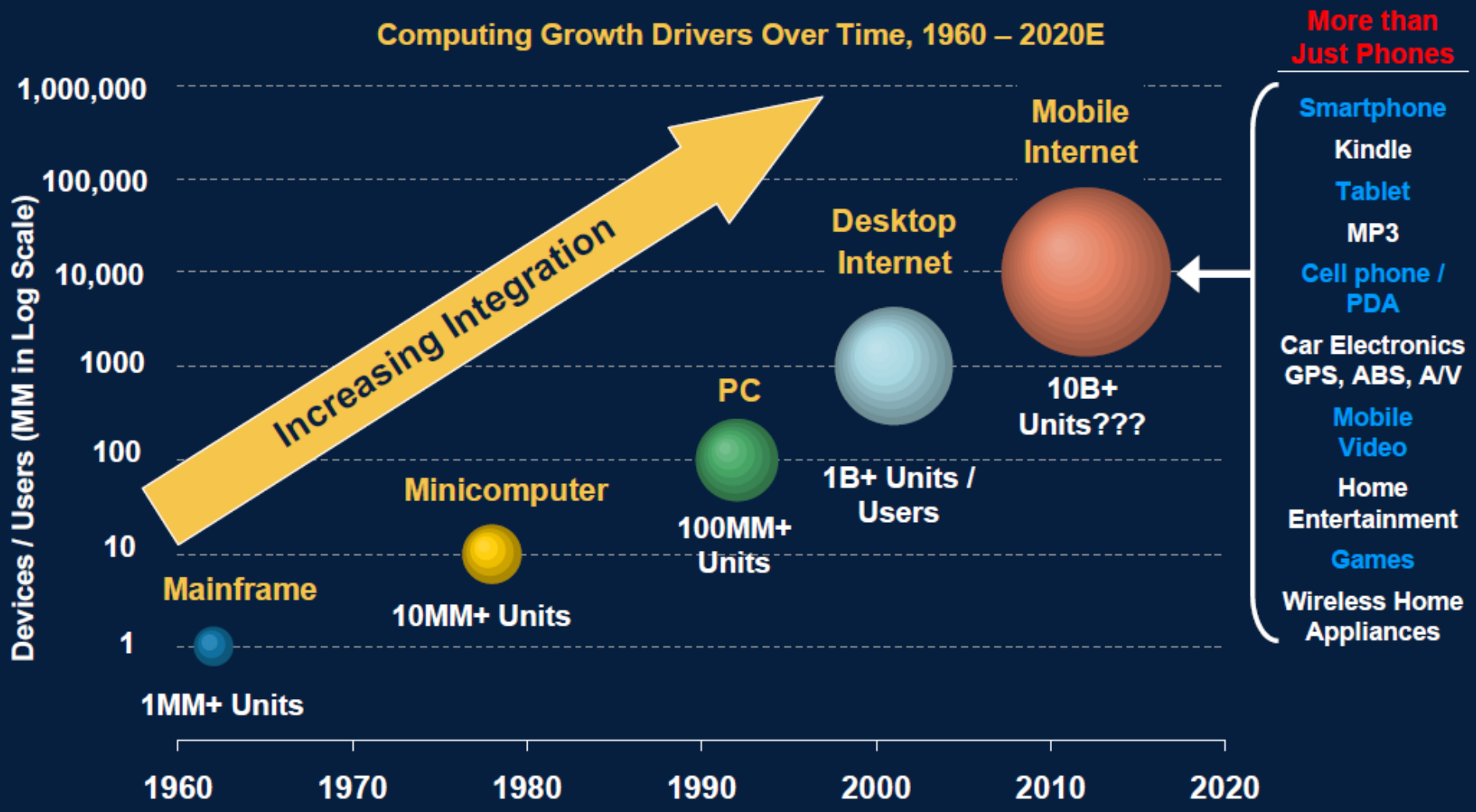
Motivation

New Computing Cycle Characteristics

Reduce Usage Friction Via Better Processing Power + Improved User Interface + Smaller Form Factor + Lower Prices + Expanded Services = 10x More Devices



Morgan Stanley

Note: PC installed base reached 100MM in 1993, cellphone / Internet users reached 1B in 2002 / 2005 respectively;
Source: ITU, Mark Lipacis, Morgan Stanley Research.

Connectivity = Cloud Computing

Consumers Expect to Get Their Stuff 24x7 from Palms of Their Hands

User Generated Content

Facebook is the leading repository for user-generated photos / videos / comments / links to music / social games

Unified Digital Locker

Professional Content

Leading repository TBD

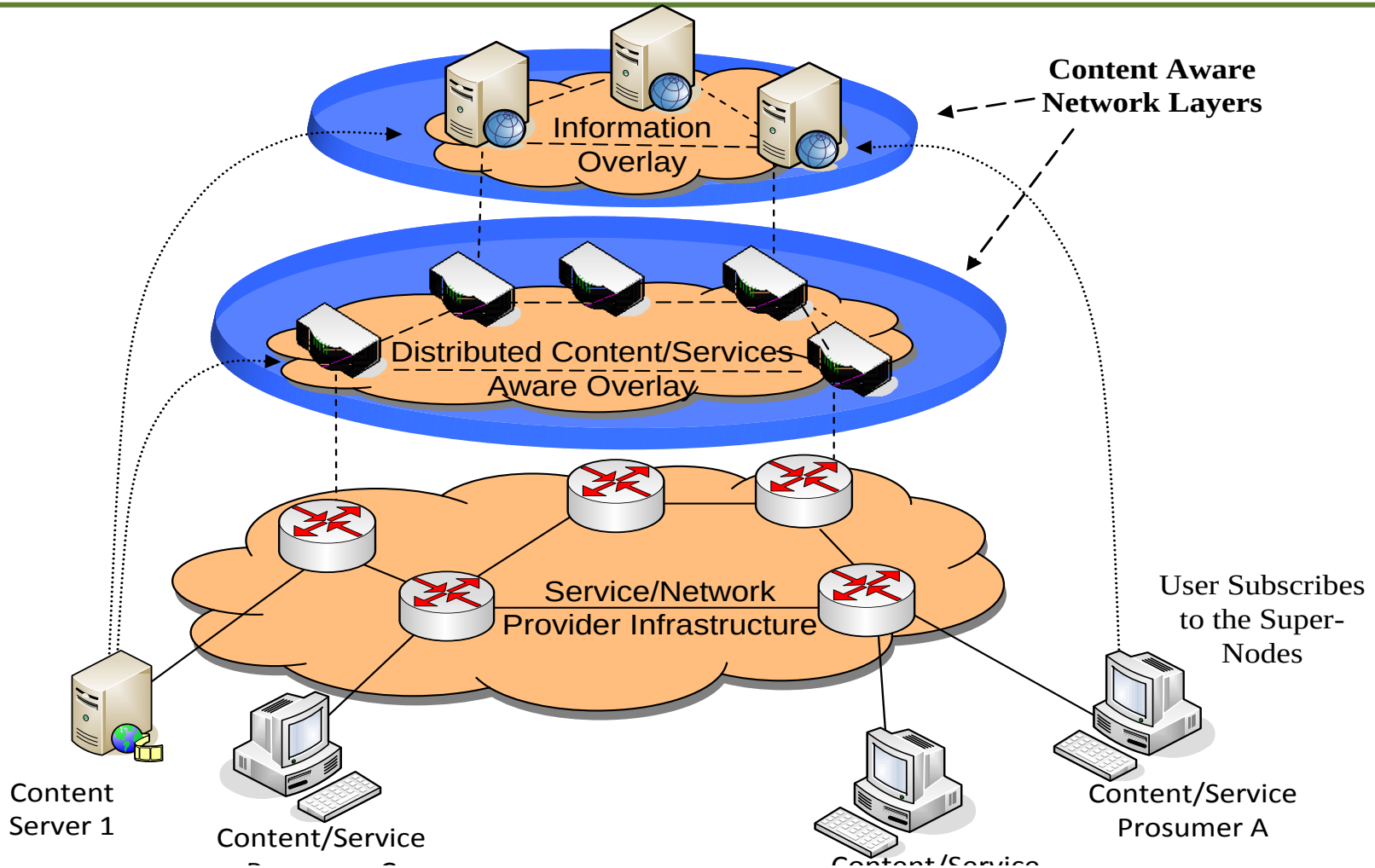
Apple iTunes? Amazon.com? Netflix? Hulu? Spotify?

Morgan Stanley

Note: Apple iTunes yet to offer full length media streaming. Source: Company websites.

COAST Network Architecture

COAST High Level Architecture



COAST Core Functionalities

- Network monitor (i.e. ALTO)
- Deep Packet Inspection (DPI)
- Content Discovery

Search Engine

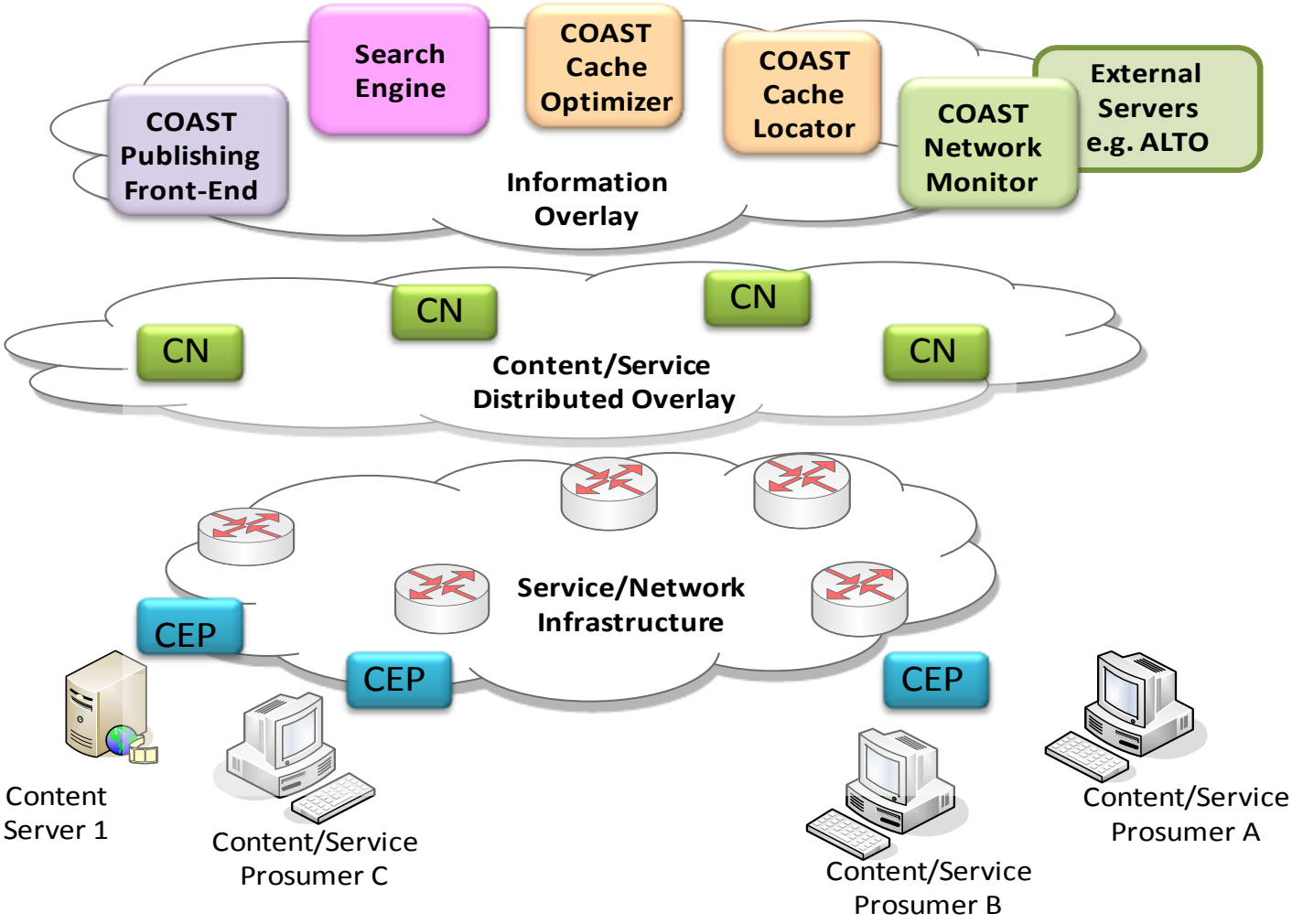
- Caching and routing
  - Content storage, replication, injection (ALTO)
  - “Best” cache and “best” path finding

Content Cache Locator & Content Cache Optimizer

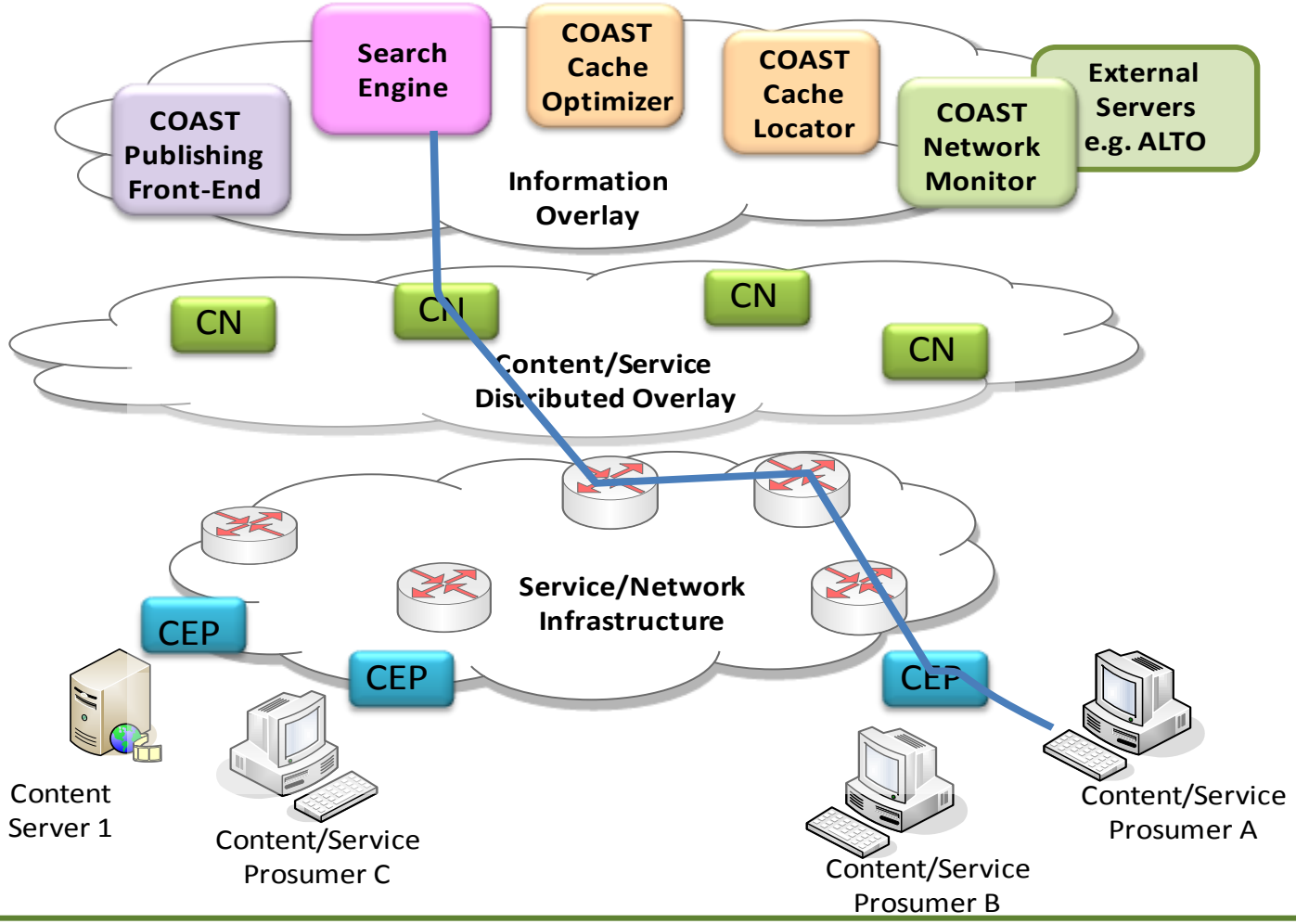
- Video streaming
  - Protocols and technologies for video delivery
- Adaptation
  - According to user context, devices, bandwidth etc.

HTTP and P2P streaming

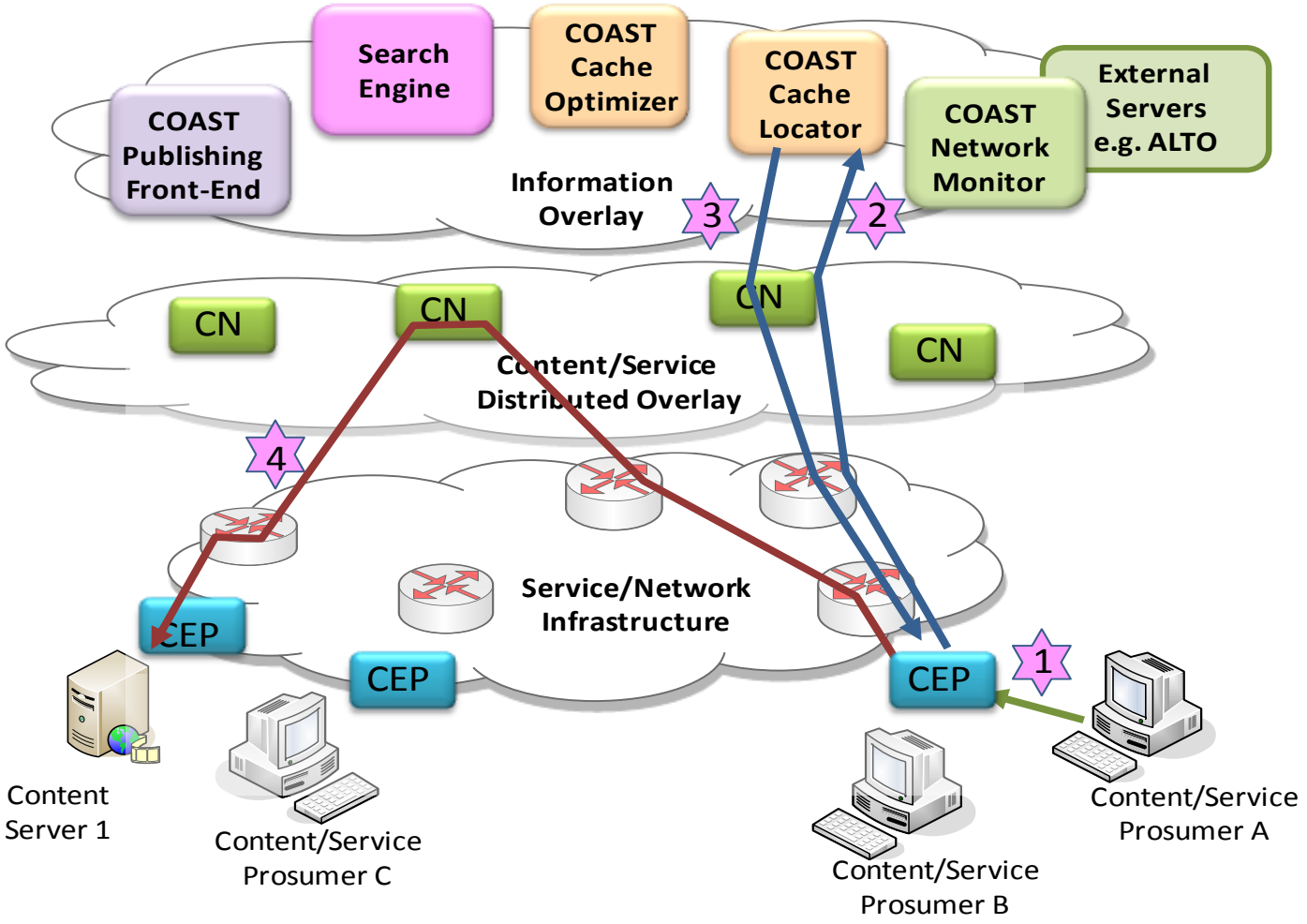
COAST Architectural Components (1/4)



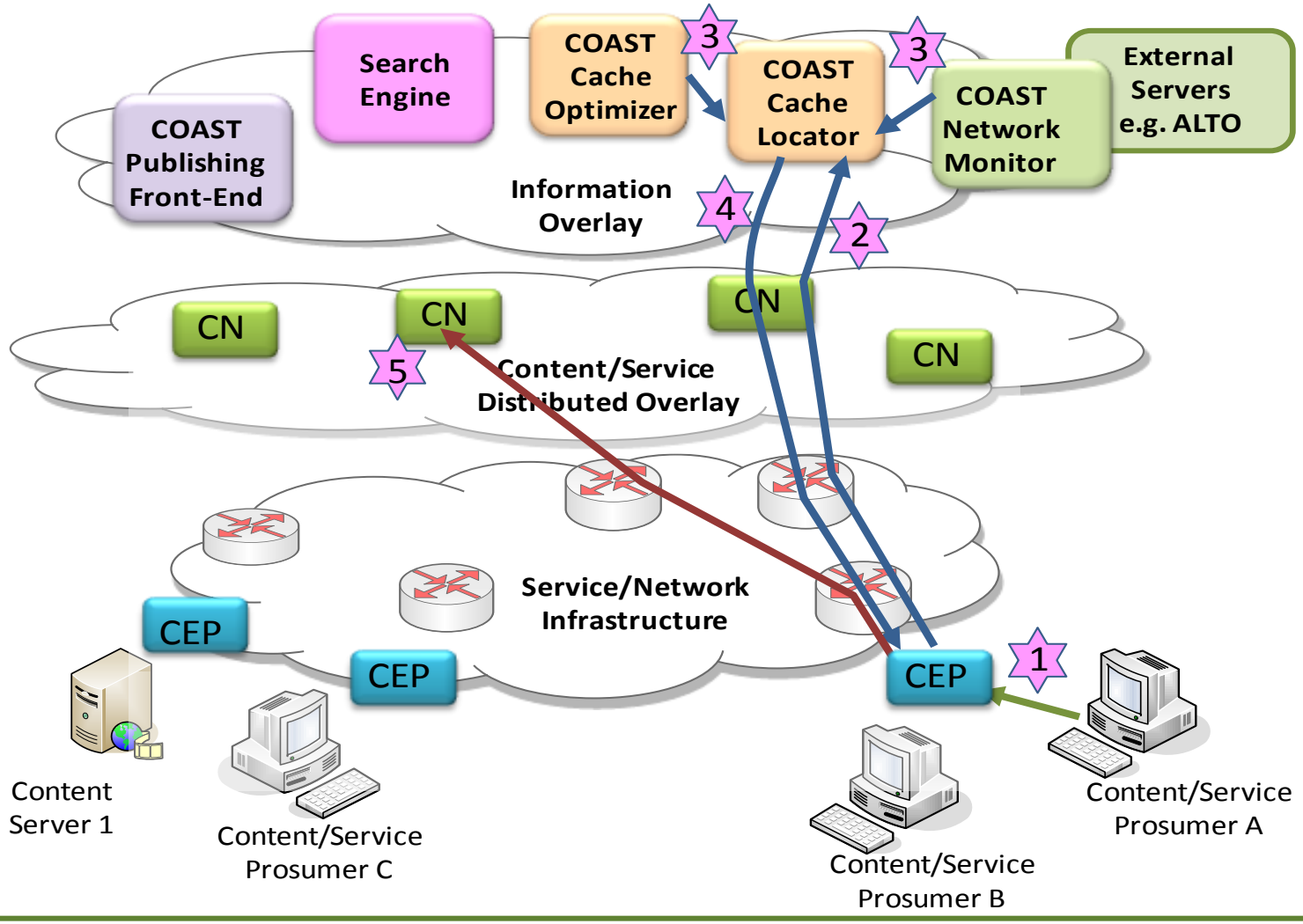
COAST Architectural Components (2/4)



COAST Architectural Components (3/4)



COAST Architectural Components (4/4)



Content Searching & Indexing

- Distributed Search Engine
  - SE servers and data centers geografically distributed to improve scalability
  - Crawling and indexing complexity distributed
- Active&Passive Crawling
  - Popular content directly pushed by COAST nodes to SE via passive Crawling
- Indexing
  - Exploitat DPI information to enhance indexing
- Search results ranking
  - Boosted thanks to the usage of DPI information
  - Results ordered and filtered according to terminal capabilities, user preference etc

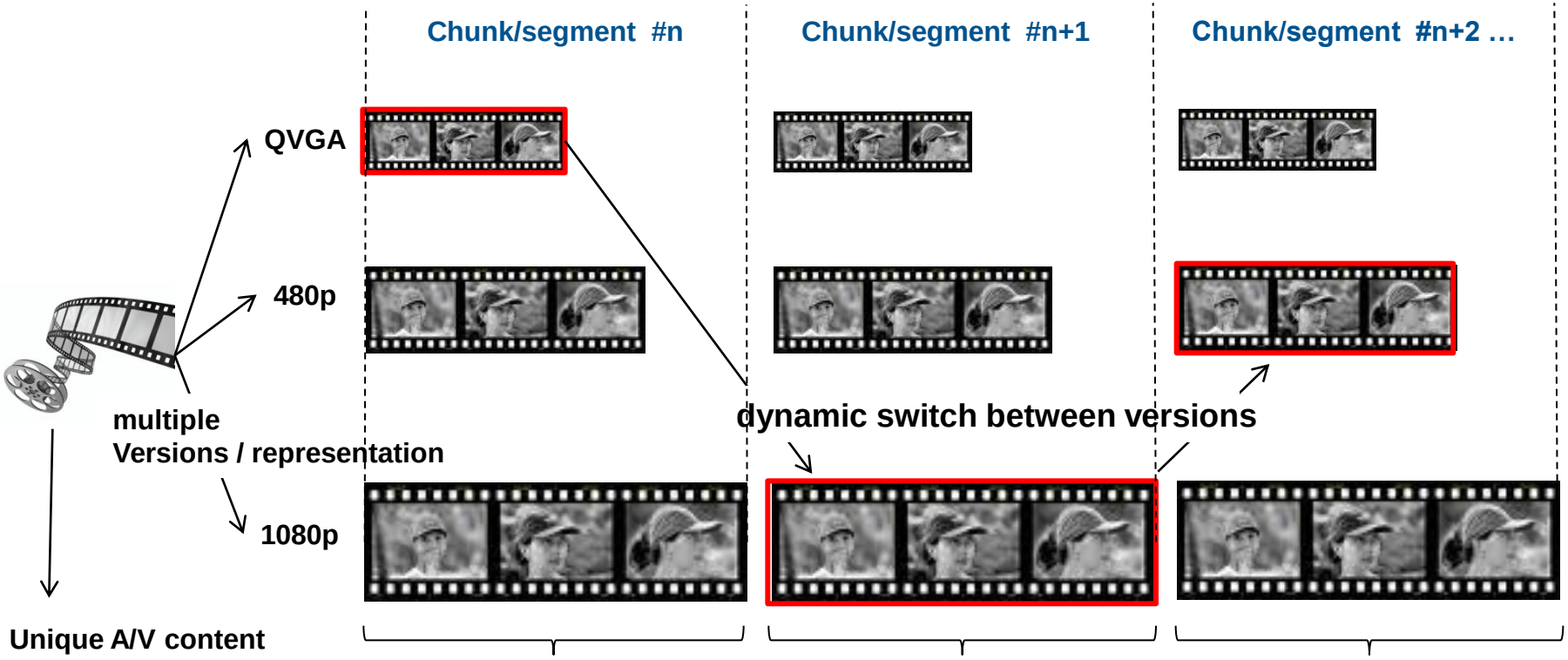
Content Caching and Routing

- Cache Overlay
  - Decentralized distributed system
- Content placement, removal and replication (CCO)
  - Exploit DPI and information from Network Monitor
- Content Cached Locator (CCL)
  - Distributed approach based on DHT
- Considered not also novel approach for routing
  - Content based routing (CCNx project)

Video delivery and adaptation

- Supported advanced media format
  - SVC, MVC, novel 3D format
- Transport and adaptation protocol
  - Dynamic Adaptive HTTP streaming (DASH) MPEG proposal
  - Technology similar to Apple, Microsoft and Adobe adaptive streaming solutions
  - More network friendly protocol (with respect to caches, proxies , firewall etc.)
  - Adaptation driven by the client application
- Adaptation
  - Terminal capabilities and network conditions
  - Supported SVC/MVC formats

Adaptive HTTP Streaming



Video delivery and P2P

- Integration of P2P video distribution overlays in COAST network delivery
- An hybrid P2P-CDN solution for video delivery will be followed
  - Exploited network locality by adding P2P functionalities to a low level of caching nodes
  - Added to CEPs caching and P2P distribution functionalities
  - No users involved in P2P swarm, data chuncks exchanged among CEPs (Proxies, Home Media Gateway, etc.)
  - Improved resilience of the P2P overlay as well as user privacy

Conclusions

- COAST project aims to build an overlay of intelligent nodes on top of existing network infrastructure providing means to:
  - Meet growing Internet data traffic
  - Efficiently discover web contents through DPI and network monitor functionalities
  - Efficiently manage and distribute web contents in an overlay of distributed caches
  - Find best delivery node and route contents to users
  - Optimize delivery and adaptation of video contents (in particular 3D video)

For further information…

- COAST web sites:

  www.coast-fp7.eu

- Deliverables:

  http://www.coast-fp7.eu/deliverables.html

- Contacts:

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