Intermediaries for the World-Wide Web: Overview and Classification

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Outline

- Definition and Motivation
- Intermediaries as an extension of the WWW-access model.
- Populating the network with Intermediaries.
- A Classification Framework and Taxonomy.
- Summary and Conclusions.

Definition

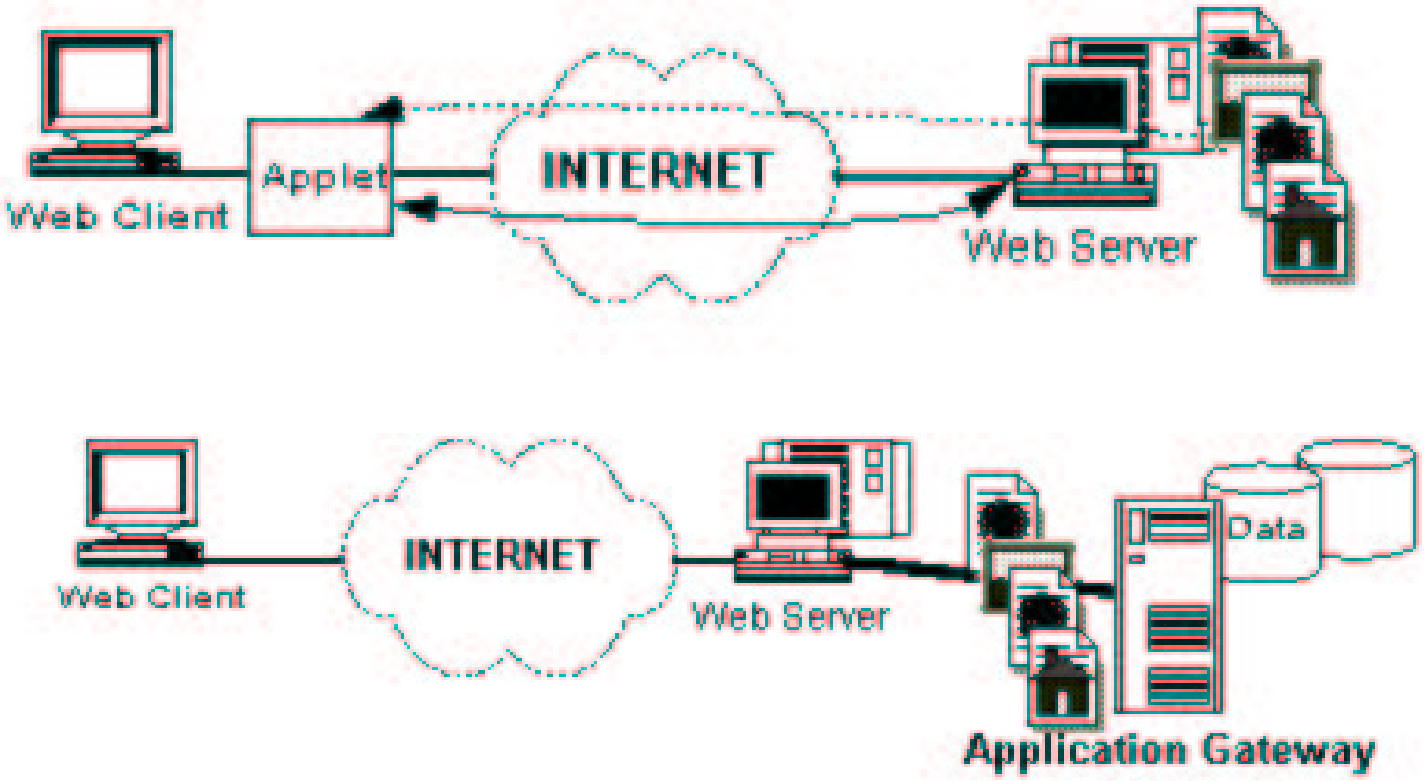
- *"Software entities that intervene to the flow of information from clients to origin servers at the application level of the WWW."*
- From simple relaying and caching to complicated transformations, such as filtering, indexing, and transcoding.
- Deployed on Internet hosts of the wireline and wireless Web between origin servers and client systems.
- Provide a reusable and expandable set of services and functions needed by many applications to function well in a networked environment: middleware components.

Motivation

- Intermediaries are important:
  - A useful abstraction for designing and studying emerging software infrastructures for the WWW.
  - Will permeate the Internet because of the increasing demand for personalization, localization, and ubiquity.

- Our goal:
  - Overview a wide range of intermediary systems and identify common characteristics and functional properties.
  - Examine the requirements and identify key components of intermediary systems.
  - Define a framework for comparing and designing intermediaries.

Extending the WWW-access model



Intermediaries at the origin server

- Enhancing dynamic-content provision by reducing Web-server load and improving QoS.
- HTTP accelerators: distribute requests, cache replies.
- Composition of dynamic content: IBM's ABR framework, INRIA's Weave. To this end, we need:
  - High-level abstractions for Web-site structure: object-models, graphs, or declarative languages.
  - Abstractions for specifying content composition: object dependence graphs with embedded trigger monitors; declarative specification of SQL queries and runtime policies.
  - Caching content or fragments of dynamic content.

Intermediaries on the net

- Web proxies and Content-Distribution Networks.
- Notification Systems (aka "Publish-Subscribe"):
  - SIFT (Stanford University).
  - AIDE by AT&T Research.
  - Grand Central Station by IBM.
  - FIGI (U. Cyprus).
- Issues and Features:
  - Description of profiles.
  - Profile execution.
  - Caching and versioning.
  - Server location and scalability.

Intermediaries for Mobility and Ubiquity: requirements

- Optimize C/S communication over the wireless medium.
- Support seamless access from a variety of devices.
- Customize content to different devices.
- Enable the provision of multiple formats to the same device over the same link.
- Support both synchronous and asynchronous interaction modes.
- Optimize the amount of useful content reaching the user (filtering).

Intermediaries for Mobility and Ubiquity: approaches

- Characteristic solutions:
  - IBM's WebExpress: C-I-S model.
  - WAP Gateways.
  - Blazer for PalmOS Handspring devices.
  - Web clipping system of Palm Inc.
- Features and Issues:
  - Single-proxy vs. end-to-end.
  - Open vs. proprietary design.
  - Centralized vs. distributed architecture.
  - Modularity and extensibility.

Intermediary Infrastructures

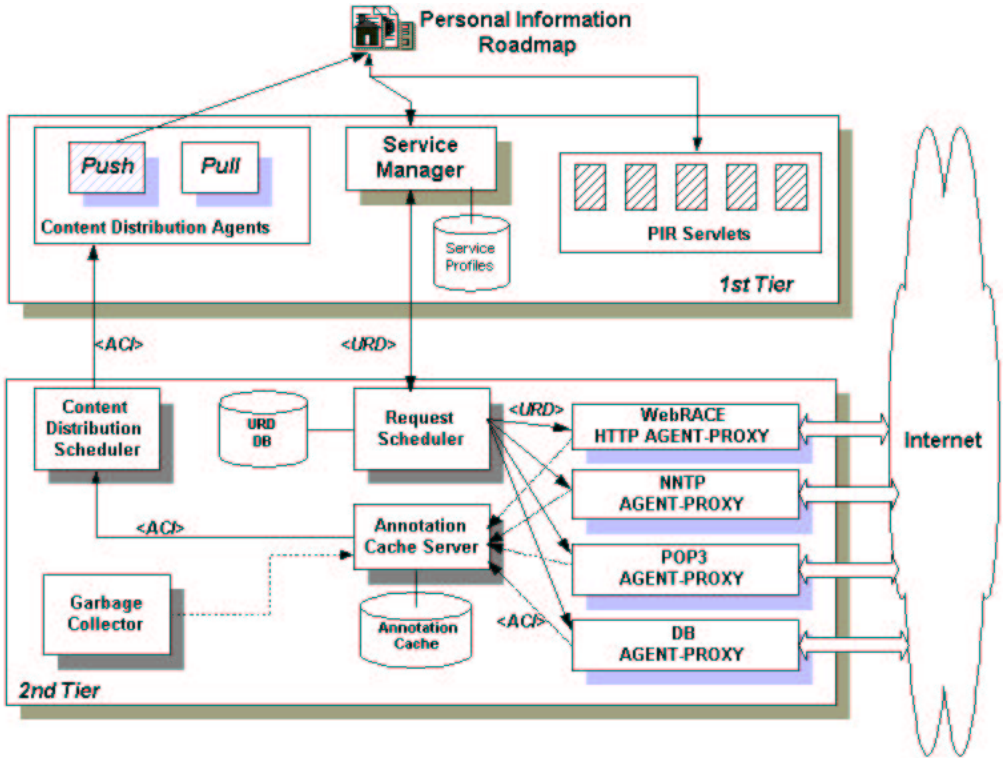
- Intermediary solutions need to support, additionally:
  - Large numbers of simultaneous end-users.
  - A large heterogeneity of end-user devices.
  - High throughput of requests for service.
  - Highly bursty workloads.
  - High-availability, robustness, and incremental scalability.
  - Definition and deployment of new services.

- Requirements:
  - Shift of computation, storage and complexity from clients, origin servers, mobile base-stations, or mobile hosts, into the network.
  - Distributed, cooperating, network-centered modules.
  - Support for programmability and/or reconfigurability.

Towards Intermediary Infrastructures

- Web Browser Intelligence or WeB Intermediaries (WBI), IBM Almaden.
  - Information Streams.
  - Requests editors, generators, document editors, monitors, autonomous functions
- iMobile by AT&T Research.
  - iProxy and let engine
  - devlets, infolets, applets
- Ninja
  - bases, active proxies, units, paths
  - design patterns: wrap, pipeline, combine, replicate

eRACE


Personal Information Roadmap
Push
Pull
Content Distribution Agents
Service Manager
Service Profiles
PIR Servlets
1st Tier
<ACI>
<URD>
Content Distribution Scheduler
URD DB
Request Scheduler
<URD>
WebRACE HTTP AGENT-PROXY
NNTP AGENT-PROXY
POP3 AGENT-PROXY
DB AGENT-PROXY
Internet
<ACI>
Annotation Cache Server
Garbage Collector
Annotation Cache
<ACI>
2nd Tier

Classifying Intermediaries

- Software architecture:
  - *Structure*: centralized vs. distributed.
  - *Location of components*: network, client side, origin-server side.
  - *Caching and Archiving* support.
  - *Programmability and Configurability*.

- Interaction with clients and origin servers:
  - *Proxy-Server Protocols*: HTTP, NNTP, SMTP, WAP, etc.
  - *Client-Proxy Protocols*: HTTP, UDP, GSM/SMS, WAP, etc.
  - *Supported Media*: wireline, wireless.
  - *Access Model*: push vs. pull.
  - *Communication Mode*: synchronous vs. asynchronous.

Classifying Intermediaries (ctd.)

- Functionality:
  - *Customization*.
  - *Filtering*.
  - *Annotation*.
  - *Transcoding*.
  - *Aggregation*.

	Palm Clippings	**SIFT**	**AIDE**	**WBI**	**TACC**	**eRACE**
Software Architecture						
Structure	central.	central.	central	distr.	distr.	distr.
Component Location	network & client	network	network	network client, server	network server	network
Caching	limited	√	√	√	√	√
Crawling support	–	–	√	–	–	√
Archiving	–	–	√	–	–	√
Programmability	–	–	–	√	√	√
Configurability	√	–	–	√	√	√
Client-Intermediary-Server Interaction						
Proxy-Server Protocol	HTTP	NNTP	HTTP	HTTP	HTTP	HTTP, NNTP SMTP
Client-Proxy Protocol	UDP and compressed msgs.	SMTP HTTP	HTTP SMTP	HTTP	wireless protocols	HTTP, SMTP GMS/SMS
Medium	wireless	wireline	wireline	wireline wireless	wireless wireline	wireline wireless
Access Model	pull	pull/push	pull/push	pull/push	pull	pull/push
Communication Mode	synch.	asynch.	asynch.	synch. asynch.	synch.	asynch. synch.
Intermediary Functionalities						
Customization	–	–	–	√	√	√
Filtering	–	√	√	√	–	√
Annotation	–	–	√	√	√	√
Transcoding	√	–	–	√	√	√
Aggregation	–	√	√	√	√	√

Conclusions

- Intermediaries represent a useful abstraction for designing, developing, analyzing and comparing emerging software infrastructures for the wireline and wireless Web.

- Classification and comparison of different intermediary systems can be perform along three main dimensions, which capture the basic properties of an intermediary.

- Design of future systems has to be established upon distributed software modules, with an explicit information architecture, communicating via pass-by-value semantics, with modular design enabling them to support new communication protocols and to achieve incremental scalability.

- Open issues: Programming and/or configuration of intermediaries, interoperability of different platforms, reusability of components.