# A CONFIGURABLE INTERNET BROWSER FOR UNRELIABLE INTERNET CONNECTION

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***Abstract***

*In this paper, we introduce a configurable Internet browser for accessing Internet using networks with low-quality connection. The goal is to build user-configurable Internet browser from existing software. We propose a new model for accessing Internet that allows a user to keep accessing the Internet even in very low speed and/or with temporary disconnection. In this model, we integrate concept of User-Oriented Quality of Service into Internet browser. The User-Oriented Quality of Service becomes a critical issue here, because the current model assumes a partial approach where access is constrained by the browser used to access the Internet. Furthermore, the browser fully controls the way access is performed, giving no opportunity for the user to specify alternative access arrangements. We therefore need a more flexible access model that allows a user to break the constraints.*

## 1. Introduction

The requirements for Quality of Service (QoS) of Internet access are traditionally expressed in terms of network oriented or systems oriented parameters. The term QoS refers to a set of performance metrics that provide an objective measurement of a user in a given network [2], [4]. Most of the researches in the provision of QoS have occurred in the context of network-oriented QoS. The research has focused on providing suitable traffic models and service. Many concepts have evolved to define and provide an improved QoS. The concept that observed by Ray [5] is referred to Policy-based Networking. It lets the network managers define service policies that govern how much bandwidth goes to specific applications and end users. Ref. [8] refers to QoS as network ability to provide service guarantees appropriate for various applications while at the same time making efficient use of network resources. More specifically, QoS refers to a set of metrics performance that provides an objective measurement.

One of the definitions of QoS is the ability to guarantee a service level [6]. If infinite network resource were available, then all the above parameters would be well within the applications requirement. It means that QoS have specified by network or systems. Access rate, bandwidth available, reliability of network and performance are the key factors that influence QoS [1]. In the situation with low-quality connection, it is difficult to achieve QoS that satisfied the users. Low-quality Internet connection can be caused by poor communication infrastructure or mobile

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environment that is characterized by inherently low-speed networks and limited end-systems performance.

## 2. Problem Description

Most third-world countries like Indonesia have poor communication infrastructure. As can be seen in Table 1, Indonesia is still bandwidth starved with 512 Kbps connection to the Internet. It is relatively slow. Fast and reliable Internet connection is a luxury for the majority of people. While cost-effective network infrastructure solutions have been available, most software tools (e.g., browser, file transfer tools, and e-mail clients) do not suit the situation. They assume all users have high-speed connection in accessing the Internet. The problem is that when the connection is bad, they decide to fail the operation without leaving the user with any option. As a result, it is extremely difficult to execute a complete access operation in a low-quality Internet connection. This situation discourages people from harnessing the potential of Internet as a communication medium or a giant information repository.

Table 1 Broadband Access Speed

| | Average Mass-Market Broadband Speeds | Maximum Speeds Available |
|---|---|---|
| Hong Kong | 6-10 Mbps | 10/100-Mbps Ethernet |
| India | 128-512 Kbps | 10-Mbps Ethernet |
| Indonesia | 384-512 Kbps | 512 Kbps |
| Malaysia | 512 Kbps | 2 Mbps |
| New Zealand | 256 Kbps-1Mbps | 2 Mbps |
| Philippines | 384-512 Kbps | 3 Mbps |
| Singapore | 1-2 Mbps | 6-Mbps cable modem |
| South Korea | 3-10 Mbps | 100-Mbps Ethernet VDSL/25 Mbps |
| Taiwan | 1-2 Mbps | Full-rate ADSL/6-8 Mbps 10-Mbps Ethernet |
| Thailand | 128-512 Kbps | 1-2 Mbps |

Source: Gartner Dataquest (July 2005)

Until recently the World Wide Web (WWW) and the associated browser have provided no support for accessing Internet in low-quality connection environment. They are designed for high-bandwidth, high-connectivity environments [7]. That is, they optimize for speed, assuming that the users can quickly look through the result and immediately run a second, modified their request if they are unhappy with the results of their access. This tight feedback loop between the users and the browser is inappropriate for low-quality connection environment.

In contrary, when a user accesses the Internet, he or she does not always expect instantaneous response from the party in the other side of the Internet. In many cases, the user is willing to wait longer. For example, many Web search attempts do not impose strict turnaround time limitations. Furthermore, a user may want to specify certain alternative actions if access cannot be executed in a specified time frame. This kind of flexible access cannot be facilitated by current browser. The browsers do not provide opportunities to the users to specify other access arrangements that may be worth trying.

In this paper we propose a new model for accessing Internet that allows a user to keep accessing the Internet even in very low speed and/or with temporary disconnection. In the new model, we will integrate a concept of User-Oriented QoS into Internet browser. Concept of User-Oriented QoS in this study is observed from user perspective. This concept is more emphasize at improving usability aspect for end-user in accessing Internet using networks with low-quality connection. This aspect was achieved by giving mechanism to specify user's requirements and mechanism to control access behavior with more dynamic.

## 3. Quality of Service Technology

The concept of Quality of Service (QoS) arises due to the fact that Internet requires guarantees for transmission of information. Quality of Service (QoS ) is defined as the set of qualitative and quantitative characteristics of a telecommunication system that are necessary to achieve the required functionality of applications and furthermore to satisfy the user [10]. The user's perceptions define the acceptable parameter values and the acceptable QoS [3], [9]. Therefore the telecommunication system supports a QoS level to make sure that application and the user's requirements are met.

Specification of QoS can be done at various system levels for e.g., protocol layers like transport/network, middleware or other applications. QoS specification includes 5 specifying requirements for performance, synchronization, QoS management, cost and the level of service. Expected performance characteristics are needed to establish resource commitments. Specification of synchronization includes characterizing the degree of synchronization between related services or events. Specification of the level of service for QoS states the degree of resource commitment required to maintain performance guarantees. The cost of service signifies the price a user is willing to incur to obtain a desired level of service. QoS management is the degree of QoS adaptation that can be tolerated and scaling actions to be taken in the event the contracted QoS cannot be met.
QoS requirements are specified by the high-level parameters of an application that convey what the user requires. An assessment of the QoS requirements should be performed to determine if they can be met. In case the specified level of service cannot be provided then trade-offs need to be specified.

## 4. The Need for Configurable Internet Browser

Given the low-quality connection, we realized that the model for accessing Internet that exists today is not compatible with the poor communication infrastructure. The browsers are designed for high bandwidth and high-connectivity environment. Browsing the news site that is image-sensitive is impossible at 28 Kbps. Although all browsers do have an option for turning off images, many users do not know that this option exists nor how to do it.

Based on this situation, we therefore need a browser that can provide support for accessing Internet in low-quality connection environment. This research develops configurable Internet browser to enable users to specify their access and preferences of QoS requirements.

### 4.1. Quality of Service Framework

In order to incorporate the concept of User-oriented Quality of Service into the Internet browser design, a QoS framework is needed. The main requirements considered in the Quality of Service framework were:

- Support for high expressiveness, allowing users to specify QoS requirements according to the notion of quality that appropriate with media application.
- Provide mechanism for mapping from user's QoS parameters to application resource requirements.

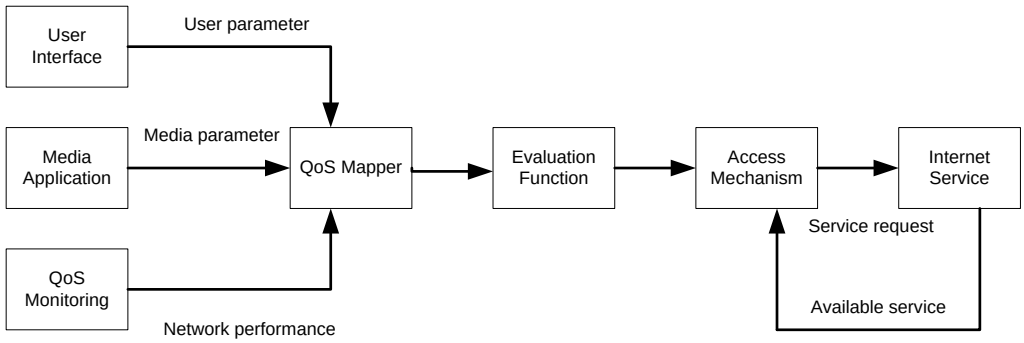


*Fig. 1. Framework Components*

Fig.1. depicts a functional diagram of the QoS framework components. The framework exhibit 7 components, namely user interface, media application, QoS monitoring, QoS mapper, evaluation function, access mechanism and Internet service. In the paragraphs below we provide the function of these components.

The user interface is responsible for capturing the personal property and preferences of the users. The ability of the user to influence the QoS mechanism is an important part of the QoS framework. The media application performs the media type and the parameters related to the application that requested by users. The QoS monitoring watches system performance at run time and reports the value regarding the state of the resource. The QoS mapper would convert high-level user QoS specifications to a set of resource requirements. QoS parameters have to be translated between different levels of abstraction to be meaningful for the mechanism present at a particular level. The evaluation function compares between the values of user's QoS parameters and the network parameters. Finally, the access mechanism is responsible for implementing the QoS mechanism necessary for the provision of services with the quality requested by the user.

### 4.2. Quality of Service Specification

Different applications demand different service qualities. Some need minimal delay and guaranteed response time, while others may need a good image quality (resolution/color information/frame rate of picture, etc.), or good sound quality (dynamic range/frequency performance/noise ratio/distortion ratio etc.).

From the user's perspective, QoS can be defined as a set of QoS parameters. In our study, users need some parameters that can be measured easily from user's side. Users also have an opportunity to set these parameters when he or she accessed the Internet.
The three dimensions that influence the user-oriented QoS are:

- Expectation refers to a user requirement in accessing Internet. User appreciation based on period of time to get response from their request.
- Performance deals with systems reliability, such as availability and throughput. From user point of view, this dimension reflects request successfulness, so it will influence user expectation of QoS.

- Perception puts emphasis on user opinion about service level subjectively and truly depends on their perception. It refers to information content that corresponding with their request. It is necessary to compare between user expectation of QoS and systems delivery of QoS.

In this paper, we proposed three parameters to set QoS specification, namely response time (**t**), access availability (**s**), and content (**c**). These parameters will be an attribute that characterized the modeling of Internet access based on user-oriented QoS. The first parameter estimates a period of times that needed by user for receiving response for their access. The second parameter represents certainty that service can be fulfilled by the system. And the third parameter represents characteristic related to accuracy measure or level of concordance between content of output and function or service which performed.

User's specification can be modeled as follows:

**$S_i$:** { **precondition** : ($S_n$ ,f) | (**action** : ($a_i$ , [$q_{exp}$]) | **postcondition** : $(f \rightarrow S_t \vee \neg f \rightarrow S_f)$ }

The State ($S_i$) represents transition from one condition to another condition. The Operation relate to two conditions: Pre-condition and Post-condition. Pre-condition express a state before the action ($a_i$) is done and Post-condition express a state after the operation have finished the action ($a_i$).

### 4.3. Architectural Components

Based on the model, we develop architectural components that represent system functionalities. Fig. 2 and Fig. 3 describe the architectural components at user-level and application-level respectively. As depicts in Fig. 2, the user interface captures the user's specification. The user selects the media that he or she is willing to be provided with. This media is constraint by QoS requirements express by QoS parameter.

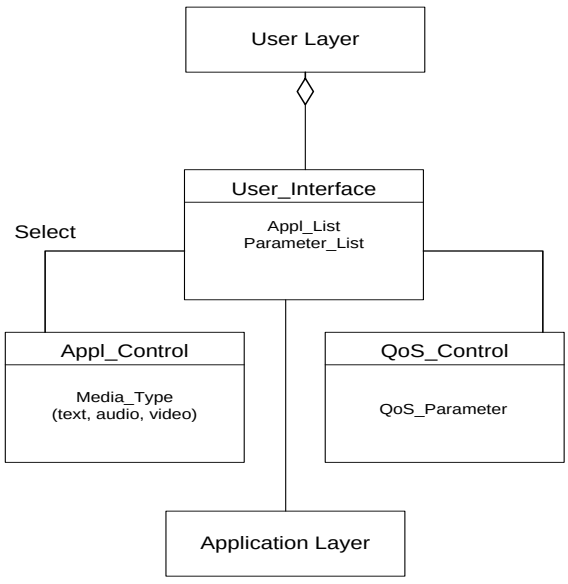


*Fig. 2. Architectural Componentsat User-level*

The application layer performs a first refinement of the information supplied by user layer. Each layer may incorporate many media type which relate to the user's purposes about the service to be provided. The application layer also contains a controller which is responsible for deploying the appropriate function in response to requests from the user layer.

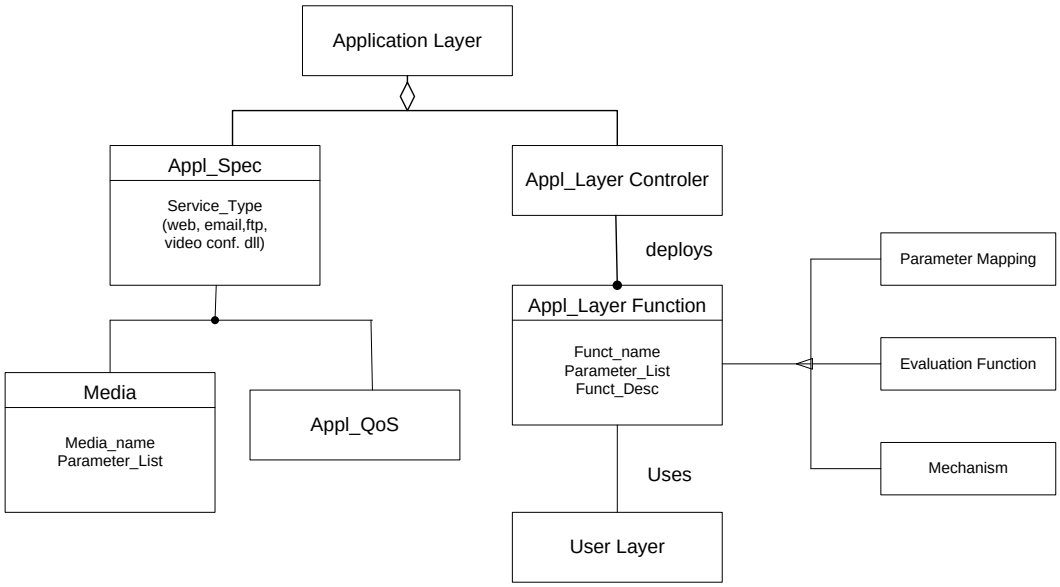


*Fig. 3. Architectural Components at Application-level*

## 5. The Browser Model

We have designed and implemented a configurable browser with intent to addressing the limitation of previous browser.

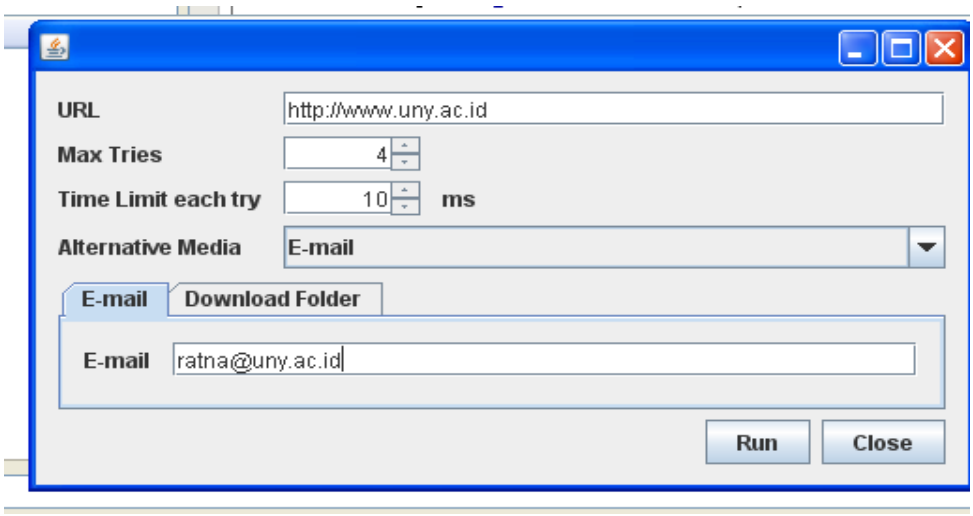


*Fig. 4. User Interface*

Using the user interface, the users enter the URL and the values of QoS parameters to specify their access. In the case that quality of service can not be fulfilled by the system, there is an option for the users to send the result to the user's email address.

Fig. 5 shows the implementation diagram of the functional prototype. The functional prototype consists of the component used for specification of QoS parameters and user's option for their access, the System Monitor, Media Base, Media Parameter, and the Decision Maker.

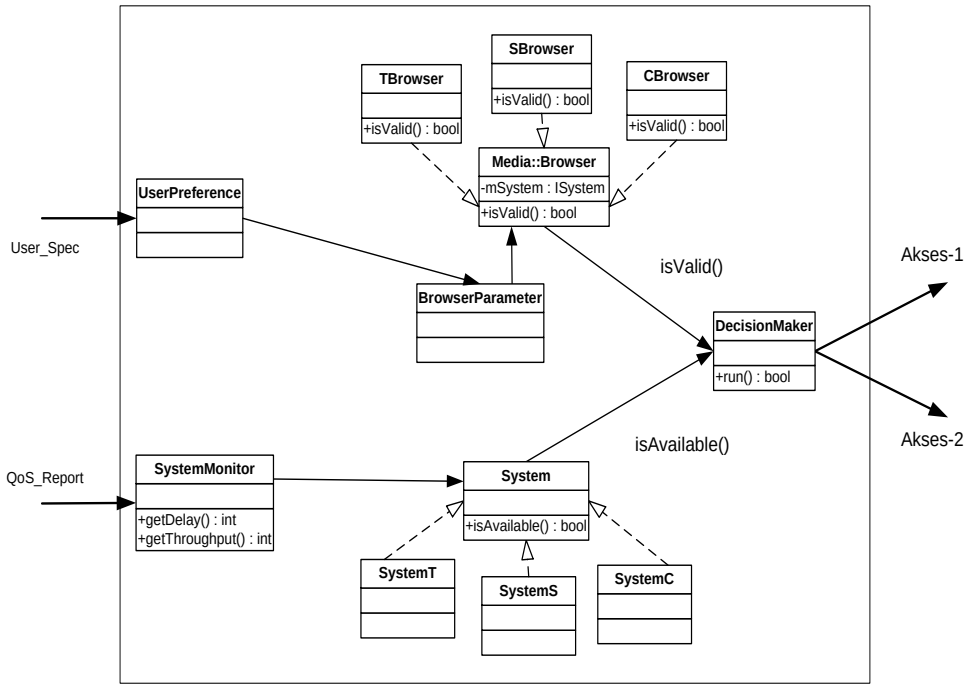


*Fig. 5. Implementation Diagram*

## 6. Conclusion

In this paper we have proposed a prototype of the configurable browser that addresses the problem associated with QoS enforcement for accessing Internet in low-quality connection environments. The browser allows the user to specify their access arrangement so that they can control the access behavior more dynamic.

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