

Usage of Analytic Hierarchy Process for Communication Service Selection

Rahamatullah Khondoker

Integrated Communication Systems, University of Kaiserslautern
67663 Kaiserslautern, Germany

Abstract. Several current (e.g. TCP/IP, UDP/IP, SCTP/IP) and future (SONATE, NENA) service providers offer similar communication functionality but differ in quality on a variety of important criteria. As the number of service providers increases, the need to select the best service based on criteria for certain application requirements is increasing. However, this process is complex and must be automated. We used Analytic Hierarchy Process (AHP) to do this task as it supports relative prioritization and consistency checking. In this paper, I will present how can AHP be used to select the best service among the six service providers on the basis of six selection criteria [1].

1 Introduction

The current network architecture is inflexible where integration of new functionality and deletion of existing functionality is sometimes nearly impossible. For example, almost sixteen years have been passed from the emergence of the first RFC1883 for IPv6 protocol in December 1995 [2], it is still cannot be accommodated into the Internet. Even though IPv4 cannot fulfill the demands for the future in terms of the number of equipment to be addressed, deleting the protocol from the network is not possible. This inflexibility issue of the Internet leads to the research towards future network architectures which created architectures like Adaptive, DaCaPO, FCSS, ANA, Network Service Architecture, Net-Silo, RBA, RNA, NENA and SONATE [3]. As these architectures can offer communication services like reliable transmission, routing, addressing, encryption, authentication and unreliable transmission, those architectures can be seen as service providers.

Current network stack offers only a limited number of communication services. For example, reliable transmission (TCP/IP), unreliable transmission (UDP/IP) and security (IPSec, TLS/SSL). We assume that, in future, there will be several future network architectures. In that case, similar services in terms of functionality can also be offered by several providers. These similar services can differ in quality parameters. For example, a reliable transmission service which is provided by forward error correction mechanism can have less delay than when the same service is provided by retransmission mechanism. Similar services having different quality parameters, the best service should be selected and used.

For taking similar type of managerial decisions, decision makers usually use Multi-Criteria Decision Analysis (MCDA) methods such as Multi-Attribute

Utility Theory (MAUT), Analytic Hierarchy Process (AHP), Evamix, Regime, ELECTRE III, NAIADe and Multi-Objective-Programming/Goal Programming (MOP/GOP). In the year 2000, Andrea de Montis et al. completed an extensive survey of different MCDA methods and compared them based on the operational components of the methods, their applicability in user context and their applicability for problem structure [4]. One of the operational components of the methods was the inter-dependencies among criteria. They showed that no other methods except AHP allows the interdependence among criteria. The selection criteria for communication services are delay, throughput, loss rate, jitter, energy consumption and data length. These criteria are dependent on each other. That is why, among the existing MCDA methods, only AHP can be used. AHP uses absolute scales to derive priorities that also belong to relative absolute scales (like probabilities) that can be combined like the real number system. All other methods use ratio or interval scales that cannot be combined meaningfully when there is interdependence. Moreover, in AHP, there is a way to measure the consistency of the evaluation measures.

AHP can be used to select the best communication service. AHP works as follows: 1. the selection criteria are distinguished. 2. pairwise priority is assigned among the criteria. 3. the overall priority for all of the criteria are calculated. 4. consistency of the priority assignment are checked. if there is a inconsistency, pairwise priority are changed and repeat from step 2. 5. Reach to the final decision. In this paper we assume that the quality parameters and their values of each offered services are known. The parameters which are not dependent on network can be pre-calculated and pre-assigned. For example, CRC32-IEEE 802.3 can detect maximum 8 bit error and AES256 encryption uses 256 bit keys. But, the parameters which are dependent on network needs to either pre-calculated based on probability, can be assigned based on traffic characteristics or can be collected by using sensing software.

For selecting the best communication service using AHP, the offered services need to pairwise prioritized for each selection criteria. This pairwise priority assignment can be automatized based on user expectation. For example, less delay, more throughput, no loss and less jitter are expected by every application user.

2 Results

We implemented and evaluated AHP for communication service selection. The implementation is done using java programming language. The evaluation is done in two steps. In the first step, we incremented the number of services and criteria from 2 to 6 and we tracked the mapping time. Mapping time is the time between assigning the priorities of offered services considering their measured values and obtaining the hints from the application requirements. In step 2, we incremented the number of services and criteria from 2 to 6 and we tracked the selection time. Selection time is the processing time of service selection without considering the mapping time. In the first step, we found that mapping time is linearly increased

and took maximum 23 microsecond for 6 effects and 6 services. In the second step, we found that the selection time is exponentially increased and took only 480 microsecond for selecting the best service among 6 services considering 6 criteria.

References

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