

Design of Analytic Hierarchy Process Algorithm and Its Application for Vertical Handover in Cellular Communication

Under the Guidance of
Asso. Prof. Mr. Saurav Dhar
Deptt. of Electronics and Communication Engineering
Sikkim Manipal Institute of Technology

Asst. Prof. Dr. Ashish Pathak
Deptt. of Mathematics
Sikkim Manipal Institute of Technology

Presented By
Ashish Kumar Sharma
B-Tech, Deptt. Of Electronics and Communication Engineering
Sikkim Manipal Institute of Technology

How to make Decision: The Analytic Hierarchy Process

The most creative task in making a decision is to choose the factors that are important for that decision. In the Analytic Hierarchy Process we arrange these factors, once selected, in a hierarchy structure descending from an overall goal to criteria, sub-criteria and alternative in successive levels.

To a person unfamiliar with the subject there may be some concern about what to include and where to include it. When constructing hierarchies one must include enough relevant details as:

- I) To represent the problem as thoroughly as possible, but not so thoroughly as to lose sensitivity to change in the elements.
- II) To consider the environment surrounding the problem.
- III) To identify the issue or attributes that contribute to solution.
- IV) To identify the participants associated with the problem

Arranging the goals, attributes, issues and stakeholders in a hierarchy serves two purposes.

- It provides an overall view of complex relationships inherent in the situation.
- It helps the decision makers assess whether the issue in each levels are of the same order of magnitude, so he can compare such homogeneous elements accurately.



We can apply AHP technique in many of our day to day scenarios as Deciding which candidate to be elected as public representative for State and Central Legislative Assemblies, At Company Meetings for taking decision's related to policy up gradations and other company related issues.

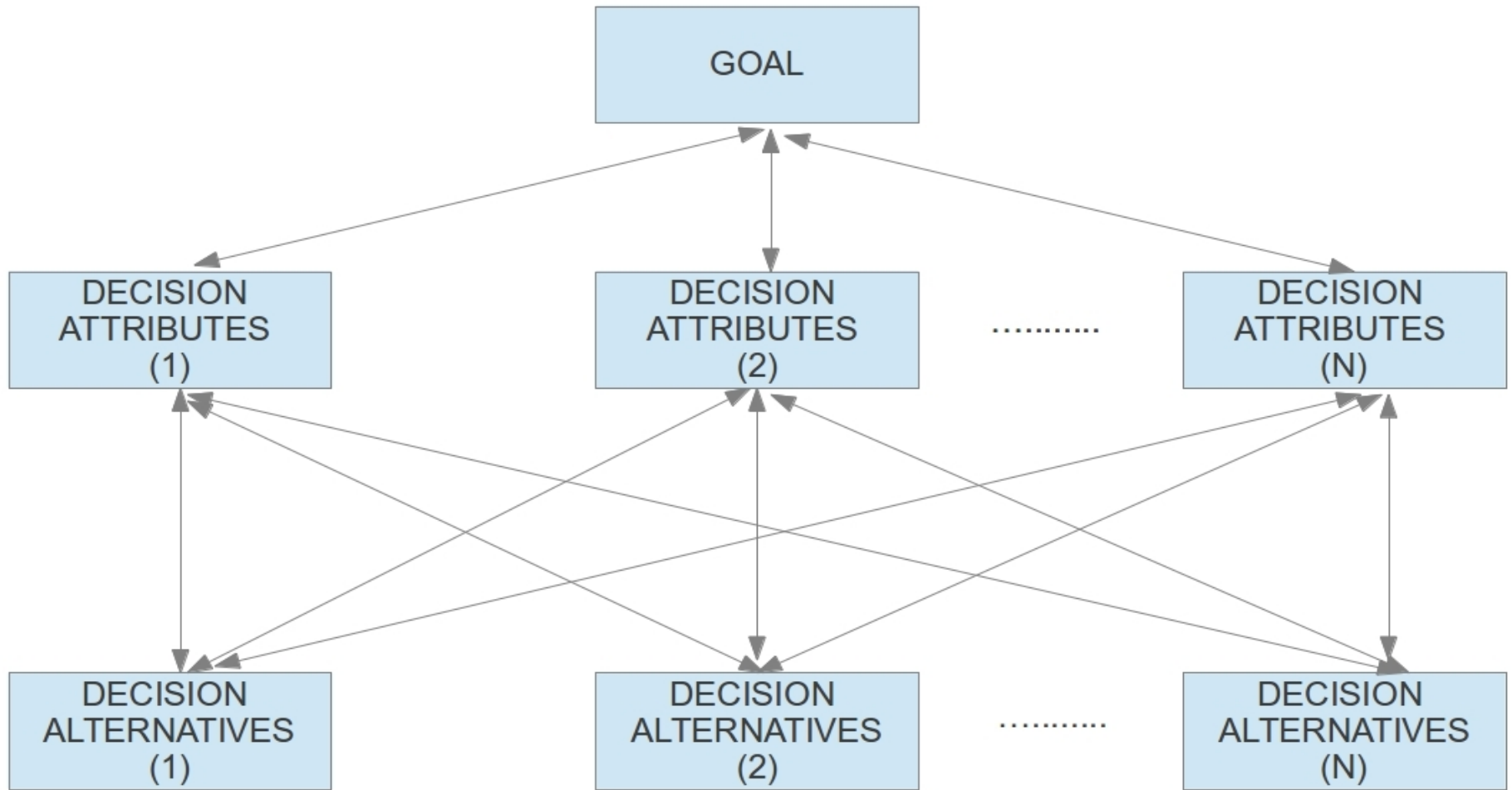
Intensity of Importance on an absolute scale

Definition

Explanation

1	Equal Importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and Judgment strongly favor one activity over another
5	Essential or Strong importance	Experience and Judgment strongly favor one activity over another
7	Very strong importance	An activity is strongly favored and its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When compromise is needed
Reciprocals	If activity ' <i>i</i> ' has one of the above numbers assigned to it when compared with activity ' <i>j</i> ', then ' <i>j</i> ' has the reciprocal value when compared with ' <i>i</i> '	
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining n numerical values to span the matrix

The Fundamental Scale



Flow Chart Demonstrates Level - Controls of Analytic Hierarchy Process (AHP)

Mathematical Formulation (Steps to be followed for Solving Problem's)

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1,n} \\ a_{21} & a_{22} & \dots & a_{2,n} \\ a_{31} & a_{32} & \dots & a_{3,n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{n,n} \end{bmatrix}$$

$$a_{i,j} = 1, \text{ for } i = j, a_{i,j} = \frac{1}{a_{j,i}} \text{ for } a_{i,j} \neq 0$$

Normalized Matrix ----- $A' =$

$$\begin{bmatrix} \frac{a_{11}}{\sum a_{i,1}} & \frac{a_{12}}{\sum a_{i,2}} & \dots & \frac{a_{1,n}}{\sum a_{i,n}} \\ \frac{a_{21}}{\sum a_{i,1}} & \frac{a_{22}}{\sum a_{i,2}} & \dots & \frac{a_{2,n}}{\sum a_{i,n}} \\ \frac{a_{31}}{\sum a_{i,1}} & \frac{a_{32}}{\sum a_{i,2}} & \dots & \frac{a_{3,n}}{\sum a_{i,n}} \\ \dots & \dots & \dots & \dots \\ \frac{a_{n1}}{\sum a_{i,1}} & \frac{a_{n2}}{\sum a_{i,2}} & \dots & \frac{a_{n,n}}{\sum a_{i,n}} \end{bmatrix}$$

	1	2	3	4	5	6	7	8
1	1	5	3	7	6	6	0 1/3	0 1/4
2	0 1/5	1	0 1/3	5	3	3	0 1/5	0 1/7
3	0 1/3	3	1	6	3	4	6	0 1/5
4	0 1/7	0 1/5	0 1/6	1	0 1/3	0 1/4	0 1/7	0 1/8
5	0 1/6	0 1/3	0 1/3	3	1	0 1/2	0 1/5	0 1/6
6	0 1/6	0 1/3	0 1/4	4	2	1	0 1/5	0 1/6
7	3	5	0 1/6	7	5	5	1	0 1/2
8	4	7	5	8	6	6	2	1
C_SUM	9.0095	21.8667	10.2500	41.0000	26.3333	25.7500	10.0762	2.5512

N_VEC

	1	2	3	4	5	6	7	8	P_VEC
1	0.1110	0.2287	0.2927	0.1707	0.2278	0.2330	0.0331	0.0980	0.1744
2	0.0222	0.0457	0.0325	0.1220	0.1139	0.1165	0.0198	0.0560	0.0661
3	0.0370	0.1372	0.0976	0.1463	0.1139	0.1553	0.5955	0.0784	0.1702
4	0.0159	0.0091	0.0163	0.0244	0.0127	0.0097	0.0142	0.0490	0.0189
5	0.0185	0.0152	0.0325	0.0732	0.0380	0.0194	0.0198	0.0653	0.0353
6	0.1667	0.1667	0.0833	1.0000	0.4000	0.1667	0.0286	0.0208	0.2541
7	0.3330	0.2287	0.0163	0.1707	0.1899	0.1942	0.0992	0.1960	0.1785
8	0.4440	0.3201	0.4878	0.1951	0.2278	0.2330	0.1985	0.3920	0.3123

$$P = \begin{bmatrix} p_1 \\ p_2 \\ p_3 \\ \cdot \\ \cdot \\ \cdot \\ p_n \end{bmatrix} \quad p_k = \text{Avg}(k^{\text{th}} \text{ row of } A')$$

$$\Lambda = \frac{(A \times P)}{P} = \begin{bmatrix} \lambda_1 \\ \lambda_2 \\ \lambda_3 \\ \cdot \\ \cdot \\ \lambda_n \end{bmatrix}$$

$$\lambda_{\max} = \frac{\lambda_1 + \lambda_2 + \lambda_3 + \dots + \lambda_n}{n}$$

$$\text{Consistency Index } C_I = \frac{(\lambda_{\max} - n)}{(n - 1)}$$

$$\text{Consistency Ratio} = \frac{C_I}{R_I} \quad R_I \text{ is Random Index.}$$

$$\mathit{result} - \mathit{mat} = \sum_{i=0} P_{(i, k)} P_{(k)} a$$

$$\mathit{RESULT} = \max(\mathit{result} - \mathit{mat})$$

➤ **IMPORTANT KEY POINTS TO KEPT IN MIND WHILE PERFORMING AHP BASED ANALYSIS**

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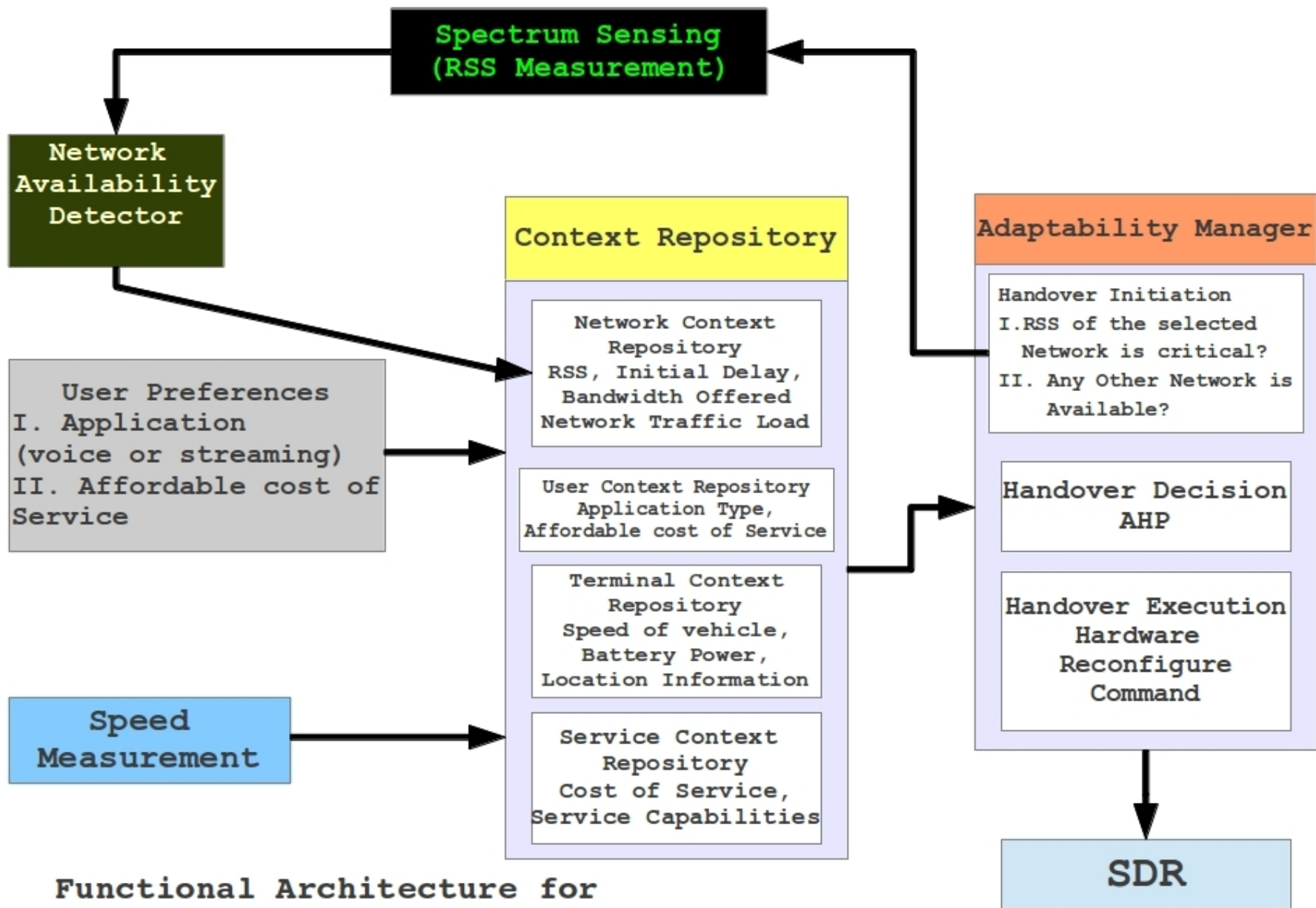
➤ **AHP tolerate some inconsistency, and according to the theory if the consistency ratio is $< 10\%$, then the level of inconsistency is acceptable, Otherwise, the inconsistency is high and elements of the decision matrix must be reworked or revised.**

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➤ **The final ranking of the alternatives are determined by multiplying the priority vector of the criteria (found from first level AHP matrix) by the priorities (found from each second level AHP matrix) for each decision alternatives for each objective.**



Functional Architecture for Vertical Handover

**THANK YOU
ALL!
FOR YOUR SUPPORT
AND
FOR THIS OPPORTUNITY
PROVIDIED TO PRESENT
MY WORK**

