**PROJECT REPORT**

*on*

**TRANSIT TRAFFIC ROUTING**

*Submitted in partial fulfilment for the award of the degree*

*of*

**Masters of Science in Computer Science**

*by*

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**Problem Description**

This report is based on solving the following problem statement:

* We are defined with four nodes namely A, B, C, D connected to each other in such a fashion that A is connected to B and D, B with A and C , C with B and D and lastly D with A and C with eight different as shown in figure below:

3 5

4 3

2 6

5 1

*Figure 1*

* Above given is the figure showing 8 independent links and each links’ capacity.
* Also we are given the traffic flow intensity for the source –destination pair as:

|  |  |
| --- | --- |
| Source-destination pair | Traffic flow intensity |
| A -> C | 4 |
| B -> D | 3 |
| C -> A | 2 |

* Traffic control variable decide the fraction of data incoming from a source to be distributed among various paths to the destination.

As we have 3 source-destination pair we these are defined as

* α for the path ABC
* (1-α) for the path ADC
* Β for the path BCD
* (1-β) for the path BAD
* γ for the path CDA
* (1- γ) for the path CBA

* Utilization of a link IJ given by

**uIJ = lIJ / sIJ. lIJ**

where lIJ is the intensity of total traffic offered to link IJ, and sIJ denotes capacity of this link. Here we assume that uIJ >1.

|  |  |
| --- | --- |
| Link | Utlilization |
| uAB | 4α/3 |
| uBC | 4α+3β/5 |
| uCD | 3β+2 γ /1 |
| uDA | 2 γ /5 |
| uBA | 3(1-β)+2(1- γ)/4 |
| uCB | 2(1- γ)/3 |
| uDC | 4(1-α)/6 |
| uAD | 4(1-α)+3(1-β)/2 |

* The **cost** uXTY of a transit path {XT,TY} is equal to

**uXTY = uXT+ uTY,**

where uXT is the utilization.

So, cost for different links will be calculated as:

|  |  |
| --- | --- |
| Links | cost |
| uABC | 4α/3 + 4α+3β/5 |
| uADC | 4(1-α)+3(1-β)/2 + 4(1-α)/6 |
| uBCD | 4α+3β/5 + 3β+2 γ /1 |
| uBAD | 3(1-β)+2(1- γ)/4 + 4(1-α)+3(1-β)/2 |
| uCDA | 3β+2g /1 + 2 γ /5 |
| uCBA | 2(1- γ)/3 + 3(1-β) + 2(1- γ)/4 |

* All traffic flows using link IJ contribute to its offered traffic lIJ, e.g. fractions of fBD and fCA routed over {BC, CD} and {CD, DA} respectively, contribute to lCD .
* Each source selects for an incoming packet a transit path to the destination with the lowest cost

**Algorithm**

**Step 1**: Considering the traffic control variable as mentioned below for the traffic flow between the nodes mentioned in the problem description

* α for the path ABC
* (1-α) for the path ADC
* Β for the path BCD
* (1-β) for the path BAD
* γ for the path CDA
* (1- γ) for the path CBA

Step 2: The traffic control variables, α, β and γ are initialized with the input provided by the user (Assumption: The values provided by the user for α, β and γ must be between the values 0 to 1)

**Step 3**: The value of the utilizations of each path is calculated based on the formula,

Utilization of the link UIJ = lIJ/SIJ

Where,lIJ is the intensity of total traffic offered to the link IJ.

SIJ denotes the capacity of this link.

And cost of the paths from A->C, B->D and C->A is calculated via the formula,

Cost UXTY of a transit path {XT,TY} is equal to UXTY = UXT + UTY ,

Where, UIJ is the utilization of a link IJ .

**Step 4:** The traffic for the path A->C, B->D and C-> A is routed via,

* the paths {ABC and ADC} from node A(Source) -> B(Destination)
* the paths {BCD and BAD} from node B(Source) ->D(Destination)
* the paths {CDA and CBA} from node C(Source) -> A(Destination)

**Step 5:** Repeat Step 5 and Step 6 until the value of the utilizations become same or similar, that is, the difference between the values of the utilization of the pair of paths mentioned above in a source/destination pair.

**Step 6:** On each traffic flow via traffic route chosen based on the least utilization as mentioned above between the source/destination pair update the values of α, (1-α), β, (1-β), γ and (1- γ).

If UABC is greater than UADC -

Decrement the value of α by .001

Calculate (1-α).

Else

Increment the value of α by .001

Calculate (1-α).

If UBCD is greater than UBAD

Decrement the value of β by .001

Calculate (1- β).

Else

Increment the value of β by .001

Calculate (1- β).

If UCDA is greater than UCBA

Decrement the value of γ by .001

Calculate (1- γ).

Else

Increment the value of γ by .001

Calculate (1- γ).

Where,

* UABC  is the cost of the path obtained by UABC = UAB + UBC.

UAB = LAB / CAB . i.e.LAB is the Load of the link AB and CAB is the capacity of the link AB

UBC = LBC / CBC . i.e. LBC is the Load of the link BC and CBC is the capacity of the link BC

* UADC is the cost of the path obtained by UADC = UAD + UDC.

UAD = LAD / CAD . i.e. LAD is the Load of the link AD and CAD is the capacity of the link AD

UDC = LDC / CDC . i.e.LDC is the Load of the link DC and CDC is the capacity of the link DC

* UBCD  is the cost of the path obtained by UBCD = UBC + UCD.

UBC = LBC / CBC . i.e. LBC is the Load of the link BC and CBC is the capacity of the link BC

UCD = LCD / CCD . i.e. LCD is the Load of the link CD and CCD is the capacity of the link CD

* UBAD is the cost of the path obtained by UBAD = UBA + UAD.

UBA = LBA / CBA .  i.e. LAD is the Load of the link BA and CAD is the capacity of the link BA

UAD = LAD / CAD . i.e.LDC is the Load of the link AD and CAD is the capacity of the link AD

* UCDA  is the cost of the path obtained by UCDA = UCD + UDA.

UCD = LBC / CBC . i.e. LBC is the Load of the link BC and CBC is the capacity of the link BC

UDA = LCD / CCD . i.e. LCD is the Load of the link CD and CCD is the capacity of the link CD

* UCBA is the cost of the path obtained by UCBA = UCB + UBA.

UCB = LCB / CCB .  i.e. LCB is the Load of the link CB and CCB is the capacity of the link CB

UBA = LBA / CBA . i.e.LBA is the Load of the link BA and CBA is the capacity of the link BA

**Step 7:** Update the value of utilizations, load and cost of each link and path based on the latest values of α, β and γ.

**Step 8:** Stop the execution, whenever the above steps are executed successfully. The values of the traffic control variables, cost of the paths and utilizations of the same are printed in the final output.

**Flow Diagram**

Input values of traffic control variables and intensity at each source.

Calculate the **utilization, traffic load of all links and cost** of all the paths.

Difference of the cost of the two paths of a

**STOP**

single source-destination

**YES**

pair > 0.001

**NO**

Increment or decrement the Traffic control Variables by the value of 0.0001.

Calculate the **new utilization, load and cost** of all the links with the updated values of the traffic control variables.

**Conclusion**