Component Based Performance Analysis for MANET Routing Protocols
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Abstract
In consideration of adaptability to environment and flexibility in protocol construction, a novel Component Based Routing for MANET is presented. To facilitate quantitative analysis of Component’s impact on overall performance, the innovative Component Dependence Network (CDN) is introduced here. Firstly, the hierarchical structure of CDN is proposed as a four-layer structure. And, each intermediate nth layer completely d-separate (n-1)th layer and (n+1)th layer. Secondly, Include-Exclude algorithm is introduced, and is illustrated by an example.

1. Architecture Of Component Based Routing Protocol

- Path Discovery Component (PD)
- Topology Database Maintenance Component (TM)
- Route Maintenance Component (RM)
- Data Packet Forwarding Component (DF)

2. Hierarchical Structure for Component Dependence Network

- Component layer
- Derivative Component Metric Layer
- Allocated Component Metric Layer
- Overall Performance Metric Layer

3. Determine the parent set for layer 3 variable: Include-Exclude algorithm

Including Phase:

Step 1, initiate an empty evidence set E0={}.
Step 2, each time, include a new second layer variable X2j to create new evidence set Ej, go to step 3.
Step 3, test if Ind(X1i, X3k | Ej)=1. If so, then stop the growing steps, and go to excluding phase.
Otherwise, if Ind(X1i, X3k | Ej)=0, go back to Step 2.

Excluding Phase:

Step 1, each time, delete a second layer X2j variable from evidence set Ej to create new evidence set Ej-1. Go to step 2.
Step 2, test if Ind(X1i, X3k | Ej-1)=1. If so, go to step 1, and continue to delete next second layer variable from evidence set Ej-1. Otherwise, if Ind(X1i, X3k | Ej-1)=0, go to step 3. When all second layer variables are deleted once from evidence set, go to step 4.
Step 3, put back X2j to evidence set Ej-1 to restore evidence set Ej. And go to step 1.
Step 4, After all second layer variables are deleted once from evidence set to test the conditional independence, the minimal set for source destination pair <X1i, X3k>, is returned. It’s denoted as E1(X1i, X3k).

Step 5, Repeat step 1 to step 4, En(X1i , X3k) is returned at the end of each repetition. When En(X1i , X3k) = En-1(X1i , X3k), the excluding phase is completed, and cutmin(X1i , X3k) = En(X1i , X3k)

4. Example

Including Phase:

Initiate an empty set E0={}
Add in a second layer variable X21 to create new evidence set E1={X21}. Because Ind(X11, X31 | E1)=0(by independence test), continue Include Phase.
Create new evidence set E2={X22,X21} by inserting new second layer variable X22. Since Ind(X11, X31 | E2)=0 (by independence test), continue Include Phase.
Continue to insert second layer variable X23 into new evidence set E3={X23,X22,X21}. Because Ind(X11, X31 | E2)=1, stop Include Phase, and go to Exclude Phase

Excluding Phase 1:

1. Delete X23 from E3, E2={X22,X21}. Because Ind(X11, X31 | E2)=0, restore E3={X23,X22,X21}.
2. Delete X22 from E3, E2={X23,X21}. Because Ind(X11, X31 | E2)=0, rstore E3={X23,X22,X21}.
3. Delete X21 from E3, E2={X23,X22}. Since Ind(X11, X31 | E2)=1, keep E2={X23,X22}, And return E1(X11 , X31)={X23,X22}.

Excluding phase 2:

1. Delete X23 from E2, E1={X22}. Because Ind(X11, X31 | E1)=1, return E2(X11 , X31)={X22}.

Excluding phase 3:

1. Delete X22 from E2, E1={X22}. Because Ind(X11, X31 | E1)=1, return E3(X11 , X31)={X22}.
Since E3(X11 , X31)=E2(X11 , X31), Excluding Phase is stopped. And cutmin(X11, X31) = E3(X11 , X31)={ X22}. 