Fault Isolation In Networks With Partial Information
Srikar Tati (PSU), Scott Rager (PSU) and Tom F. La Porta (PSU)

Motivation and Objective

Active Monitoring:
-Uses active measurements (probes) in the network to localize the fault. Accurate, but too invasive resulting in high overhead.

Passive Monitoring:
-Uses passive end-to-end measurements and network topology to localize faults. Not very accurate, but incurs less overhead. Extensively used in network tomography.

Hybrid Monitoring:
-To increase the accuracy and decrease the overhead, hybrid monitoring can be employed.

Partial information in Networks:
-Assuming complete information of network topology is practically not feasible because of various reasons.
-Implications of partial information in networks should be analyzed for the validation of proposed fault localization algorithm.

Objective:
-To find the possible combination of links that can cause the given fault scenario using end-to-end measurements and topology.
-To localize the fault exactly using active probes in the network.
-Analyze this result in the case of partial information in networks.

Fault Localization Algorithm

-Uses the information of connected and disconnected sites (destinations) either from a single source or multiple sources.
-Assumes that we know all paths from sources to different destinations (both single and multiple paths).
-Checks every possible faulty link combination. Eliminates several possibilities using end-to-end measurements and other optimization schemes.
-Implements intelligent probing strategy on the resulting possibilities from the passive monitoring part.

Pseudo Code

```cpp
for(\( i = 1 \) to \( \text{num\_discon\_sites}\))
for(\( j = 1 \) to \( \text{num\_links\_source\_to\_site}\))
add link[\( i \)][\( j \)] to possible\_faulty\_links
list;
possible\_comb[all] = 1;
for \( (i = 1 \) to \( \text{num\_faulty\_link\_combinations}\) )
{
if \( \text{possible\_comb}[i] == 0 \)
break;
for \( (j = 1 \) to \( \text{num\_sites}\) )
{
if \( \text{faulty\_link\_combination}[i] \) disconnects site[\( j \)]
if \( \text{connected}[j] == 1 \)
possible\_comb[\( i \)] = 0;
super\_set (possible\_comb[\( i \)]) = 0;
break;
else
continue;
}
}
possible\_comb[] == set of possible
```

Illustration

![Diagram](example.png)

Example:

Results

Partial Information in Networks

-Acquiring the information of all paths from different source to destinations is termed as Dependency Discovery.
-In practical scenarios, dependency discovery is not complete and efficient. Reasons can be limited management-plane bandwidth, frequent network topology changes etc.
-Implications of partial information in networks on the proposed fault localization algorithm is analyzed.

Metric for partial information:
-A quantitative metric is proposed for the completeness of the partial dependency information. We represent the incomplete information of a path \( p \) with the metric \( I_p \).
-Main challenge is to know the ground truth (complete information) to represent the metric. So, we estimate the complete information using partial information.

This work is sponsored by DTRA.