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WINLAB | Wireless Information Network Laboratory

Edge-Aware Inter-Domain Routing
Exploring The Telescopic Function Parameter Space

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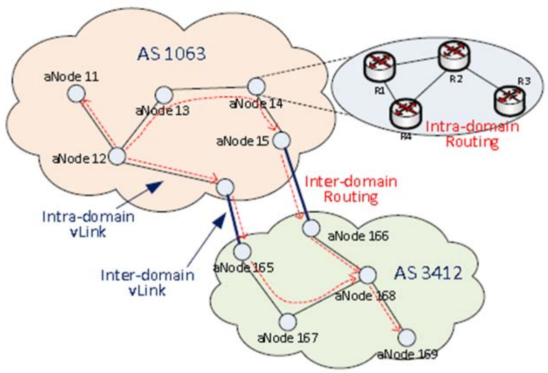
EIR

- **EIR is a clean slate inter-domain routing framework designed to support the emerging needs of mobile wireless at the edge.**
- **It optionally exposes internal network topology by aggregating and forwarding properties such as bandwidth, availability and variability in Network State Packets(NSPs).**
- **EIR is designed to work in conjunction with late binding and in-network storage in order to provide robust services.**
- **The main goal of this project is to validate EIR code on ORBIT, address design issues on telescopic parameters and mathematically characterize the overhead performance of the system.**



Telescopic Functions

- **The border aNodes relay NSPs originated from other ASs in a telescopic manner. The relaying rate of a particular packet is determined by the distance of the packet-source from the relaying aNode.**
- **Thus, a router would receive more frequent route updates from closer routers. Some common telescopic functions are,**

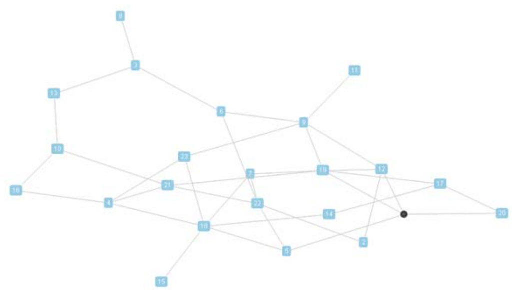
$$y = A \qquad \textbf{Constant}$$

$$y = \begin{cases} A, x < \alpha \\ Ae^{x-\alpha}, \alpha \le x < \beta \\ Ae^{\beta-\alpha}, x \ge \beta \end{cases} \qquad \textbf{Constant-Exponential-Constant}$$

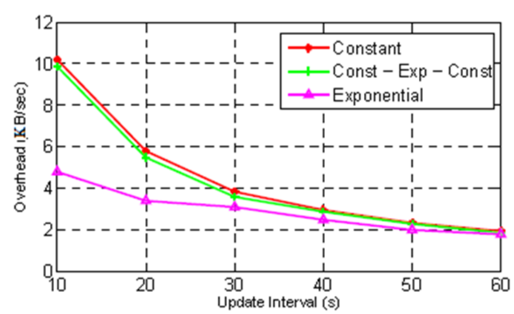
$$y = Ae^{x-1} \qquad \textbf{Exponential}$$

Experiment Setup and Results

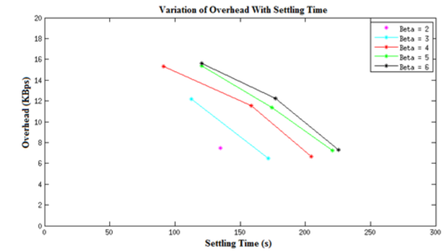
- **A network of 23 aNodes was deployed on a sandbox of the orbit test bed for experimentation.**
- **The click router implementation consists of two components. The control plane sends aSP, nSP and Link probe packets. While, the data plane sends and receives data packets to and from other routers.**
- **The GNRS server, is implemented as a daemon in one of the nodes of the testbed, is used extensively by the data plane.**
- **A visualization of the test topology is given below,**



- **The preliminary analysis done during prior experiments eliminated the use of exponential and constant telescopic functions due to overhead and bootstrap time constraints.**



- **Furthur analysis clearly suggested α=1 and β=2 as an optimal choice. However for networks with different requirements more suitable parameters can be selected.**

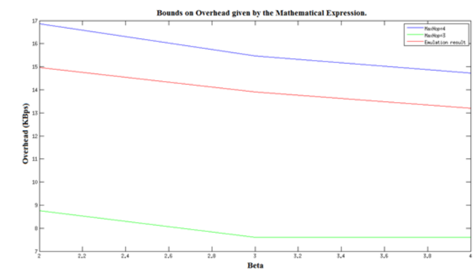


- **For this setup, a mathematical expression for the overhead was formulated. The overhead (in KBps) is a sum of the components obtained from the 2 equations.**

$$nspFORWARD_{OVERHEAD} = \frac{Pkt_{size}}{1000} * \left[\sum_{l1hop=1}^{Max\_hop} \frac{2^{l1hop}}{UI+\sum_{j1=1}^{l1hop} tele(j1)}\right] + \sum_{j=1}^{Max\_hop} Pkt_{size} * \left[\frac{1}{UI+\sum_{h=1}^{j} tele(h)}\right] * \left[\left(\sum_{lvl=j+1}^{Max\_lvl} 2^{lvl}\right) * (2^j + 2^{j-1}) + 2^j * \left(\sum_{\substack{p=2 \\ j>1}}^{j} \sum_{i=0}^{p} 2^i - \sum_{\substack{k=1 \\ j>1}}^{j-1} 2^k\right)\right]$$

$$nspGENERATION_{OVERHEAD} = \left(\frac{Pkt_{size}*h}{1000}\right) * \left[2 + 3 * \sum_{j=2}^{Max\_lvl} 2^{j-1}\right]$$

- **The Max_hop is a parameter in the equation, that is determined by the characteristic of the traffic in the network. Setting it at values of 3 and 4 gives an upper and lower estimate of overhead for any system setup.**



Conclusion and Future Work

- **An analysis of the telescopic function resulted in a setting that minimizes bootstrap time while maintaining a low overhead.**
- **A mathematical estimate of the overhead this provides bounds on the performance for internet scale topologies was formulated.**
- **The next phase of the project can focus on addressing design issues with multi-homing, storage on larger topologies.**