COSC418 Project: Load balancing in a CTP based network

Henry Jenkins and Regan Gunther

(https://github.com/steakunderscore/COSC418-Assignment)

Department of Computer and Electrical Engineering,
University of Canterbury,
Christchurch,
New Zealand

September 30, 2011

UnicastNameFreeRouting

- We took the original UnicastNameFreeRouting interface and turned this into UnicastNameFreeLoadBalRouting by adding extra load balancing features.

Code Implementation

```
interface UnicastNameFreeLoadBalRouting {

  command am_addr_t nextHop();
  command bool hasRoute();
  //Triggers a packet notification
  command void packetSent();

  event void routeFound();
  event void noRoute();
}
```

- Interface provided by CtpRoutingEngine and used by MultiHopOscilloscope

UnicastNameFreeLoadBalRouting Wiring

- We rewired the CtpForwardingEngine and CtpRoutingEngine to be connected by UnicastNameFreeLoadBalRouting rather than the original UnicastNameFreeRouting

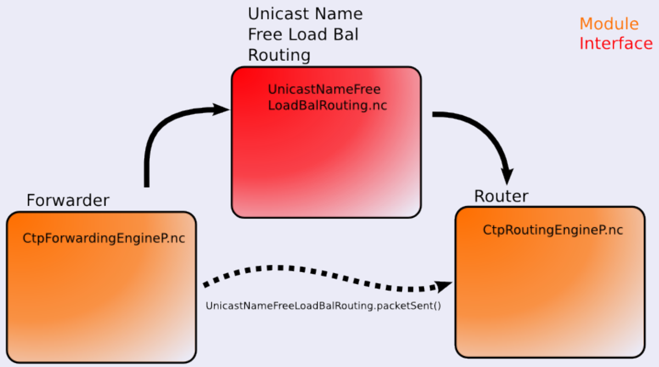
Code Implementation (CtpP.nc)

```
implementation {
  ...

  components new CtpForwardingEngineP() as Forwarder;
  components new CtpRoutingEngineP(...) as Router;

  Forwarder.UnicastNameFreeLoadBalRouting -> Router.Routing;


  ...
}
```

UnicastNameFreeLoadBalRouting Wiring (Contd.)

- The rewiring of UnicastNameFreeLoadBalRouting is shown below

Wiring block diagram



Our Design

- $p^* = \text{arg min} p \in \{ \text{ direct neighbours}\} \, [\alpha \cdot (ETX_{s,p} + ETX_p) + \beta \cdot L_p^s]$
- Our design is to keep L_p^s locally

Code Implementation

```
// ETX for load balancing
uint16_t loadEtx;

//Complete Equation:
beaconMsg->etx = routeInfo.etx +
call LinkEstimator.getLinkQuality(routeInfo.parent)
+ (loadEtx/LOAD_EFFECT_THRESHOLD);
```

t_p^s

Code Implementation

```
/*
 * Timer for the load balancing algorithm
 */
event void LoadTimer.fired() {
  //First decrement loadEtx to ensure decay
  if (loadEtx > 0) {
    loadEtx--;
  }
  //If there is a large change in loadEtx tell nabours
  if (radioOn && running) {
    if (loadEtx > oldLoadEtx + 10 ||
        (oldLoadEtx > 10 && loadEtx < oldLoadEtx - 10)) {
      post sendBeaconTask();
    }
  }
}
```

n_p^s

Code Implementation

```
/*
 * This is to be called when ever a packet is sent via the radio.
 */
command void Routing.packetSent() {
  loadEtx++;
  printf("P\n");
  //printf("Load ETX Incremented. It is now: %d\n",loadEtx);
  //printfflush();
}
```

Parameter Definitions

In TreeRouting.h:

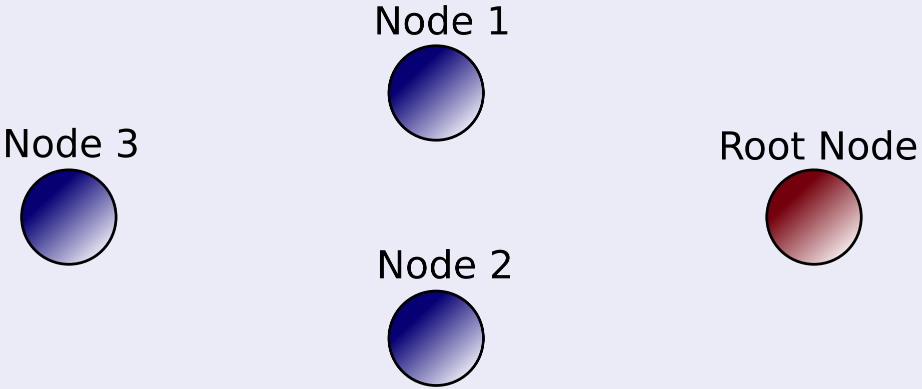
Code Implementation

```
enum {
    ...

    // Load balancing timer
    LOAD_INTERVAL = 100,

    //Number of packets per rollover
    LOAD_EFFECT_THRESHOLD = 1,

    ...
};
```

- This allowed for easy access of values during the testing stage

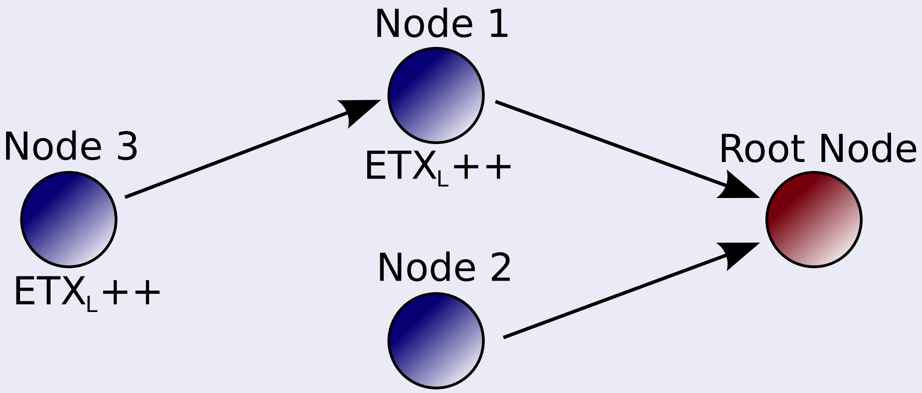
Initialisation

Data flow



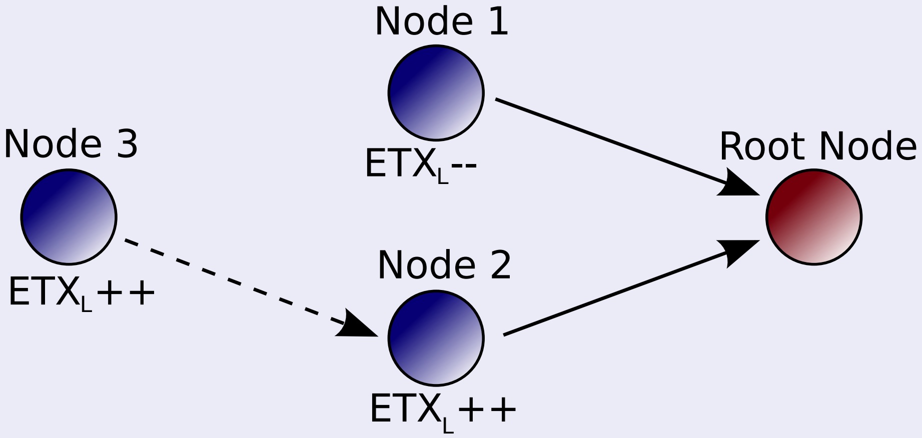
Initial route

Data flow



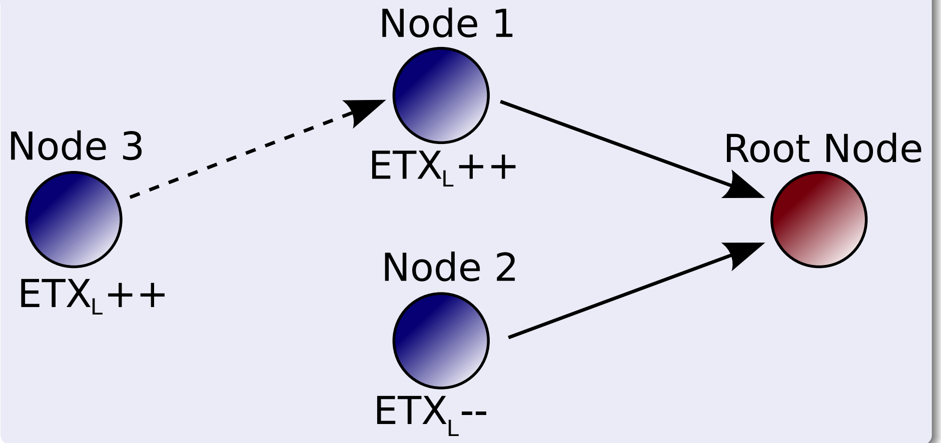
Load balanced

Data flow



Load balanced (again)

Data flow



Testing

- Using lower transmit power
- *printf* client to debug
- Listen client to view raw traffic
- Transmitting routing beacon every data packet
- Couldn't get Multihop oscilloscope working
- MViz showed our shifting ETX values

Conclusion

- Still working on finding correct thresholds
- Currently implementing and testing code
- Can visualise operation using the MViz application
- We have implemented load balancing as a component to plug into standard CTP
- Simply include our CTP to use