802.1Qbp – ECMP Multicast Load Spreading

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Observations on Multicast ECMP

- Multicast traffic cannot use the same load spreading mechanism used for unicast traffic
  - FDB has multiple forwarding ports (cannot select just one)
  - Random selection & replication can lead to duplication & loops
- ECMP for unicast traffic makes congruence (unicast-multicast and bi-directional) either easy or impractical (depending on how the definition is adjusted)
  - In either case congruence is not a concern in ECMP path calculations
- Multicast traffic must be constrained to a tree (to avoid loops and duplicate frames)
  - However, different multicast addresses may use different trees

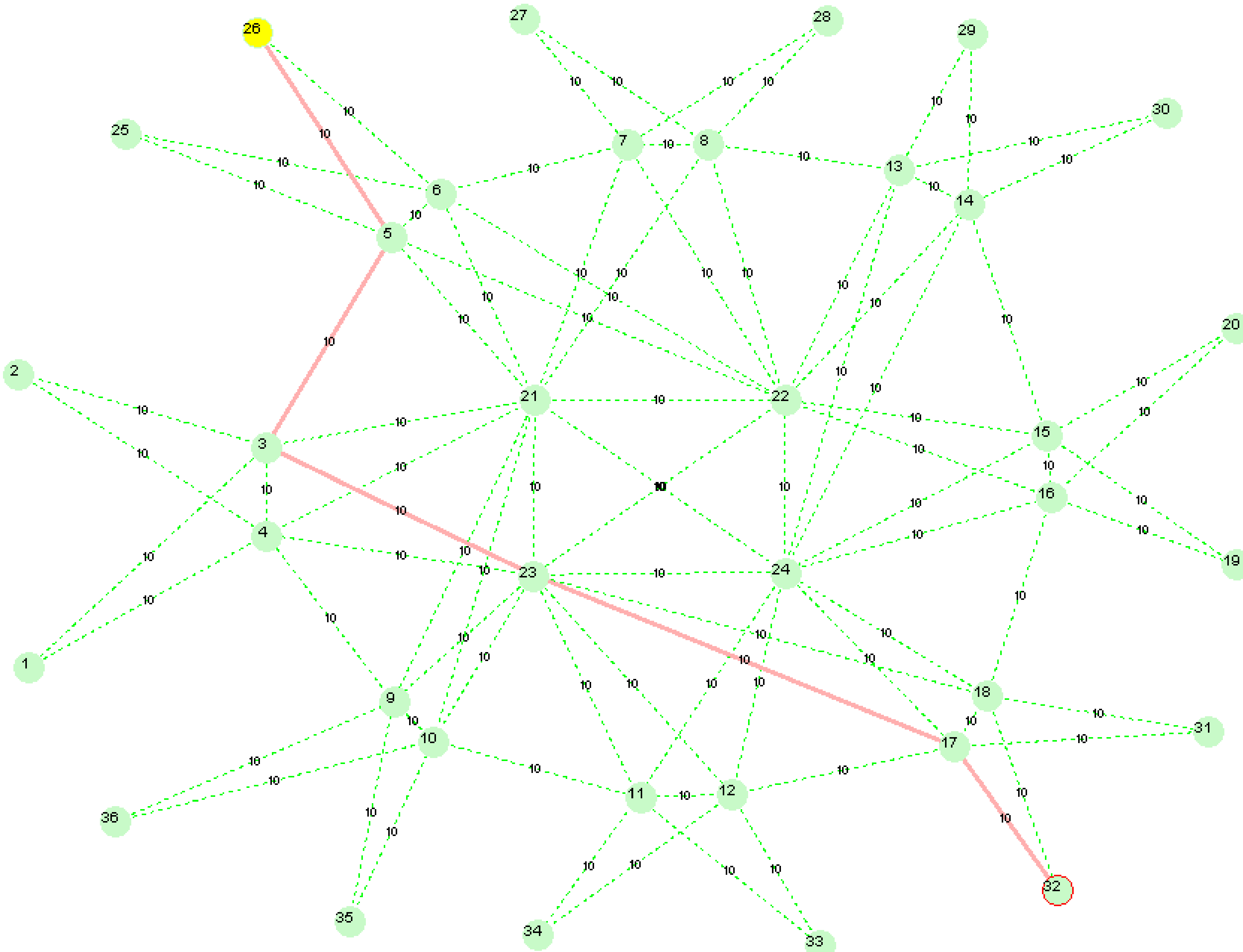
Spreading Multicast Traffic

- In SPBM each service instance (I-SID) has its own set of group addresses used to carry client multicast/broadcast traffic
  - Group addresses composed from SPSourceID & I-SID
  - # multicast flows = #service instances * #edge nodes
- Assign each flow to an ECT using a standard hash algorithm
  - so all nodes will agree on assignment and produce consistent forwarding state
- Each multicast flow can be independently assigned to an ECT
  - Potentially large calculation (random tree per I-SID)

One Approach

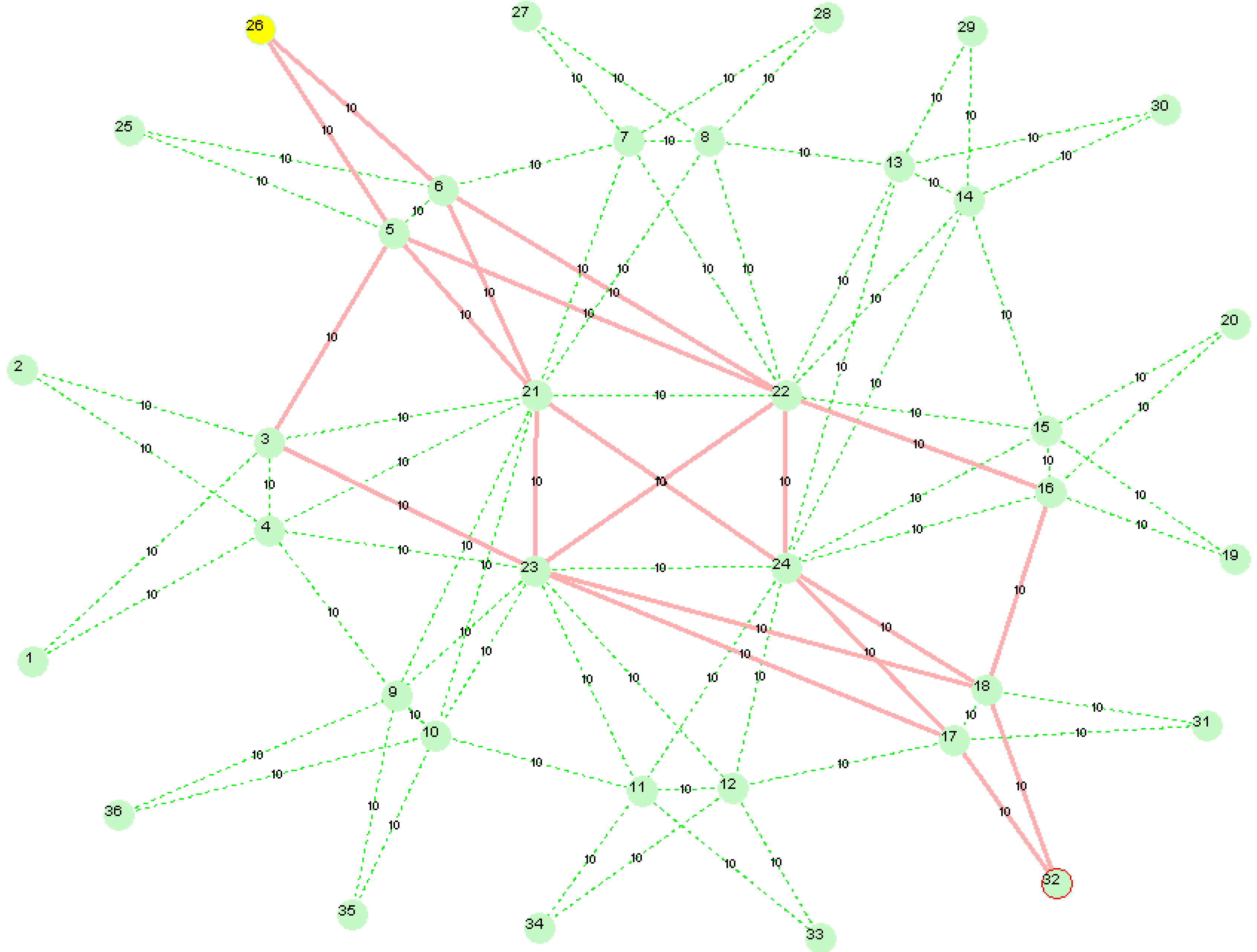
- Select “random” tree from ECT set for each root node
  - Select from all ECTs, not just those selected by std tie-breakers
- Use this tree for all flows from that node
  - All I-SID multicast from root node use same tree
  - But I-SIDs can have varied endpoints, so still some spreading
- Use hash (e.g., FNV) to select one “parent” from set of equal cost parents calculated for unicast ECMP
  - Modest addition to route calculation
  - Include root node MAC address in hash to create variation
- Tried this out in an SPB simulator…

Unicast SPB, e.g. between 26 and 32



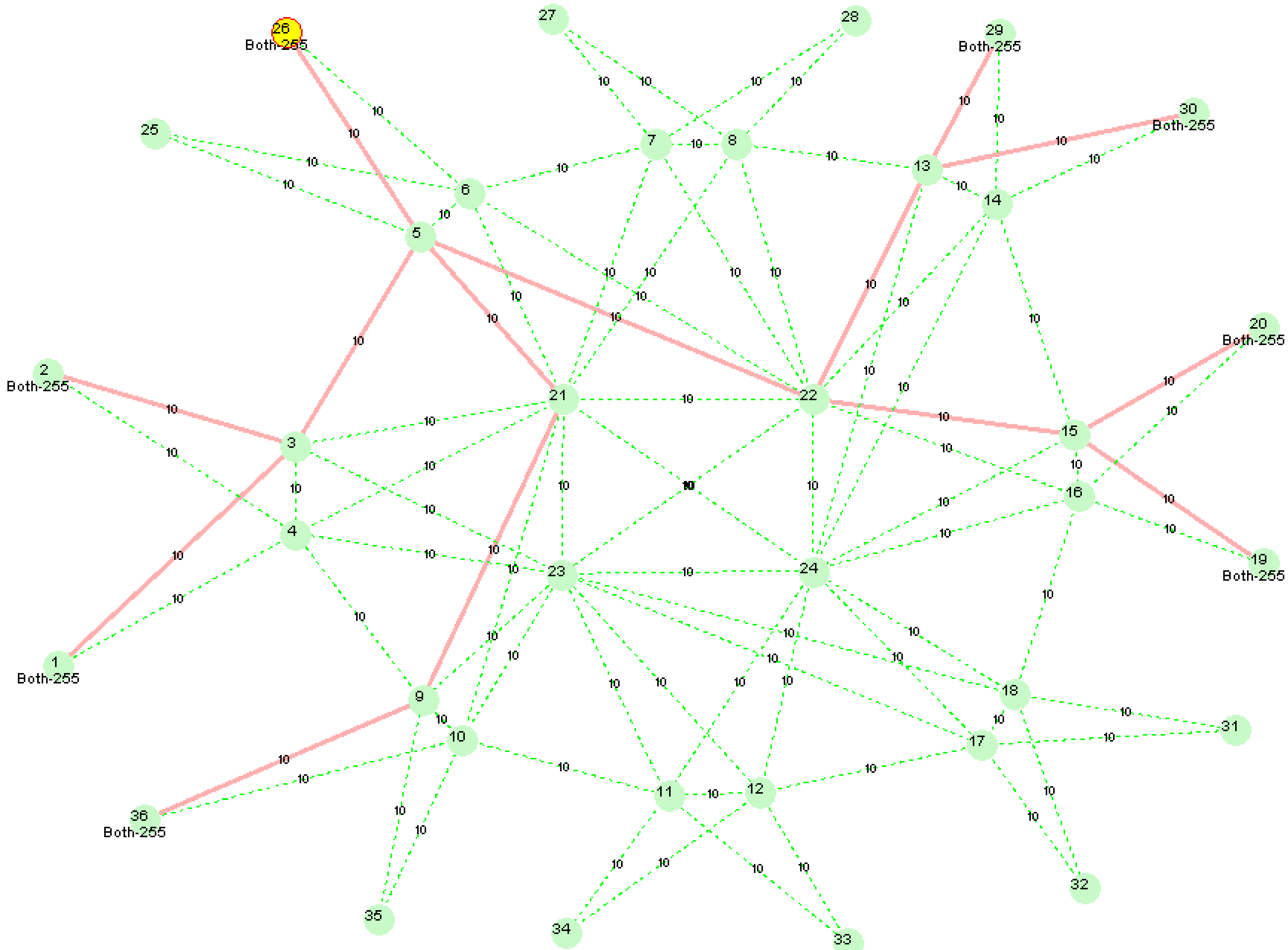
SPB selects a single path using an ECT tie-breaking function.

Unicast ECMP, e.g. between 26 and 32



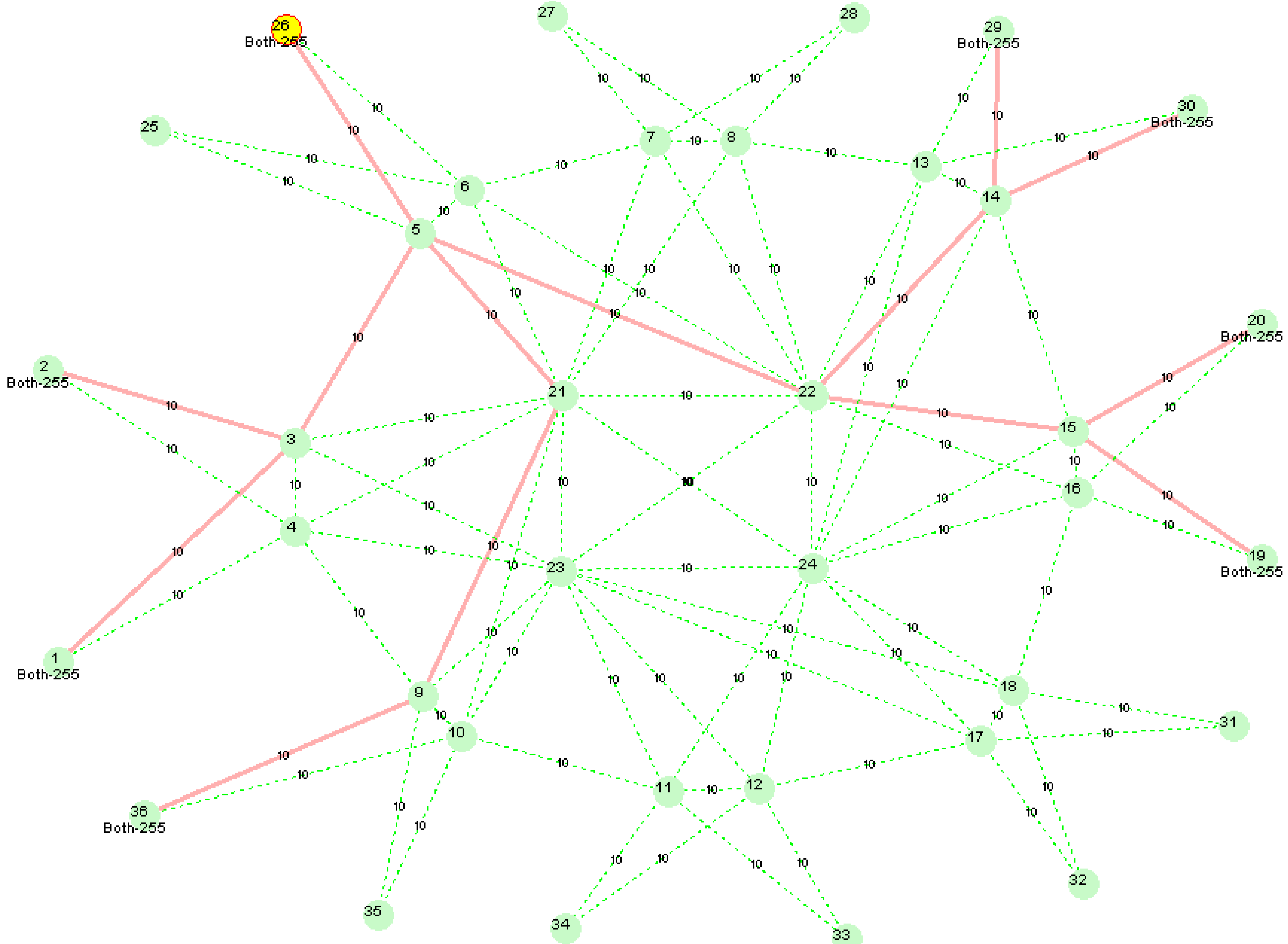
ECMP load spreading utilizes all links on equal cost paths for unicast traffic.

SPB Multicast Tree, e.g. I-SID 255 from 26



Multicast selects links from one equal cost tree using ECT tie-breaker.

ECMP Multicast Tree, e.g. I-SID 255 from 26



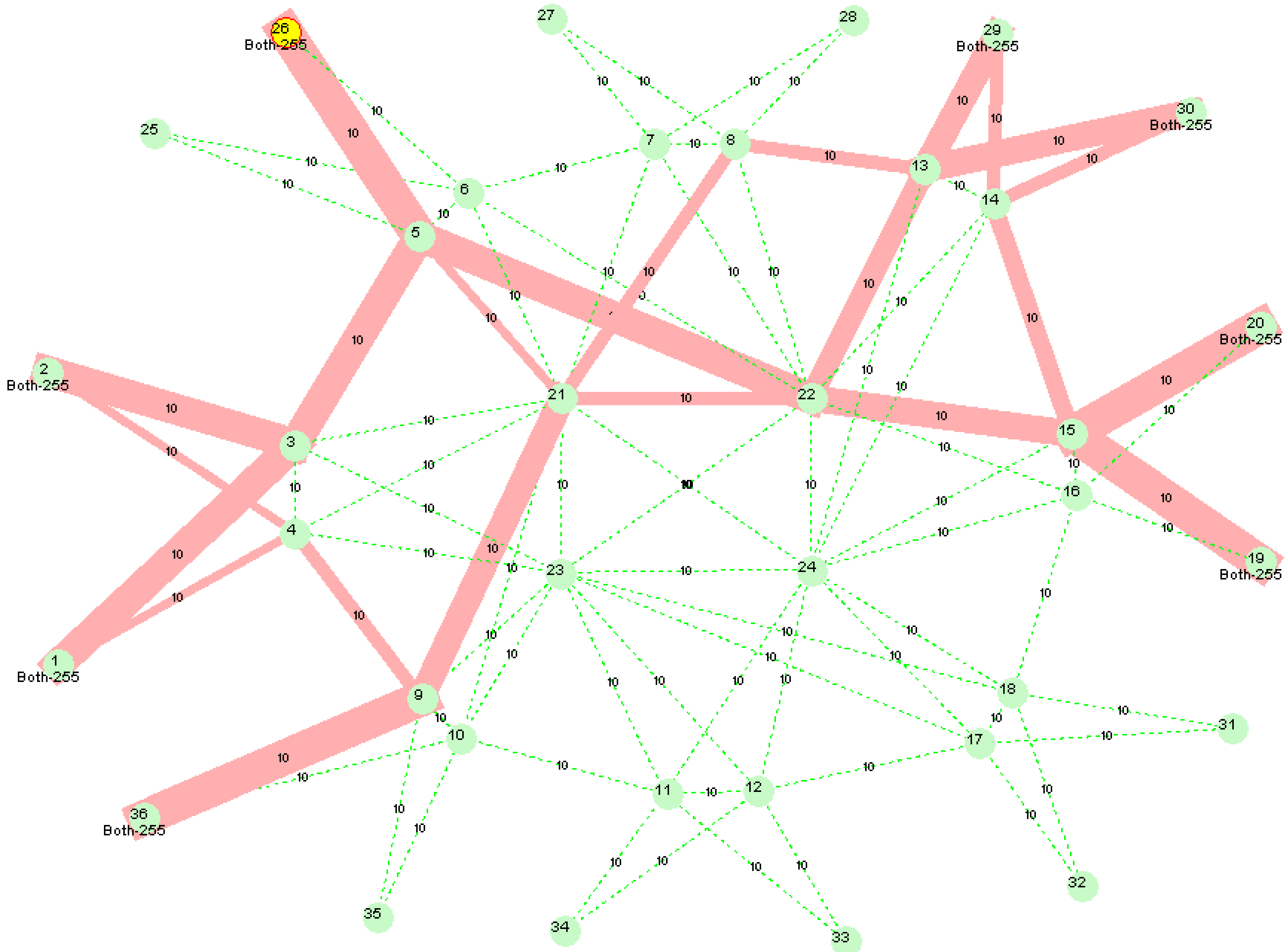
Multicast load spreading selects links from all equal cost paths using a hash function (in this case FNV).

Code for Parent FNV hash

```
#define C1AQ_SYST_HASH_PARENT(result, syst, r, n)           \
{   register tUINT32 hash = 0x811C9DC5;                     \
    register tUINT64 fodder;                                \
    register tUINT32 fnvPrime = 0x01000193;                 \
    register tUINT32 best = 0;                              \
    register int k,m, np = syst->node[n].np;                \
    for (m=0; m<np; m++)                                    \
    {                                                       \
        fodder = syst->node[r].sysIdMac[0];               \
        for(k=0;k<7;k++)                                    \
        {                                                   \
            hash = hash ^ (fodder & 0x000000ff);            \
            hash = hash * fnvPrime;                         \
            fodder = fodder >> 8;                           \
        }                                                   \
        fodder = syst->node[syst->node[n].parent[m]].sysIdMac[0]; \
        for(k=0;k<7;k++)                                    \
        {                                                   \
            hash = hash ^ (fodder & 0x000000ff);            \
            hash = hash * fnvPrime;                         \
            fodder = fodder >> 8;                           \
        }                                                   \
        if (hash > best)                                    \
        {                                                   \
            best = hash;                                    \
            result = m;                                     \
        }                                                   \
    }                                                       \
    result = (m==0 ? -1 : syst->node[n].parent[result]);    \
}
```

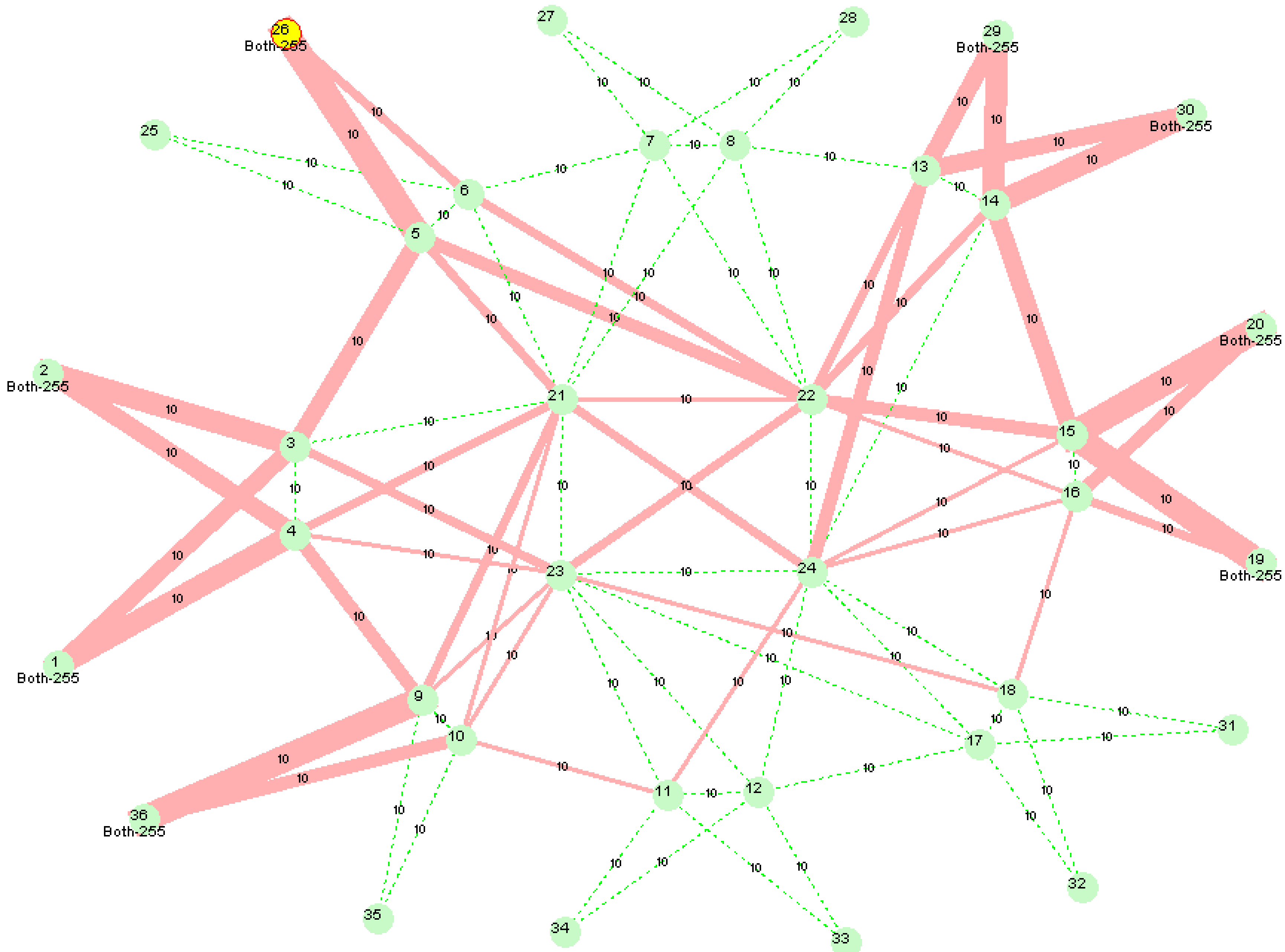
This is the code in the SPB simulator used to generate these slides – I'm not sure this is a correct implementation of FNV – comments welcome!

All SPB Multicast Trees, e.g. I-SID 255



Set of multicast trees are congruent.

All Multicast Trees, e.g. I-SID 255



Multicast load spreading selects links from all equal cost paths using a hash function (in this case FNV). Different trees are selected for each root by including root MAC address in hash.

Observations on this Approach

- Spreads multicast traffic and unicast traffic using common route calculation (all ECMP).
- Multicast spreading using a standard hash (pseudo-random).
- No selection or configuration of tie-breaker needed!
- Propose further study of spreading performance and selection of a standard hash algorithm for use in multicast route calculation.