IP Video

Multicast Networks
Open Source Software
IP Set Top Boxes

By Ted Deppner
April 5, 2005

v1.01

! Multicast

- Unicast

  - Traditional IP communications. Always point-to-point

- Broadcast

  - Destination of all ones, ie 192.168.0.255

  - Works in small "single switch" environments

  - Can do one-to-many, but floods all ports

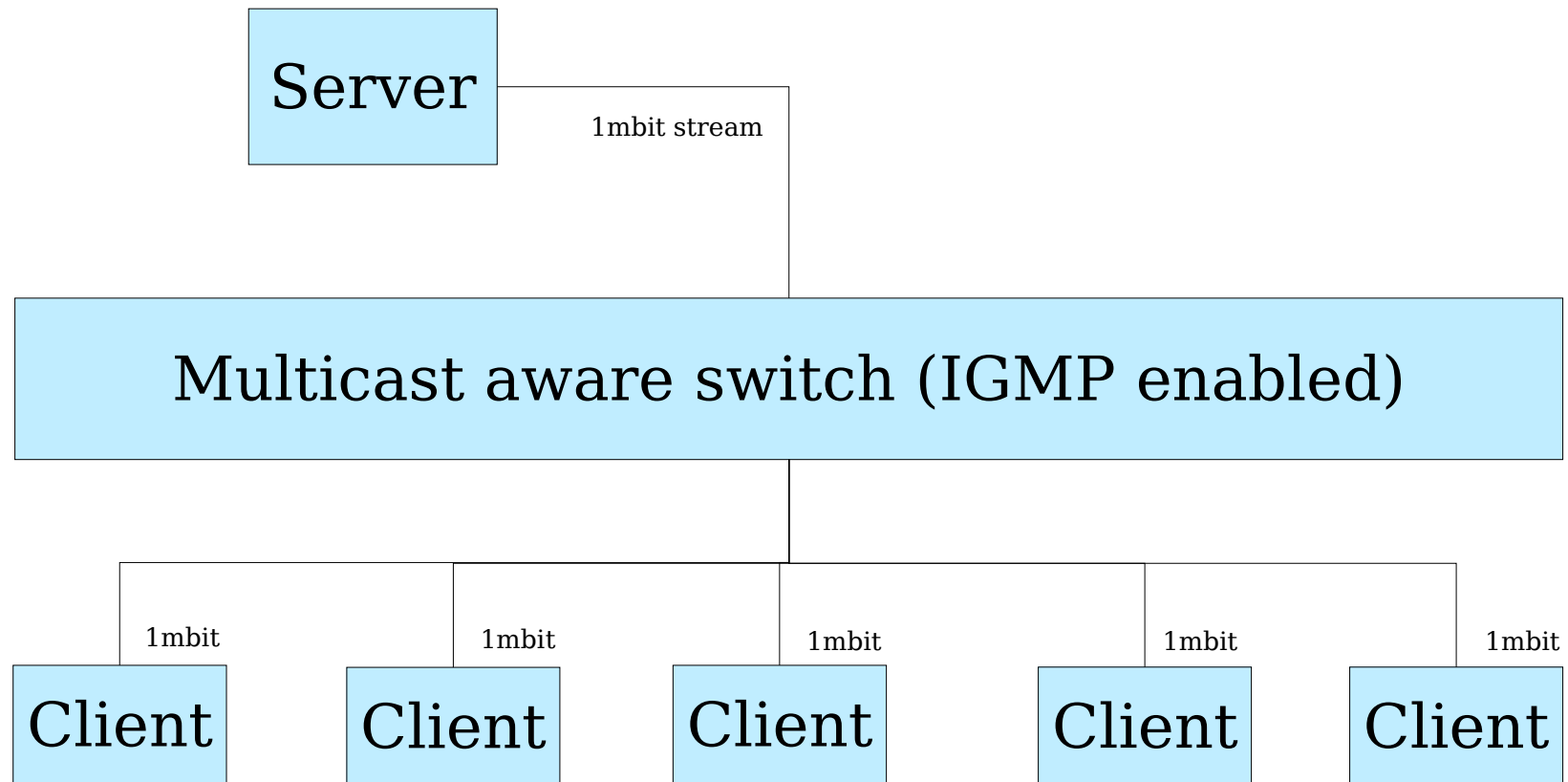# Multicast Specifics

- Special
    - IP address, aka "group"
        - 224.0.0.0 through 239.255.255.255
    - MAC address
        - 01:00:5E:xx:xx:xx
        - NOTE: 1:32 mapping of IP to MAC
    - IGMP (Internet Group Management Protocol)
        - Allows routers and switches to be smart.
        - Snooping
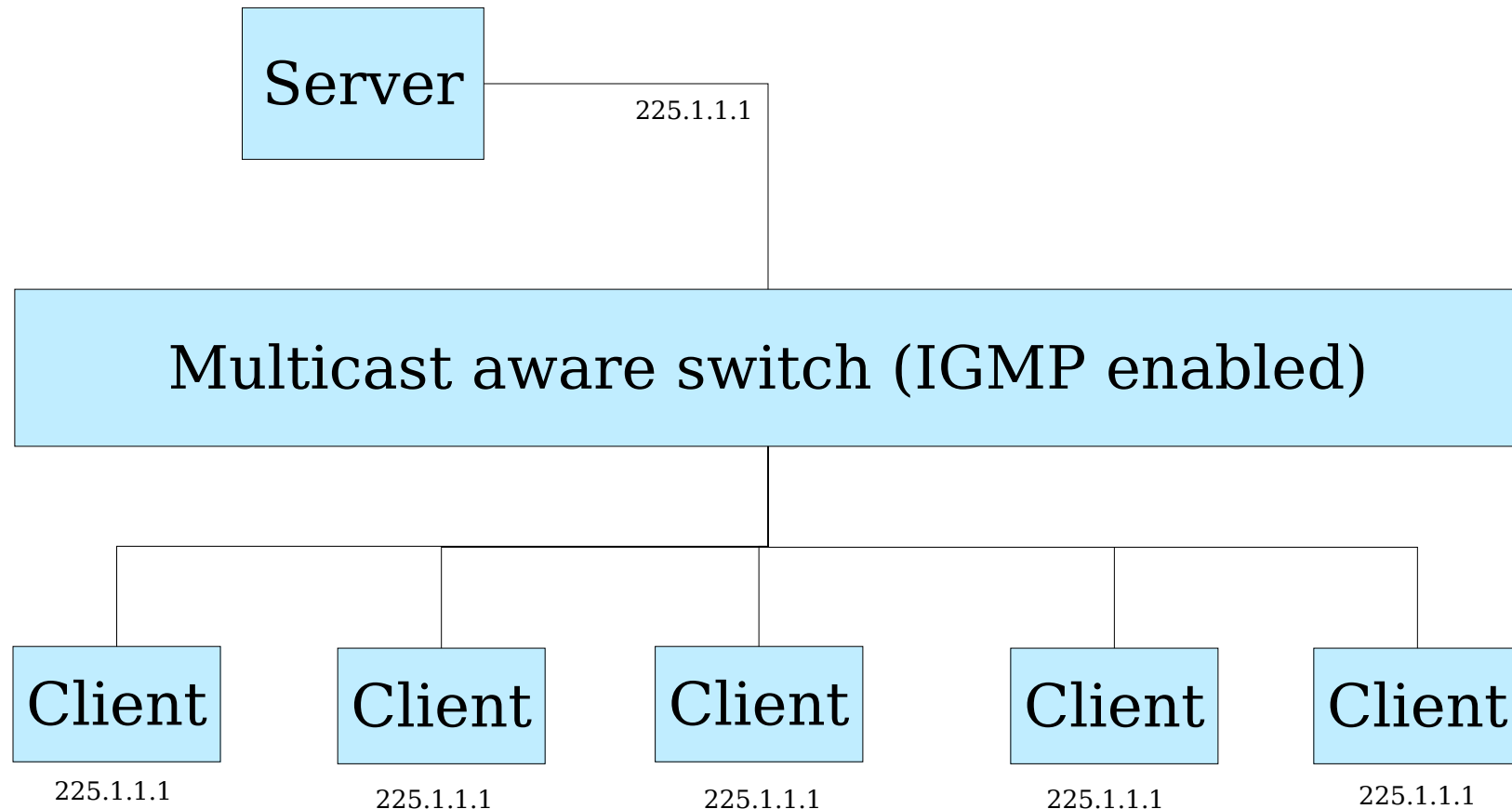
Multicast Specifics

- Must use a protocol to pass through a router.
  - DVMRP (Distance Vector Multicast Routing Protocol)
    - Dense mode only, campus applications, high bandwidth, high interconnectivity
  - PIM (Protocol Independent Multicast)
    - Sparse or Dense mode
      - Sparse allows for WAN type applications where many want data from a few

Multicast Networks

- Many-to-Many or One-to-Many
  - Mbone
  - Symantec Ghost
- Allows one source (eg video server) to send to N clients with no more bandwidth used than to serve one client
- Contrast with Unicast (traditional TCP/IP communication, for instance); which is always one-to-one

Server

1mbit stream

Multicast aware switch (IGMP enabled)

1mbit   1mbit   1mbit   1mbit   1mbit

Client   Client   Client   Client   Client

Switch builds a forwarding table per group per port based
on IGMP Join/Leave messages.

```
┌──────────┐
│  Server  │──────────────┐
└──────────┘     225.1.1.1 │
                           │
┌──────────────────────────────────────────────────────────┐
│         Multicast aware switch (IGMP enabled)             │
└──────────────────────────────────────────────────────────┘
         │         │         │         │         │
   ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐ ┌────────┐
   │ Client │ │ Client │ │ Client │ │ Client │ │ Client │
   └────────┘ └────────┘ └────────┘ └────────┘ └────────┘
   225.1.1.1   225.1.1.1   225.1.1.1   225.1.1.1   225.1.1.1
```

Many to many. It's entirely possible to have a "farm" of systems listening and talking on the same multicast group.

Uses: autoconfiguration of clients... you don't care which client is which, just that a client is online and therefore usable for a purpose. The server "autodetects" new clients and can act accordingly.

Be the packet

- Client sends an IGMP Join for 225.1.1.1

- Switch receives Join, adds that port to its forwarding table for 225.1.1.1

- Client sends a packet, UDP port 1111
  - IP address will source from the client's outbound interface
  - Destination IP address will be 225.1.1.1
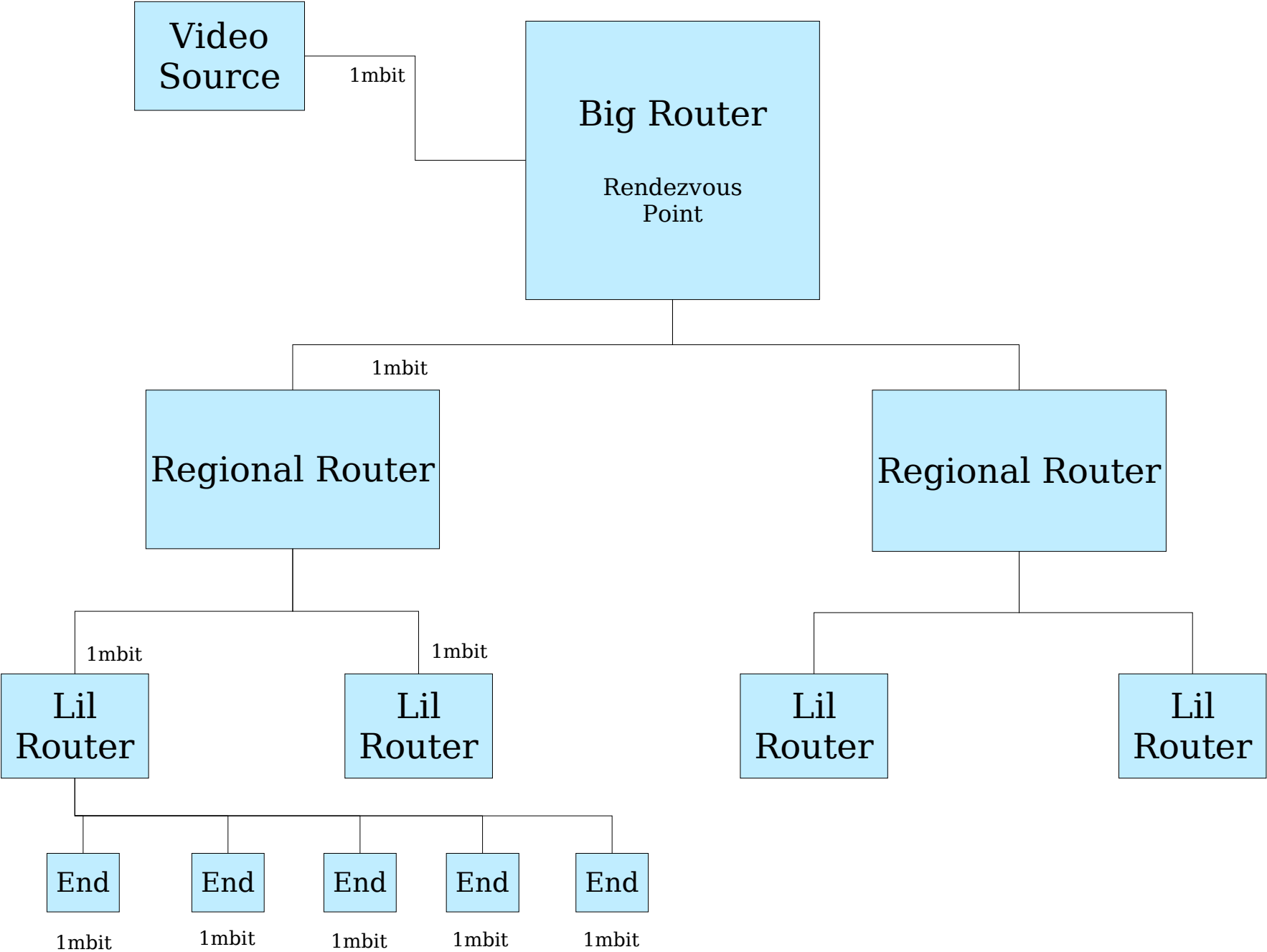 - Destination MAC address will be 01:00:5E:xx:xx:xx

Be the packet

- The switch gets to forward based on its MAC forwarding table, receiving a packet destined for 01:00:5E:xx:xx:xx

- Any UDP port may be used. Clients must listen on both the correct IP and the correct port (as it is with unicast).
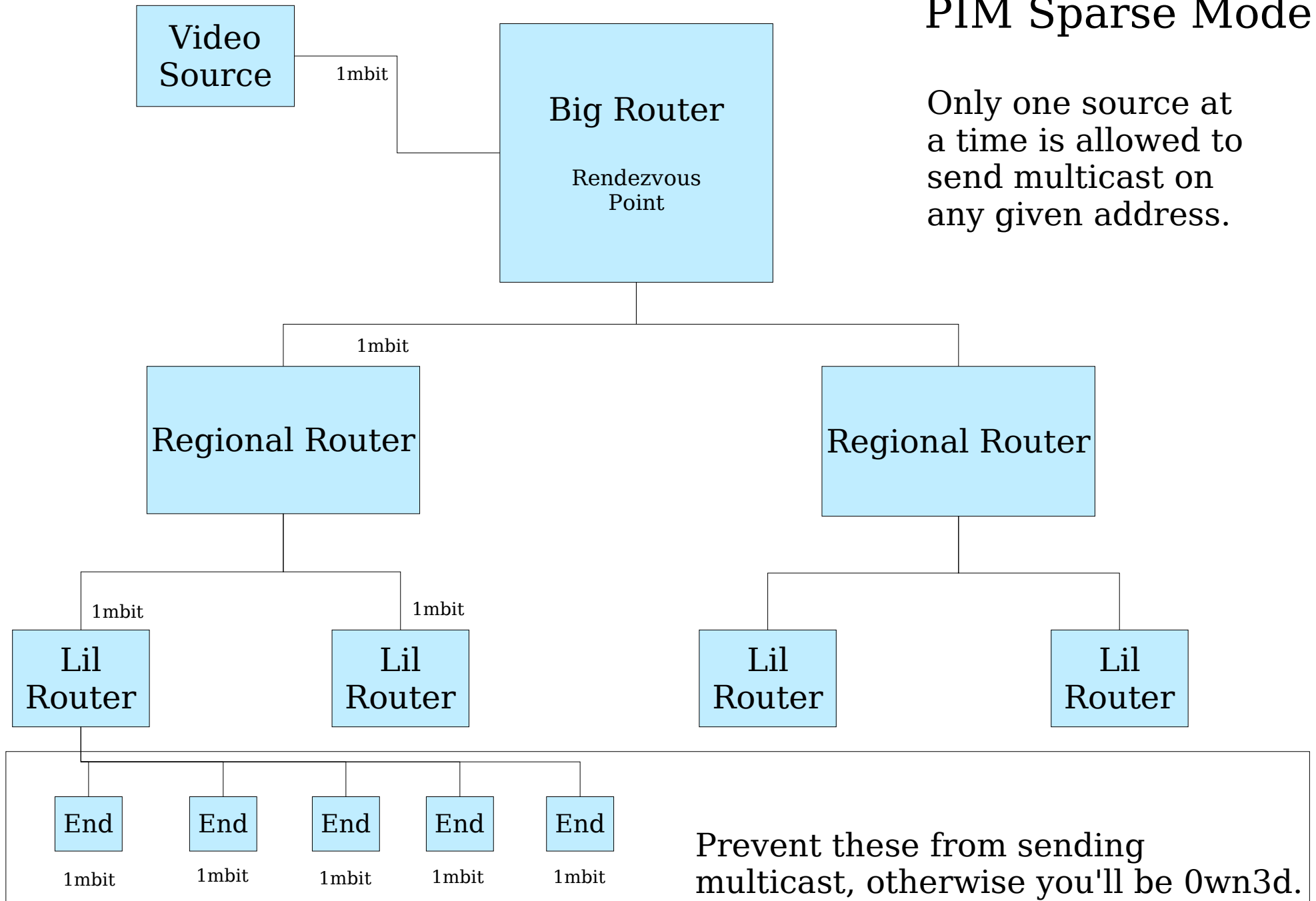
Popular Multicast Modes

- PIM (Protocol Independent Multicast)
  - Dense Mode
    - Everyone talks to everyone
    - Every router carries every group
  - Sparse Mode
    - One source talks to everyone else.
      - Eg, video source sends to 5,000 IP set tops.
    - Best for wide-scale data streaming, ala IP Video in a geographically diverse network.
    - Similar to DNS: if I don't have the requested stream, I ask my uppers for it, better known as the Rendezvous Point.

WAN Deployment

Video Source	

Video Source —1mbit— **Big Router**

Big Router

Rendezvous Point

1mbit

Regional Router

Regional Router

1mbit — **Lil Router**

1mbit — **Lil Router**

Lil Router

Lil Router

End **End** **End** **End** **End**

1mbit 1mbit 1mbit 1mbit 1mbit

WAN Deployment
PIM Sparse Mode

Only one source at a time is allowed to send multicast on any given address.

Video Source — 1mbit — **Big Router** (Rendezvous Point)

1mbit

Regional Router   **Regional Router**

1mbit   1mbit

Lil Router   **Lil Router**   **Lil Router**   **Lil Router**

End   End   End   End   End

1mbit   1mbit   1mbit   1mbit   1mbit

Prevent these from sending multicast, otherwise you'll be 0wn3d.

Video Lan Client

- Open Source Software (yeah!)
- Complete solution for A/V distribution
  - vls
    - "server", good for serving static content
  - vlc
    - "client" player, also can do streaming
  - vlm
    - "manager", a special invocation of vlc, allows multiple vlc instances to be launched via a network socket.

Video Lan Client

- Compatibility (short list)
    - MPEG
    - AVI
    - MOV
    - DVD
    - Video4Linux

vls

- Streamer for static content
  - Write your config file, launch vls, done.
  - Cannot easily dynamically change content distribution at run time.
- Rigid configuration required with specifics about each content type and distribution options.

vlc

- Client player application
  - Xwindow support
  - Windows support
  - Mac support
  - ASCII support (yup!)
- Excellent CLI
- Excellent GUI, with advanced levels

vlc

- Anything it can play, it can output
  - As a new file format
  - As a network stream (multicast or unicast)
  - Transcode (think AVI to MPEG for an MPEG-only IP set top box)
- Is very good at taking a play list of items (even DVDs) and playing or sending them elsewhere.

vlc examples

- Play a file (list)

  - `vlc file1 file2 file3`

- Stream a file to another vlc instance

  - `Vlc --sout udp:192.168.0.2 filename`

  - `vlc udp:`

- Multicast a file to multiple vlc's

  - `vlc --sout udp:227.1.1.1 --ttl 5 --loop filename`

  - `vlc udp:@227.1.1.1`

vlm examples

- Invoke vlm mode vlc

    - `vlc --ttl 5 --intf telnet`

- Stream a file

    - `telnet localhost 4212 (password admin)`

        - `new handle broadcast enabled`

        - `new handle input /filename`

        - `new handle output udp:227.1.1.1`

        - `control handle play`

vlc gotchas

- In a router environment, don't forget TTL

- vlc takes a lot of CPU to transcode and then stream. Transcode first.

- vlc can stream just about anything to itself, but use MPEG2 for IP Set Tops.

- vlm offers an http interface, but it is immature at present.

- Interface needs an IP address and default or 224.0.0.0/4 route

Amino 110 IP Set Top Box

- Nice form factor
- Outputs
  - Composite
  - Svideo
  - RF
  - SPDIF
- Plays MPEG2 up to 8mbps
- Can decode AC3 5.1

Amino 110, hackability

- Runs Linux (yeah!)
- HTML4 browser
- Alpha blending of video vs html
- HTML control of video plays
- Telnet
- Console pins inside
- USB port
- Can mount NFS shares

Links, further info

- Video Lan Client
  - http://www.videolan.org/
- http://www.riverstonenet.com/support/multicast/index.shtml
- Google
  - Multicast
  - IGMP