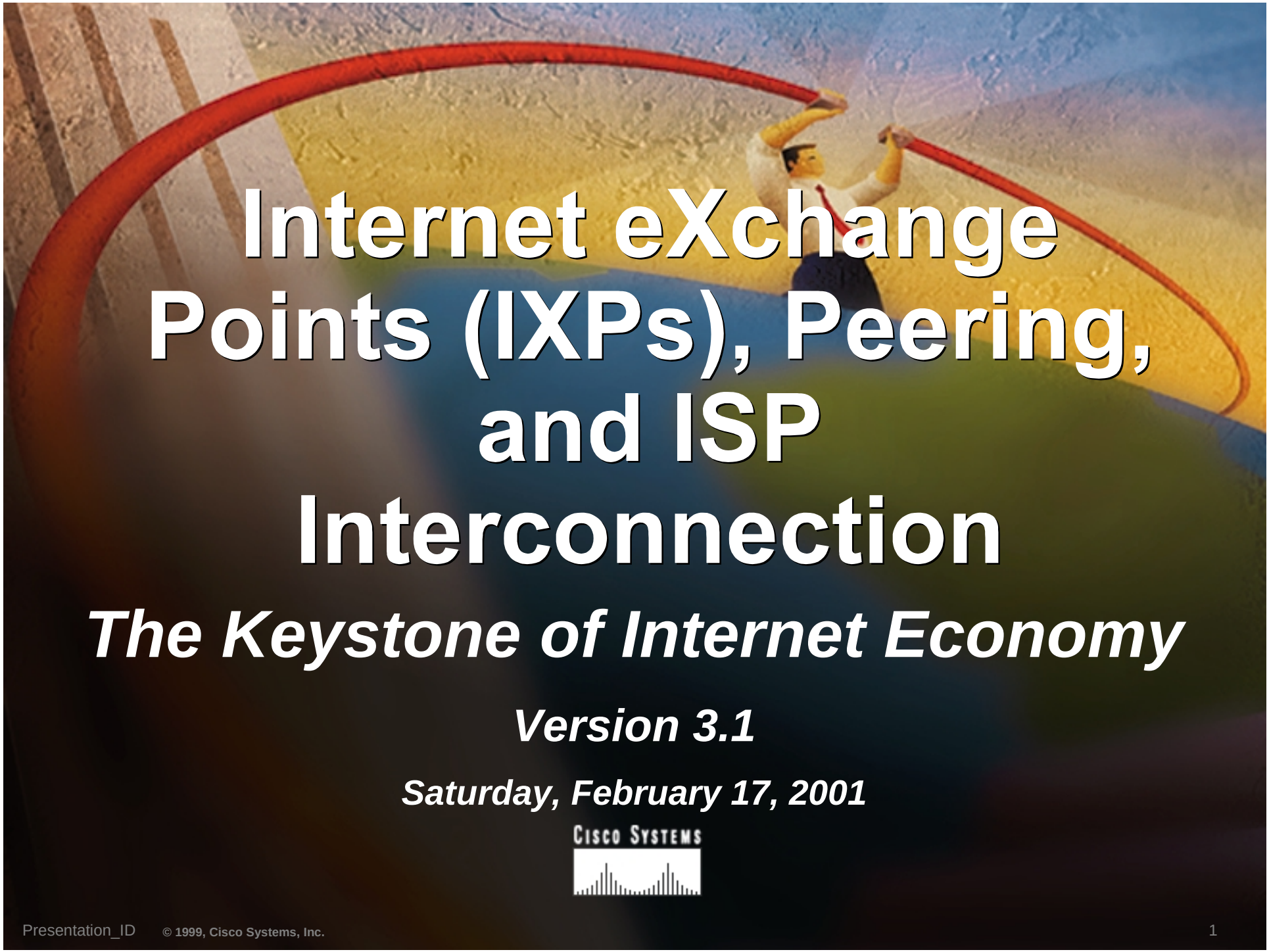


Internet eXchange Points (IXPs), Peering, and ISP Interconnection

The Keystone of Internet Economy

Version 3.1

Saturday, February 17, 2001

CISCO SYSTEMS

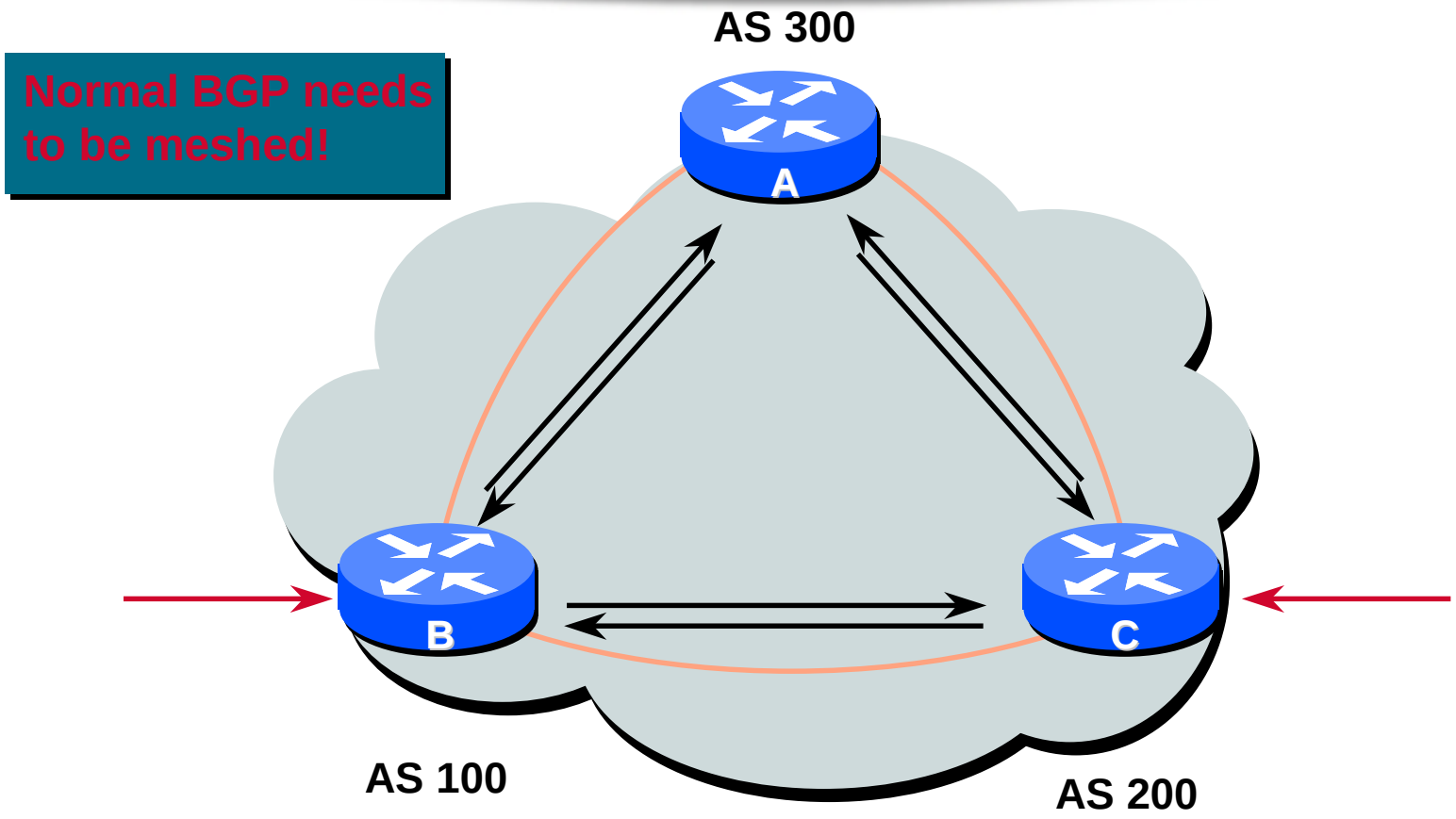
Agenda

- ✓ IXPs - The *keystone* to Internet Economy
- ✓ Why should I connect to an IXP?
- ✓ Transit and Peering
- ✓ Interconnections - A Short History
- ✓ Types of IXPs & Examples of IXPs
- ✓ Cisco's Role
- ✓ Case Studies
- ✓ Technical Addendum

IXP w/small routers & route reflector

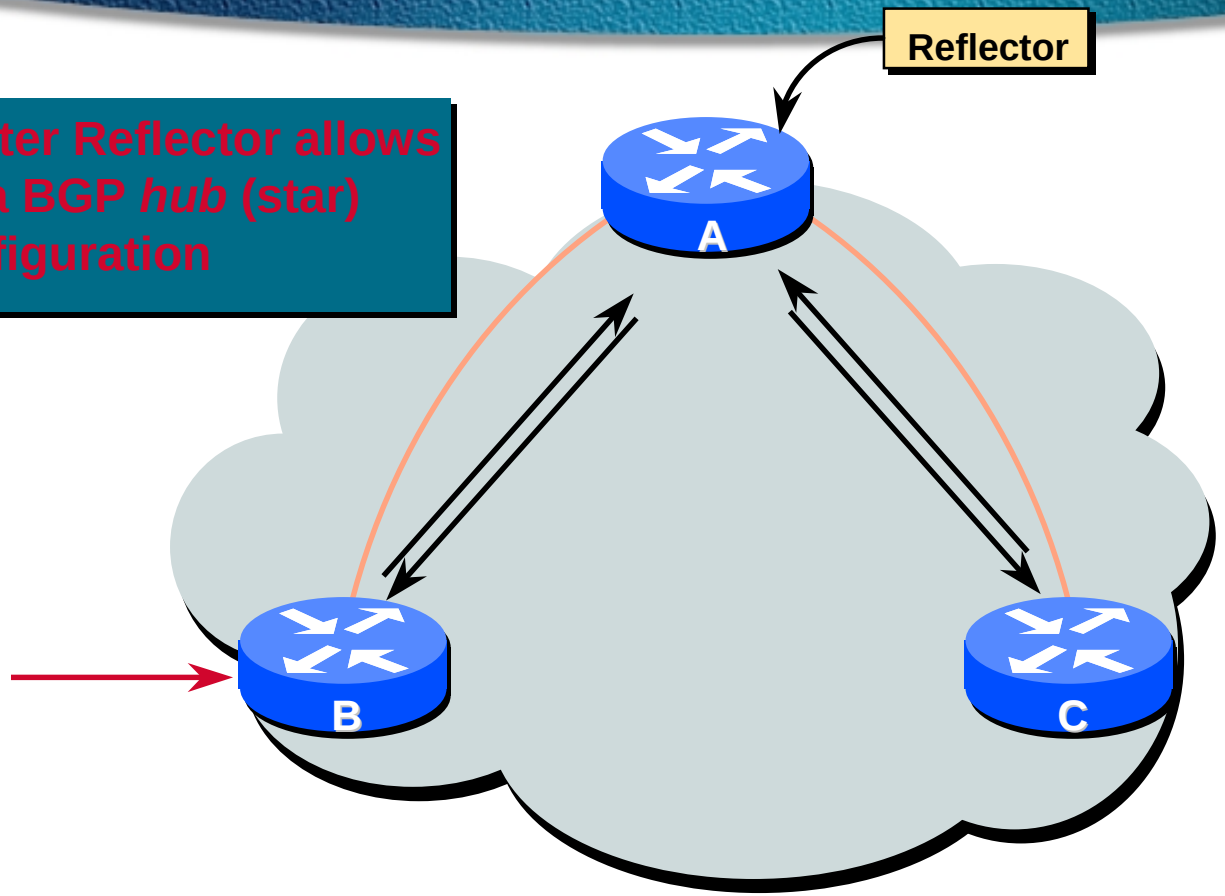
- In many places, ISP would love to interconnect, but cannot afford large core routers just to connect to an IXP.
- Route reflectors enable ISPs to use smaller affordable routers.
- These routers all interconnect with one BGP peer connection to a BGP Router Reflector.
- The Route Reflector provides the routing information

IXP w/small routers & route reflector



Route Reflector: Principle

Router Reflector allows for a BGP *hub* (star) configuration



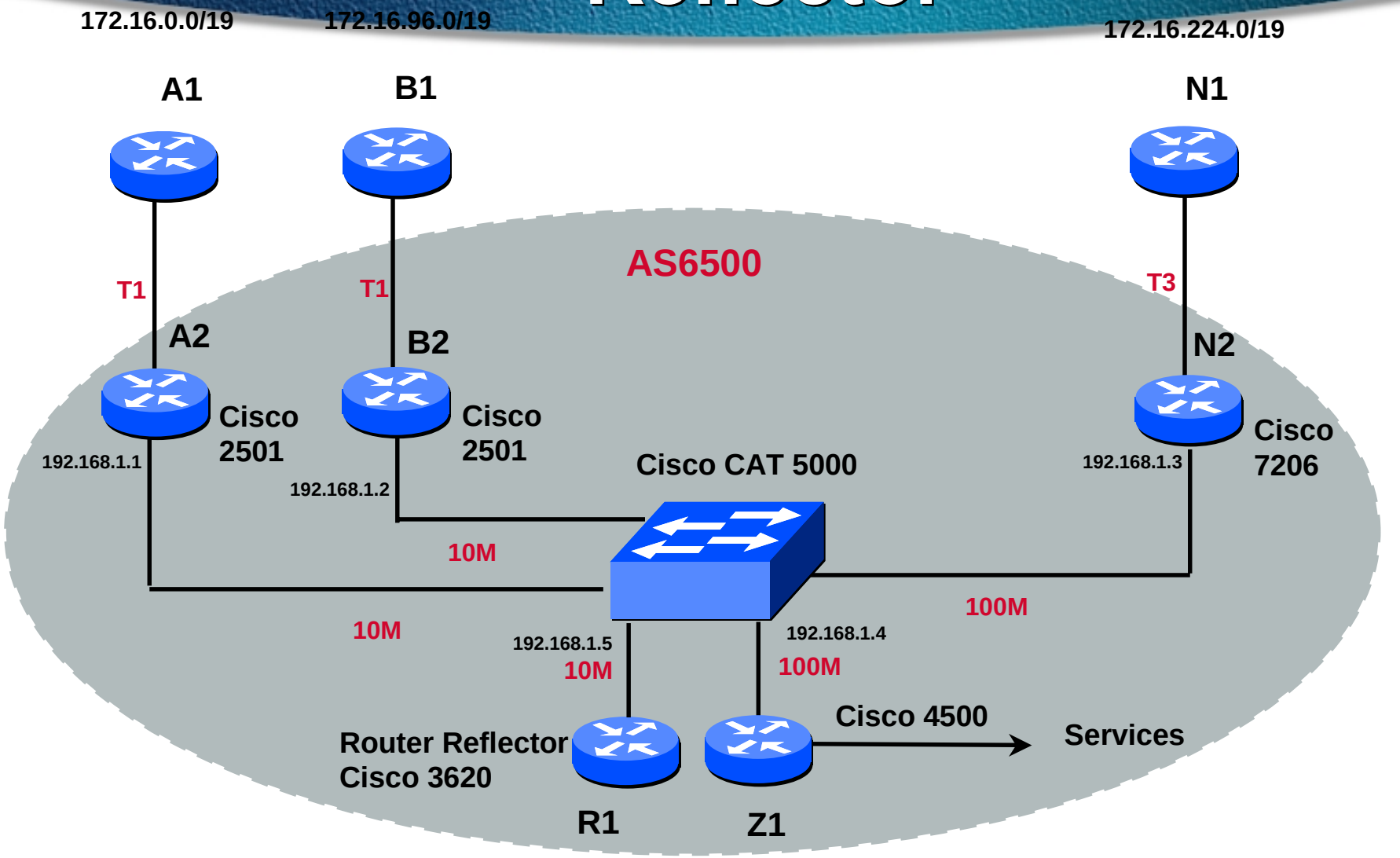
Route Reflector: Benefits

- Solves BGP mesh problem on the IXP where you need larger routers
- Packet forwarding between IXP routers is not affected.
- Normal BGP speakers can co-exist on the IXP.
- Multiple reflectors for redundancy
- Easy migration

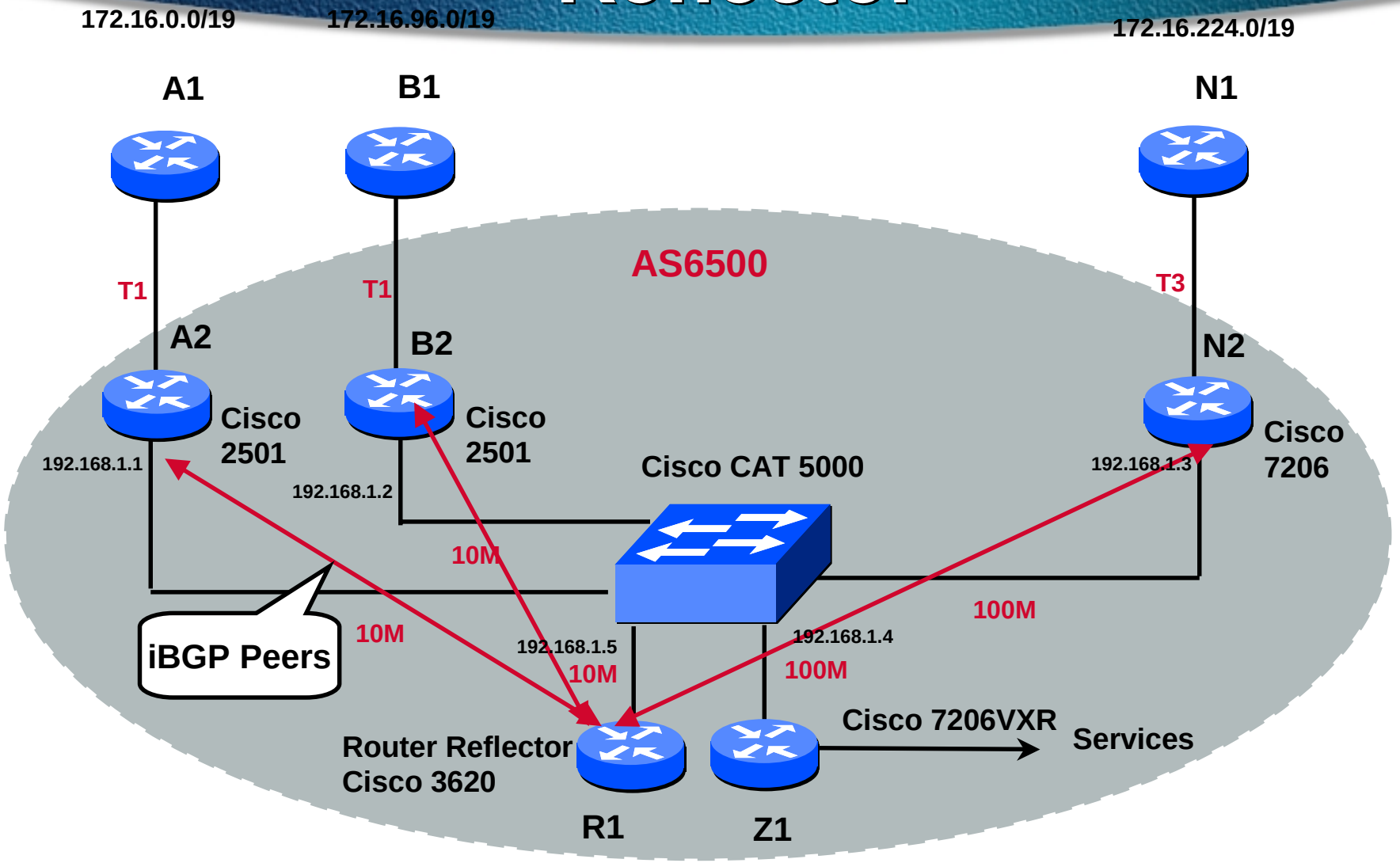
Route Reflector—Caveats

- **Single ANS for the route reflector. Private AS Number can be used as long as transit services are forbidden on the IXP.**
- **Cannot change attribute of reflected routes.**
- **Multi-lateral Peering Agreement best fits the route reflector topology.**

IXP w/ Small Routers & Route Reflector



IXP w/ Small Routers & Route Reflector



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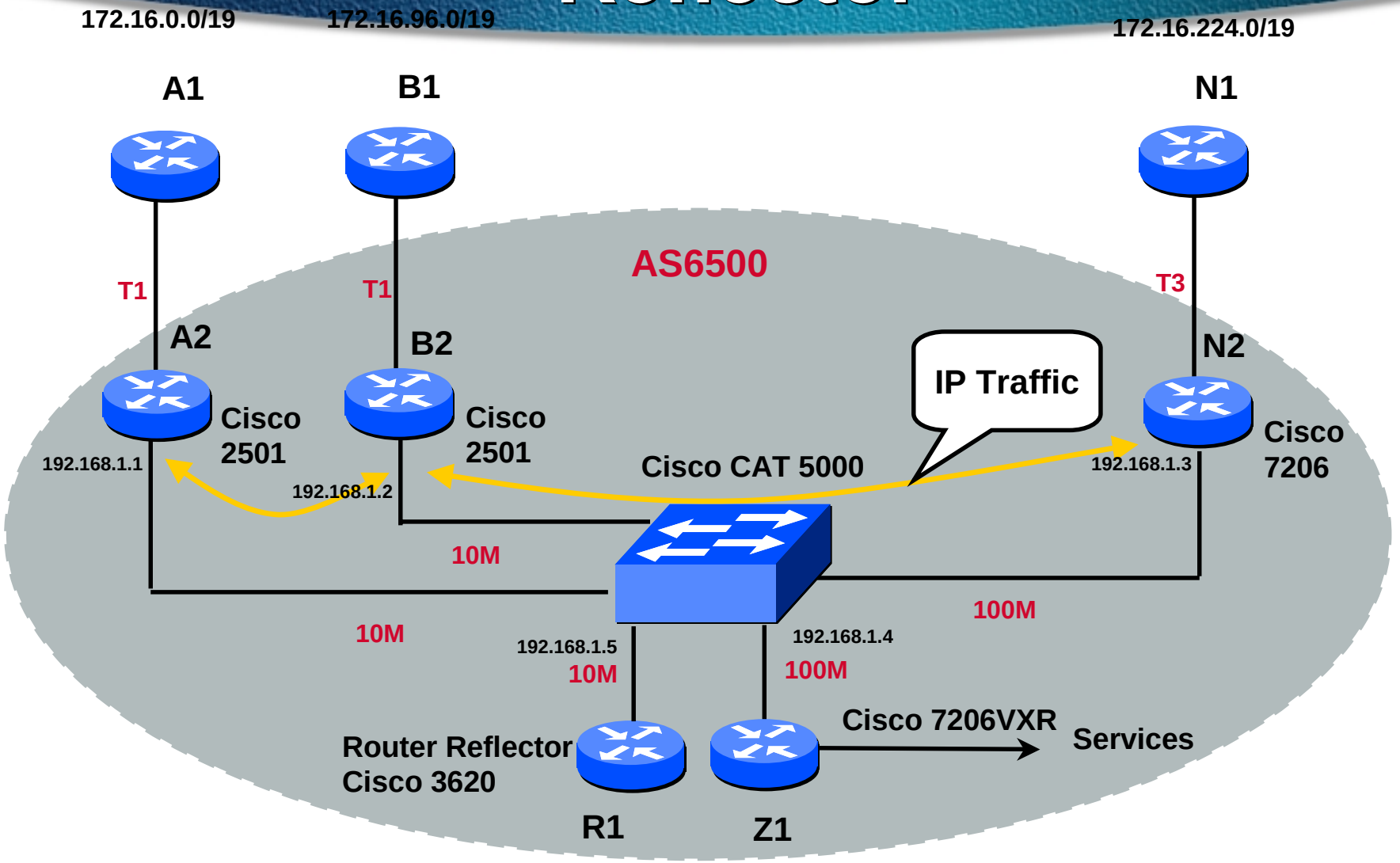


IXP w/ Small Routers & Route Reflector

iBGP Config

Router A2

```
router bgp 65000
neighbor 192.168.1.5  remote-as 100
```

Router B2

```
router bgp 65000
neighbor 192.168.1.5 remote-as 100
```

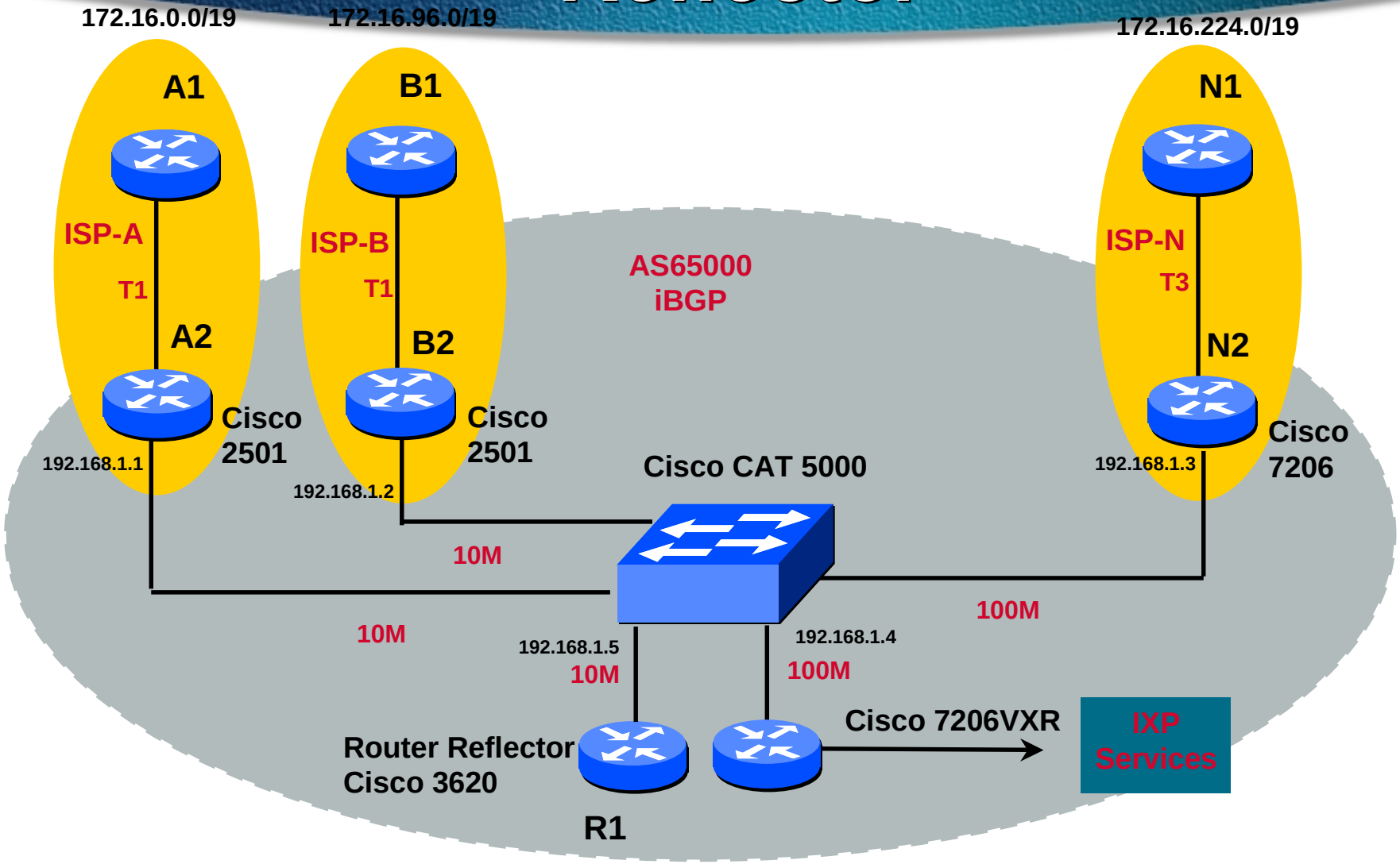
Router N2

```
router bgp 65000
neighbor 192.168.1.5 remote-as 100
```

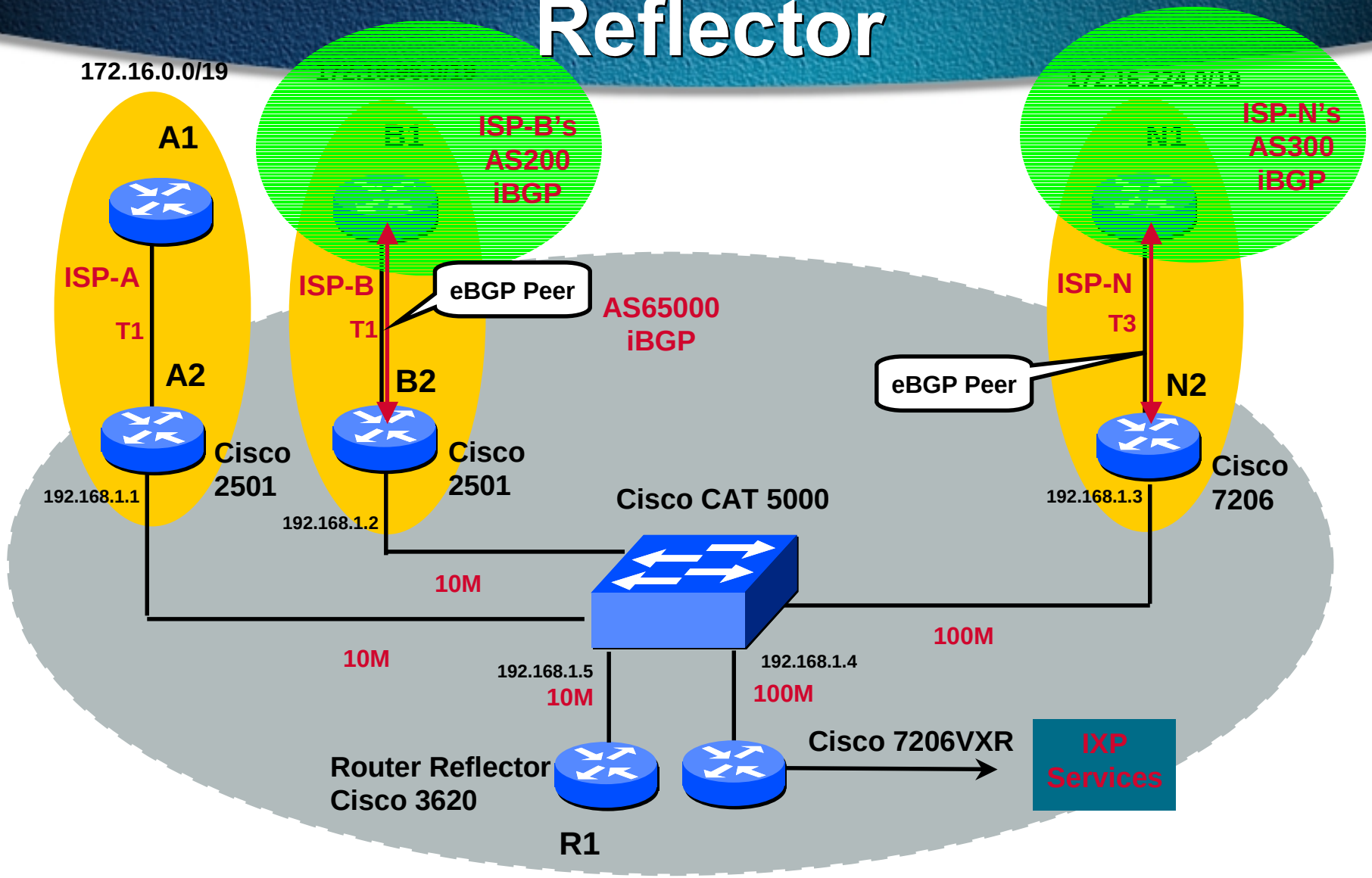
Router R1 ! Route Reflector

```
router bgp 65000
neighbor 192.168.1.1 remote-as 100
neighbor 192.168.1.1 route-reflector-client
neighbor 192.168.1.2 remote-as 100
neighbor 192.168.1.2 route-reflector-client
neighbor 192.168.1.3 remote-as 100
neighbor 192.168.1.5 route-reflector-client
```

IXP w/ Small Routers & Route Reflector



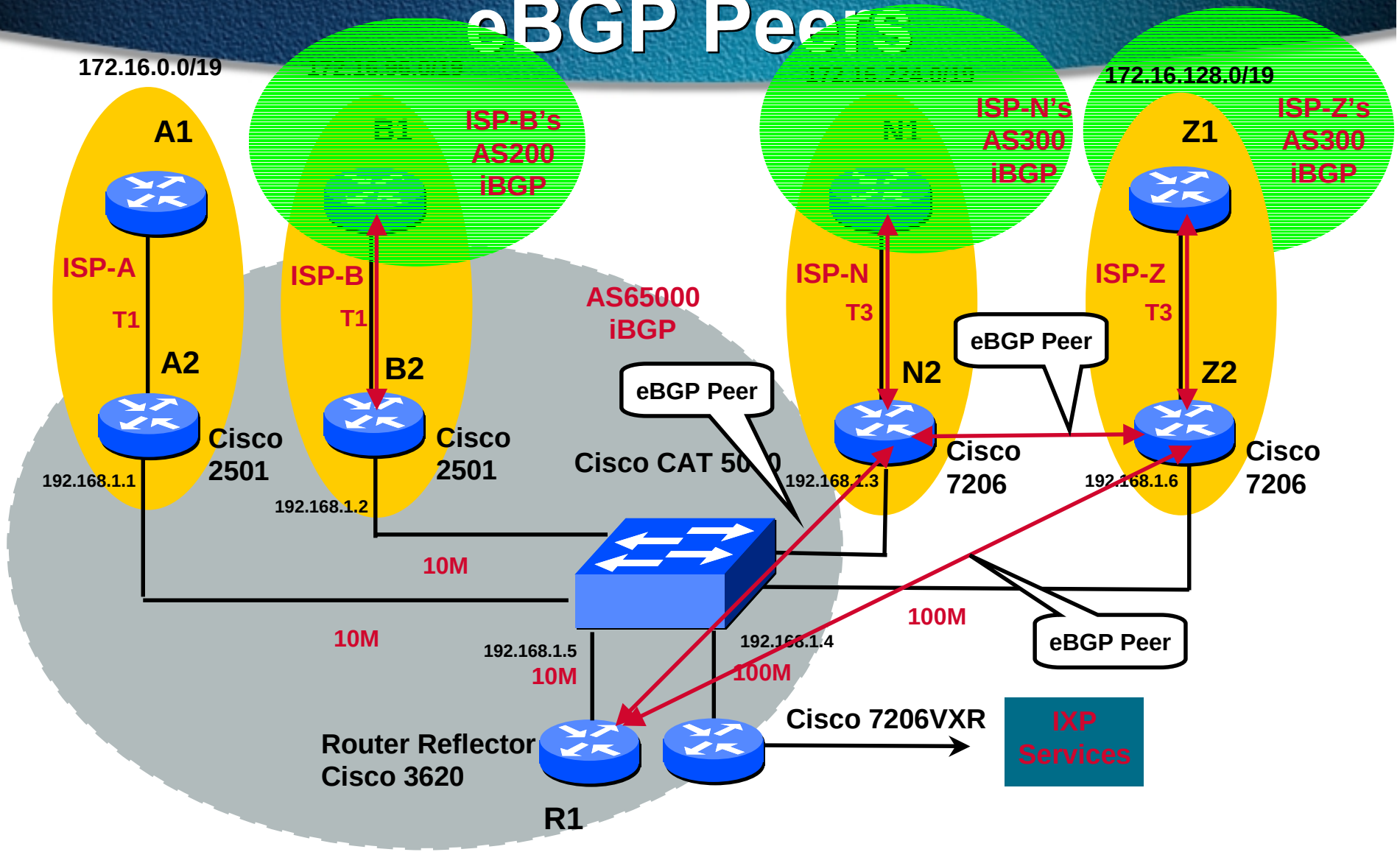
IXP w/ Small Routers & Route Reflector



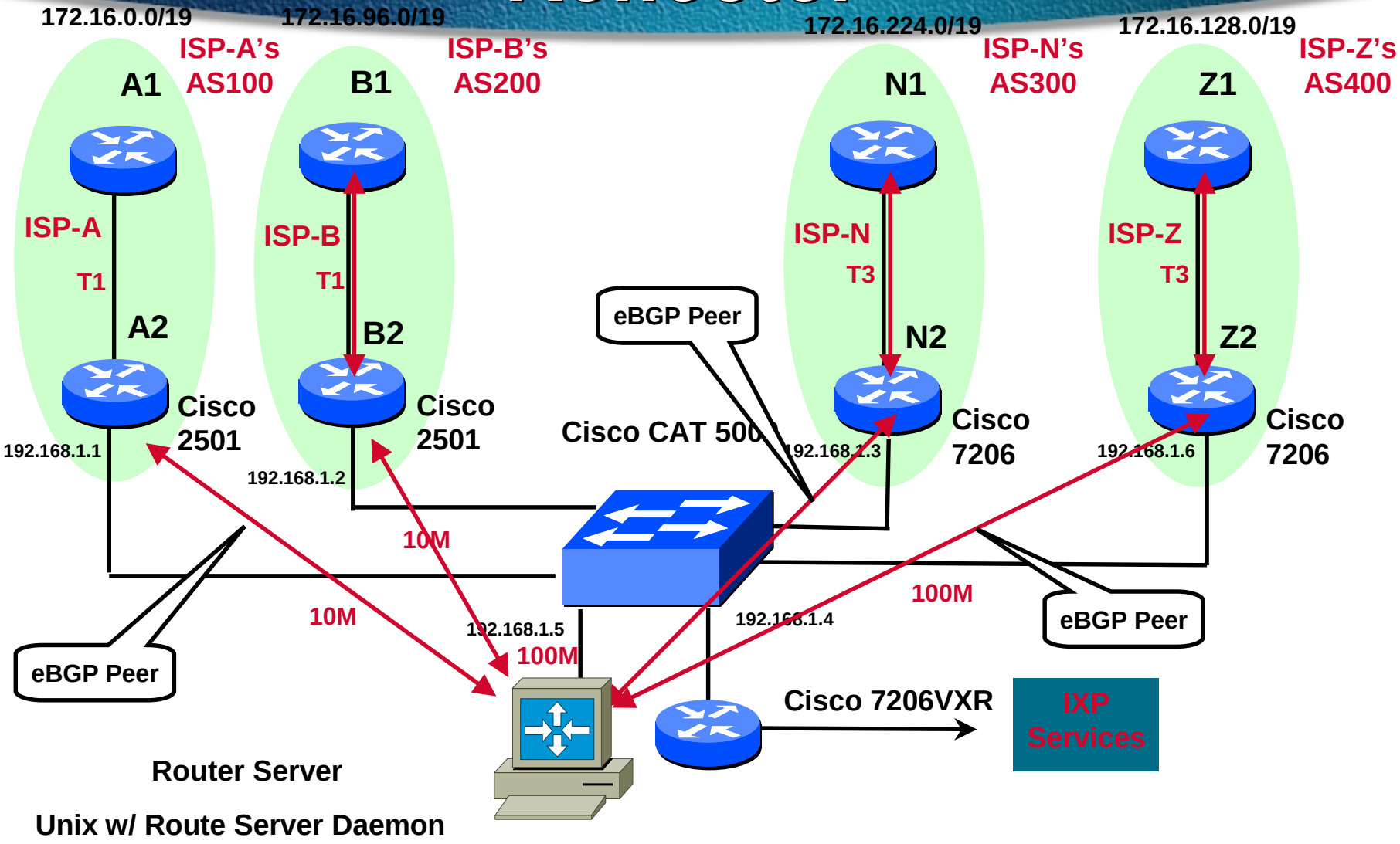
Scaling Paths

- **Router Reflector Based IXPs have proven to scale to +60 ISPs.**
- **What are the scaling options?**
  - ✓ **Direct Peering with Peers and the Router Reflector**
  - ✓ **Replacing the Router Reflector with a *Router Server***

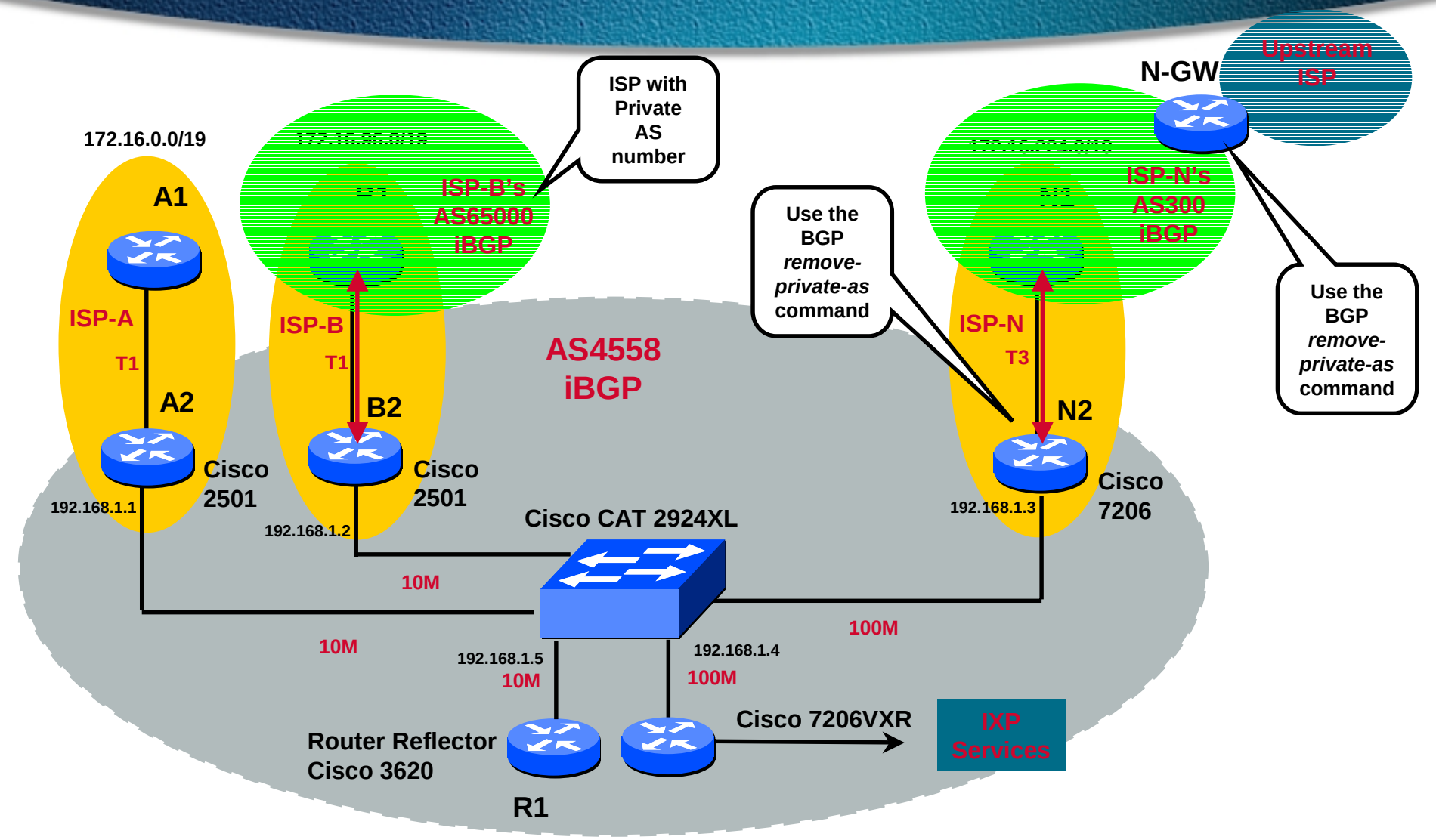
Scaling - Including Direct eBGP Peers



IXP w/ Small Routers & Route Reflector

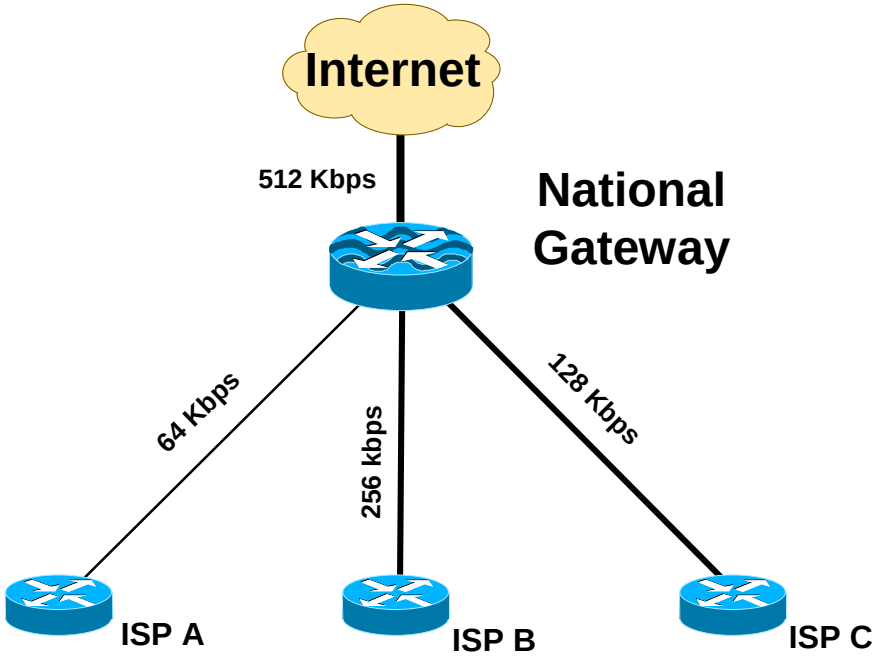


Removing Private AS numbers

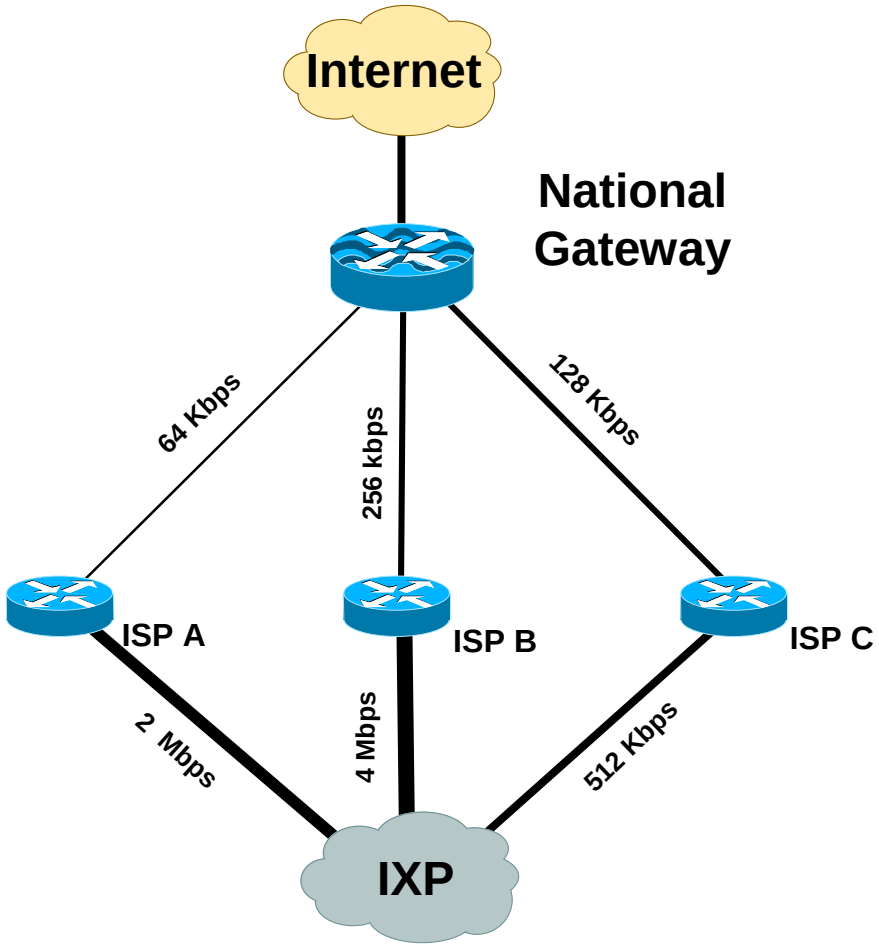


Growing Domestic BW Independently from the International BW

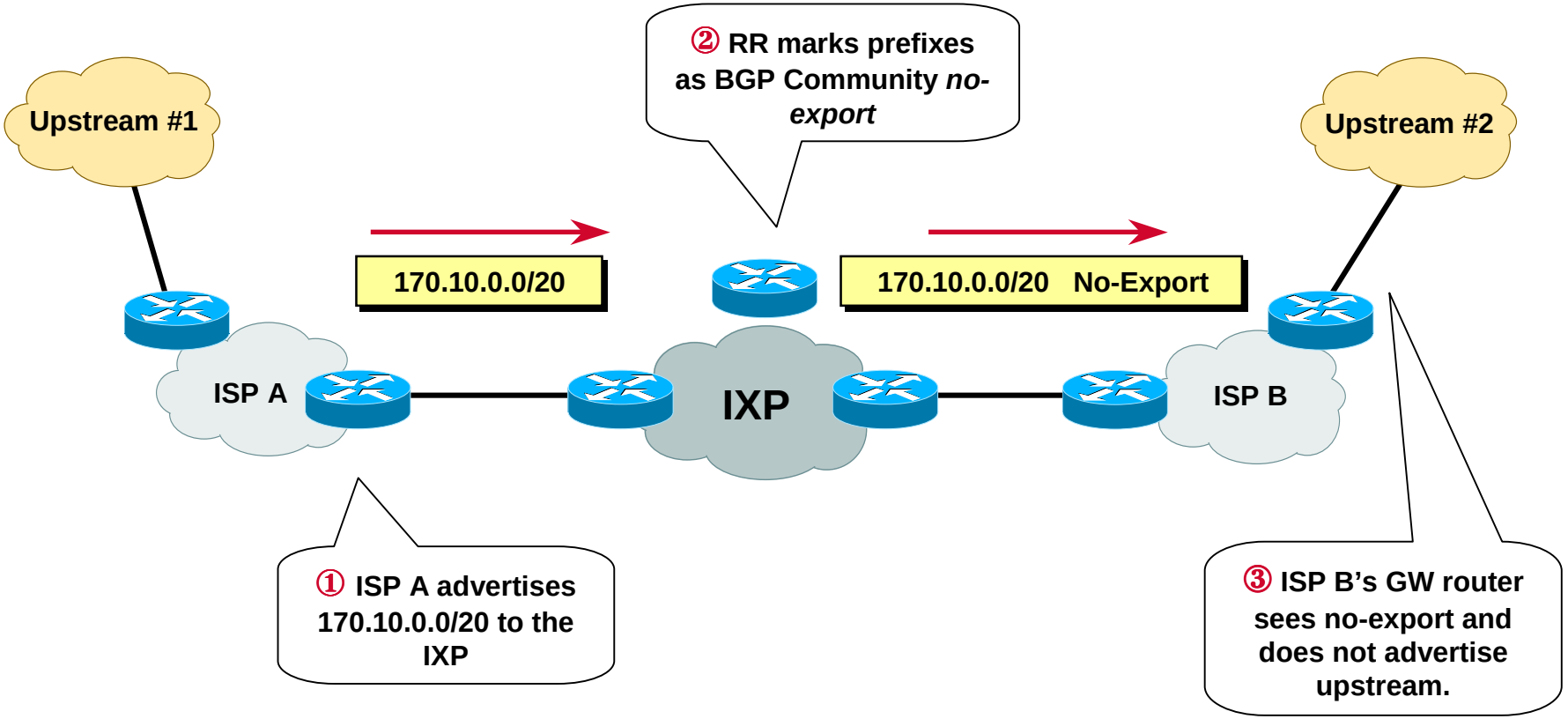
Domestic + International Together



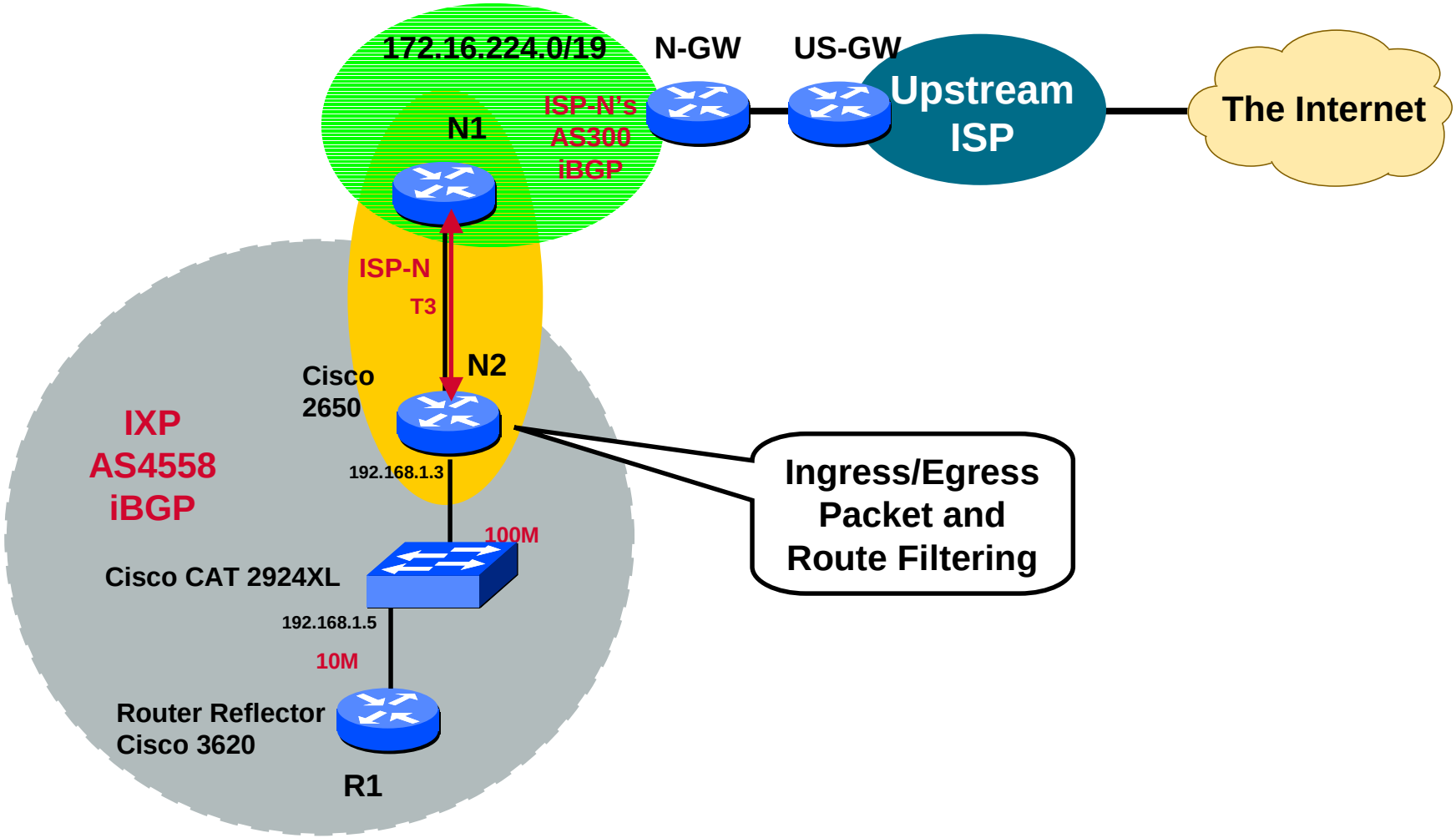
Domestic + International Separate



Using BGP Community *no-export*



Integrating the ISP's Router into the IXP



BGP Communities Used to Localize