Supporting group applications via satellite constellations with multicast

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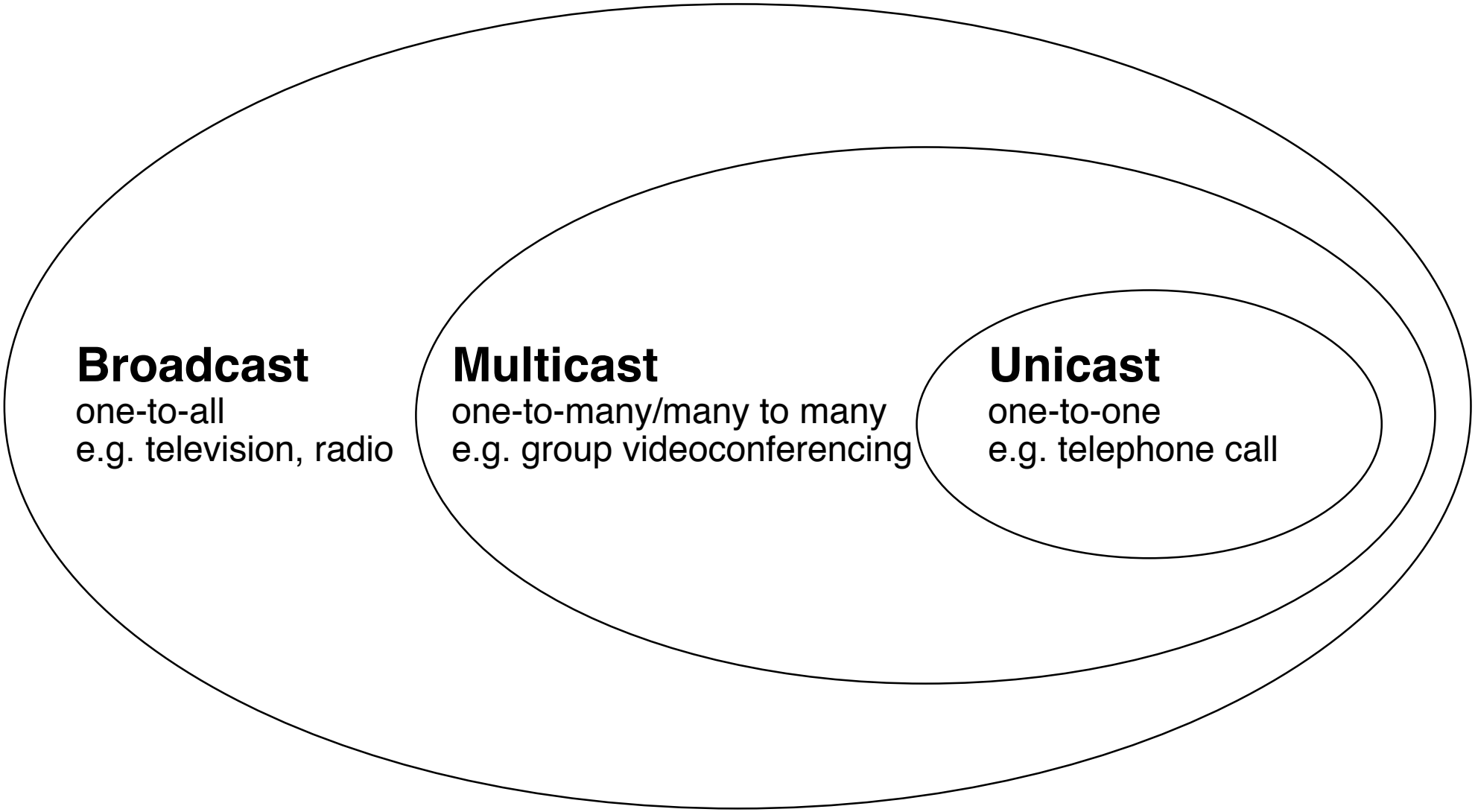
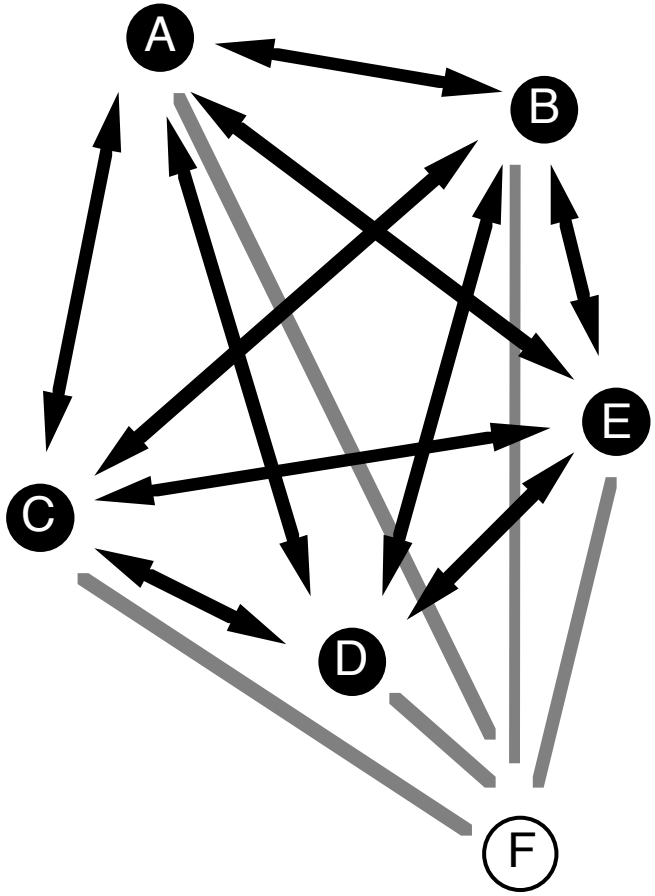
What is multicast?



Why is multicast important?

- saves network capacity - interested parties only
- removes redundant copies of information
- reduces application network management overhead

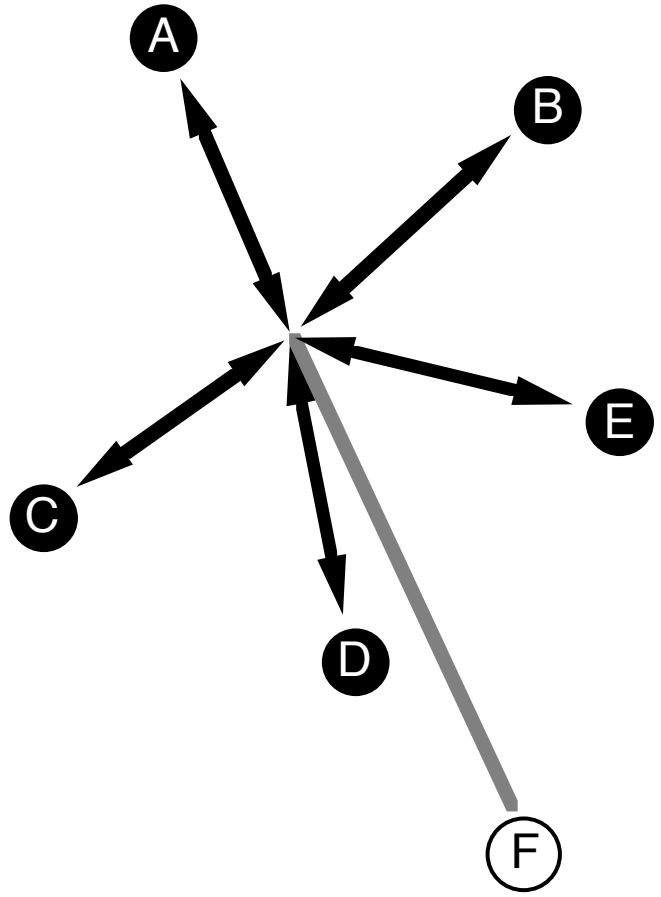
Without multicast...



It makes life easier for the applications (and their writers)

With multicast!

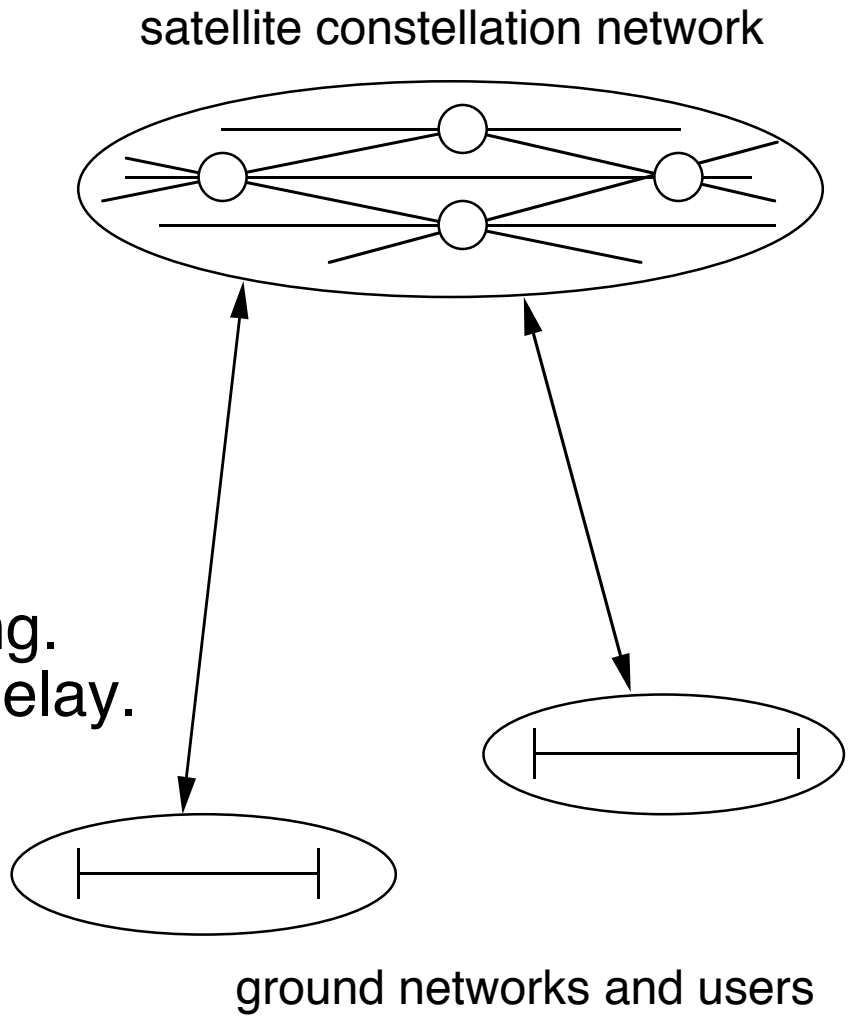
applications let the network manage the multicast group as efficiently as possible.



simplified sparse-mode multicast around a core, or an ATM multicast server.

Why does multicast matter for satellite constellations?

- Limited, expensive capacity must be used effectively.
- makes best use of intersatellite-link meshes
- Interconnected networks (broadband islands) and users will want realtime communication e.g. videoconferencing. Multicasting in the mesh decreases delay.

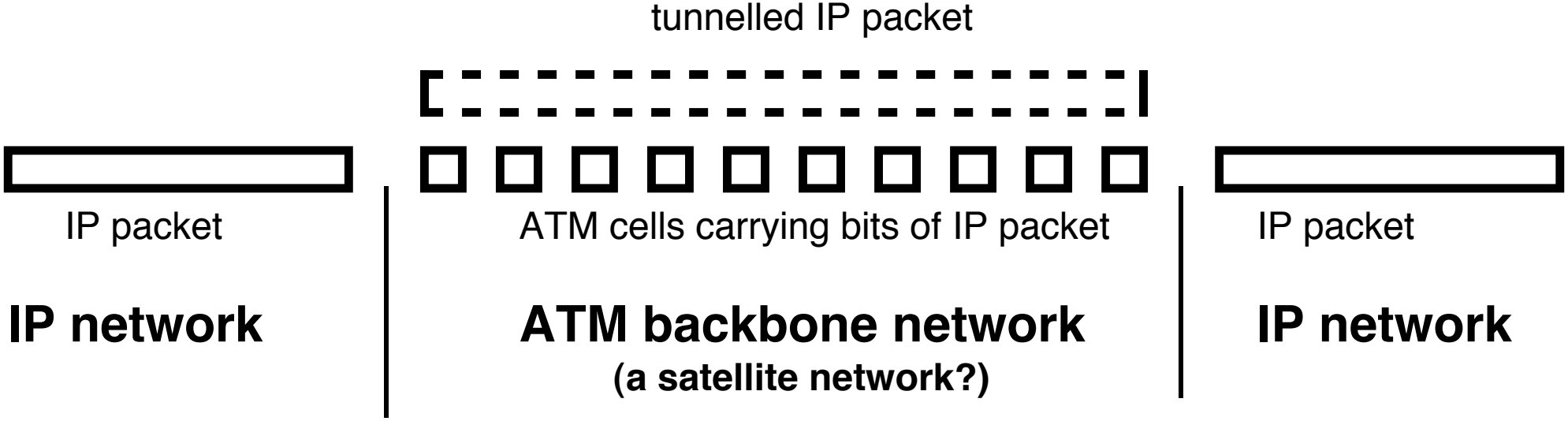


So multicast is a good idea. Is it being implemented? Er, no...

- legacy problems - internetwork multicast must work across different types of network - IP, ATM, etc
- Support for multicast in ATM isn't there yet; still being defined (PNNI 2.0) for the future.
- Constellations are being designed based on existing available hardware, software and standards now.

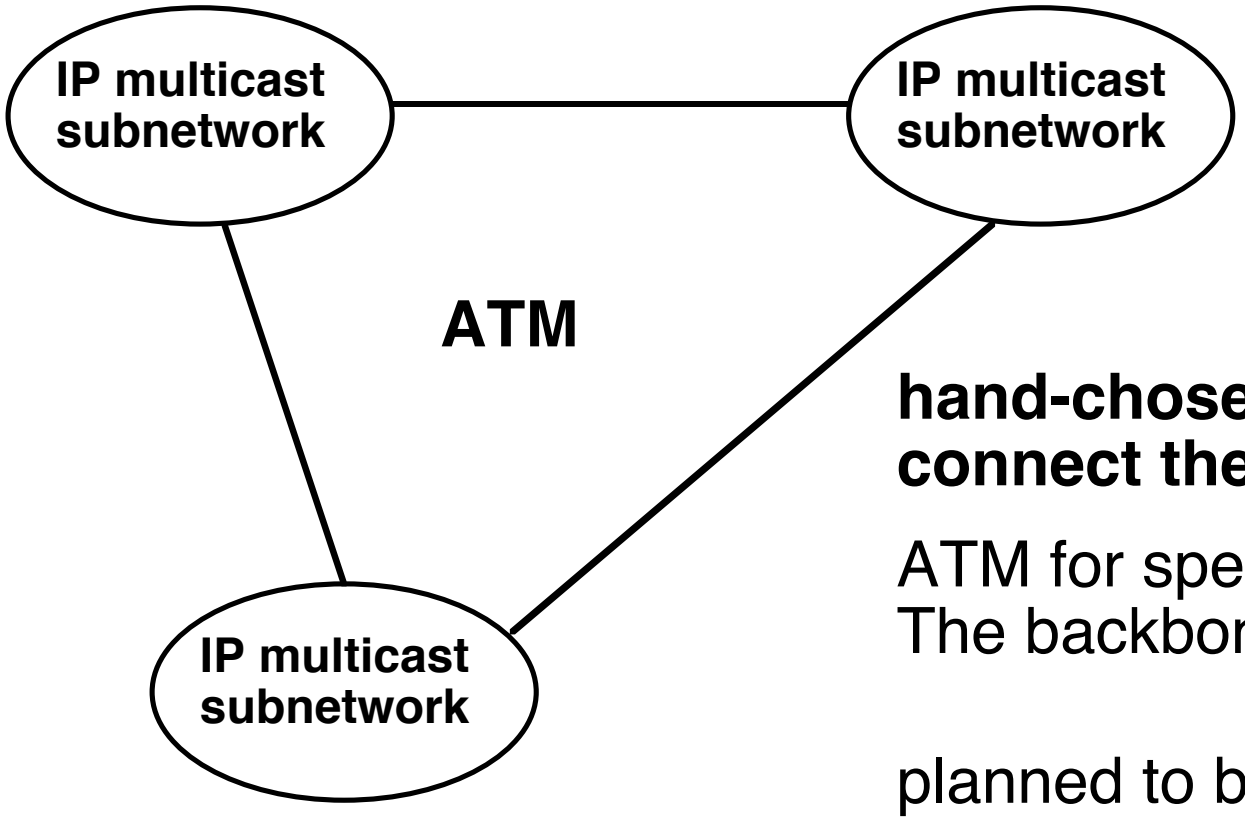
Tunnelling

TCP/IP over ATM is increasingly common.
You switch ATM cells; you don't see IP multicast packets.



Tunnelling is incompatible with true multicasting
and makes for complex border interactions

The MBone - multicast and tunnelling in action



hand-chosen ATM tunnels connect the multicast worlds

ATM for speed, IP for flexibility
The backbone is fixed

planned to be transitional, but...

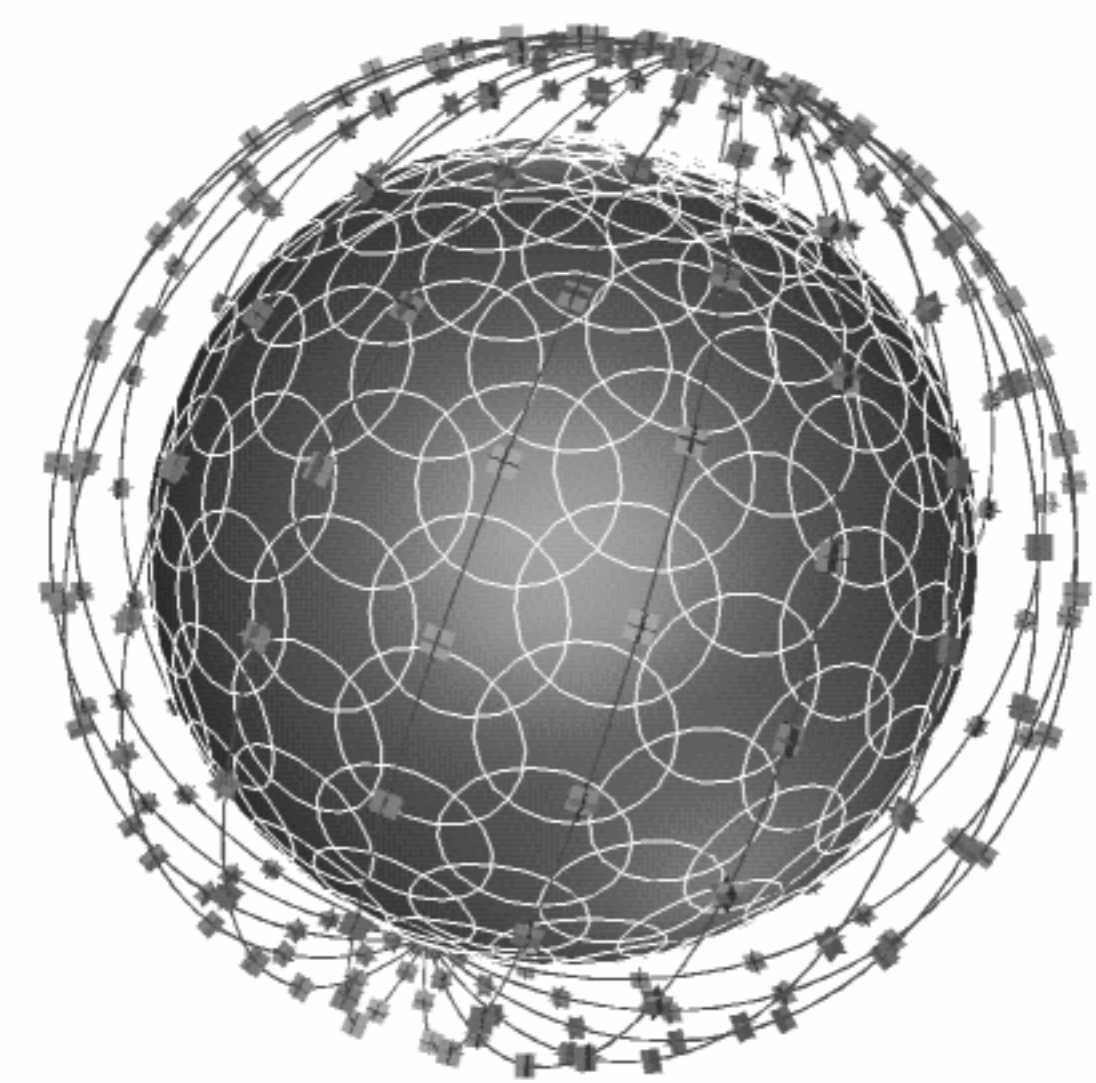
Tunnelling is fine as a transitional step - not a long-term solution
Tunnelling restricts network flexibility

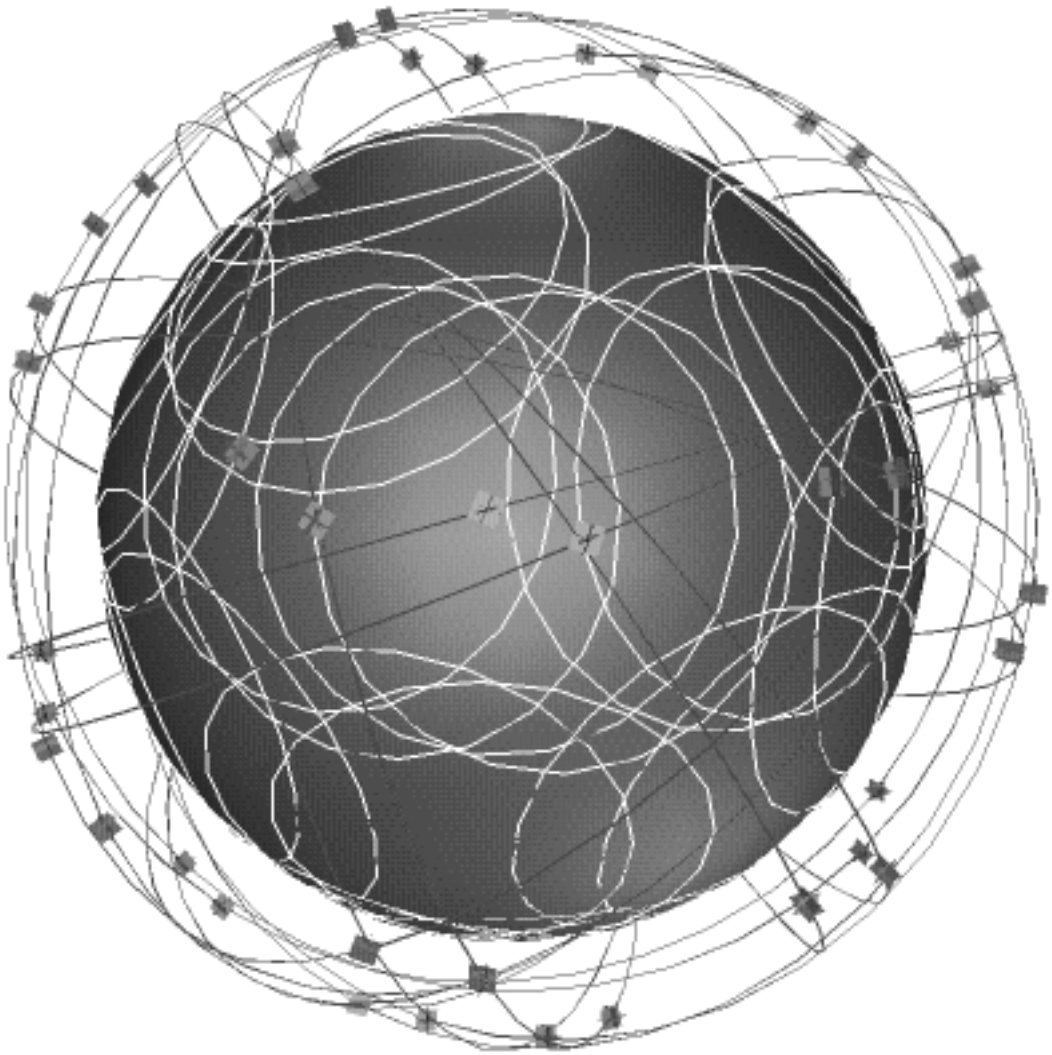
How will planned satellite constellations support multicast?

Broadband LEOs

Teledesic
designing own Layer 2 connectionless protocols and custom interface.

Tunnelling and complex gateways between networks.





Skybridge (Alcatel)
ATM interface.

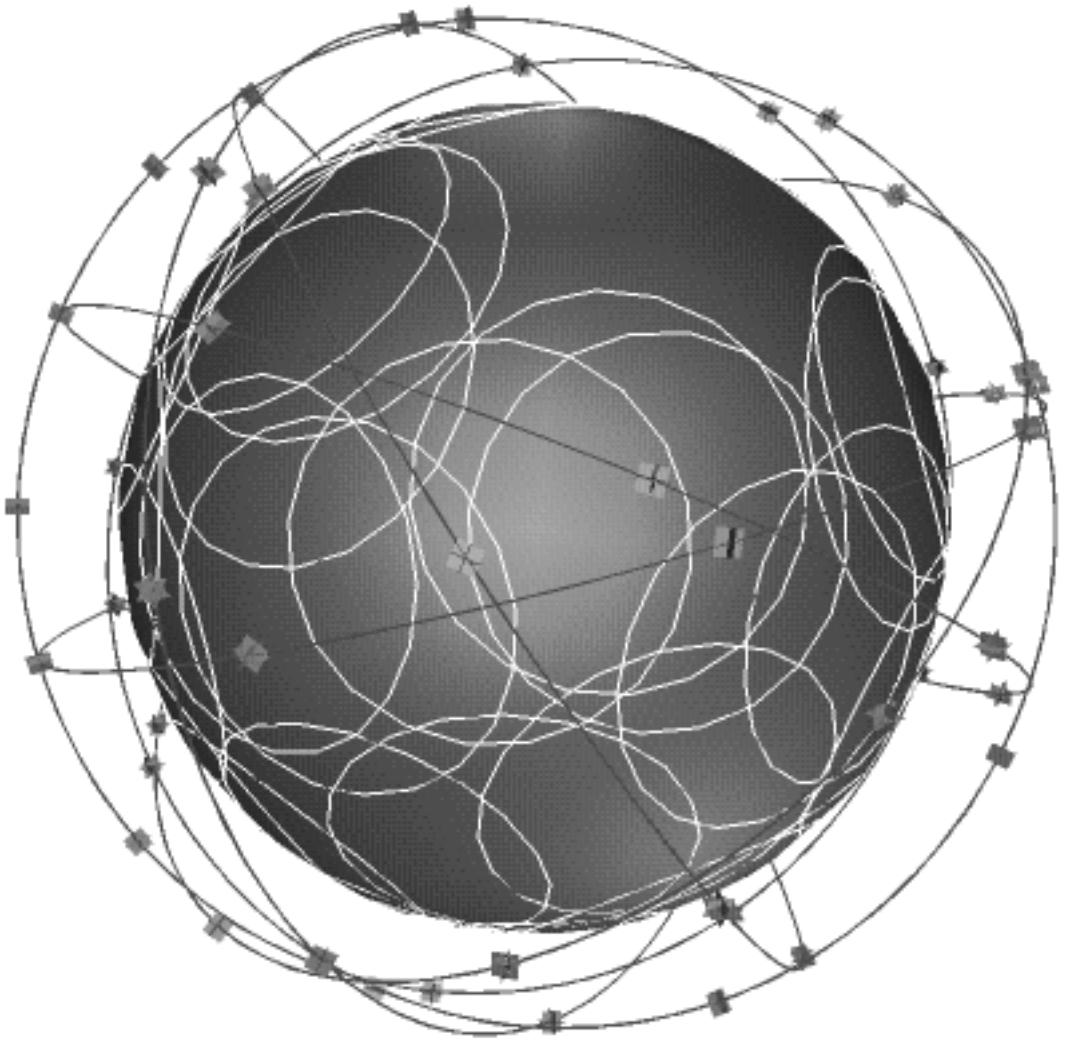
No intersatellite links; bent-pipe transponders mean it's really a ground network.

Transparent point-to-point tunnelling and ATM means easy MBONE support.

Celestri (Motorola)
ATM interfaces to both LEO and GEO constellations.

Fixed-position GEO supports the MBone.

Multicast-in-broadcast; sidesteps support issues, but with higher GEO delay. Not good for interactivity.



Celestri LEO constellation

Others

GEO - Spaceway, Astrolink, Cyberstar, etc
ATM interfaces, fixed position - MBone! But delay limits interactivity.

High-altitude atmospheric platforms (balloons) - Sky Station
ATM interfaces, fixed position - MBone! Latency is low.

Fixed-position systems are really part of the ground network; no changes required - but you'd rather have them as low as possible for better delay.

How could LEO constellations support multicast?

- **at the edges between networks, with complex gateways**

  MARS - Multicast Address Resolution Server
  maps IP to ATM, but doesn't scale for variable topologies.

- **embed some IP routing functionality in each satellite**

  IP-in-IP encapsulation at the edges simplifies updating of onboard routing tables and multicast group management, but adds switching overhead.

  flexibility or speed?

Conclusion

Multicasting is:

- **a standards problem**
  standards conflict and get in each others' way
- **a legacy problem**
  it's tempting to start from scratch
- **an interconnection problem**
  network multicast is simpler than internetwork multicast
- **a Very Hard Problem!**
  major networks are being built without adequate multicast support

Multicasting in mobile backbones (such as satellite constellations) requires further research