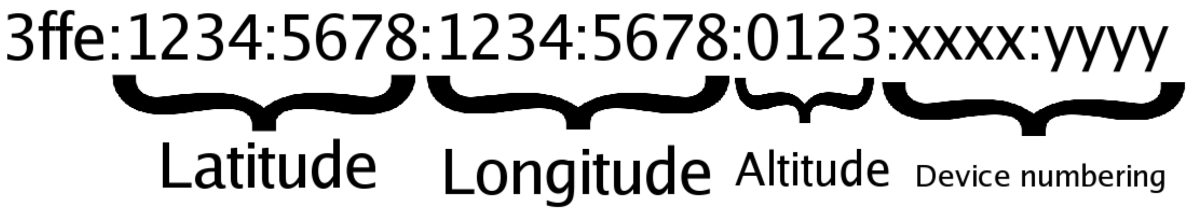
Location-based IPv6 Addressing

- The creation of metropolitan-area networks (MANs) is burdensome, as it requires heavy infrastructure (such as fiber optics) to be delivered. Last-mile delivery is a notorious problem. The use of wireless networks is currently limited to short-range (~100m) communication.
- The solution to connect communities through wireless networks is to create a mesh of simple routers. Packets can reach their destination passing through many routers, but without going through a large (and expensive) backbone.
- WiMax should deliver enough wireless bandwidth to create very high speed network meshes.
- These routers can auto-sense their neighbors and configure themselves automagically.
- When using a decentralized structure, hierarchical IP addressing makes no sense – there is NO physical hierarchy.
- **SOLUTION:** Use IPv6 addresses to represent longitude/latitude/altitude of each router.
- Out of 128 bits in the IPv6 address, we can assign 32 bits as an integer to a latitude, 32 bits to an integer longitude, and 16 bits to an integer altitude => total of 80 bits for geographical information.



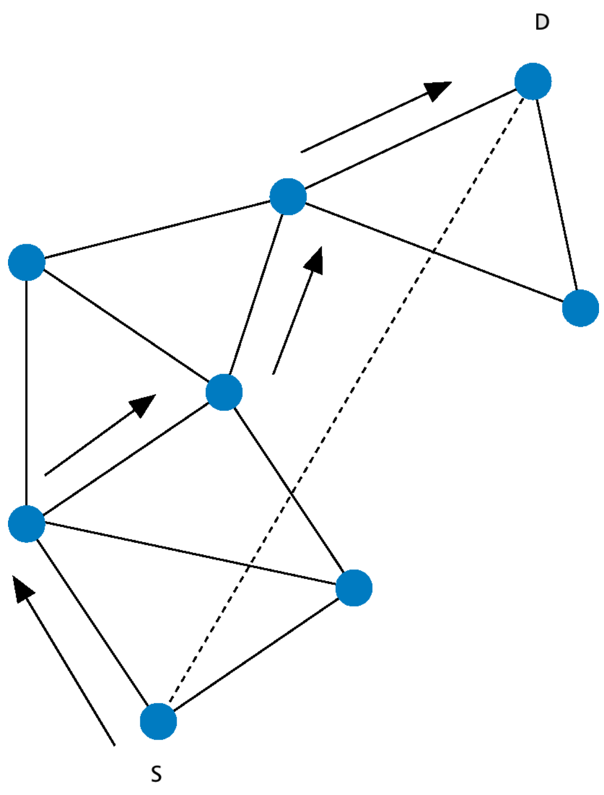
- Considering that the Earth's circumference is roughly 40.000 km, using 32 bits lead to a precision of 9 cm to longitudes and 4.5cm on latitudes (at the Equator, the worst case), which is more than enough for virtually all applications.

- If needed, the IP tree created can be made more fair by interleaving the bits of latitude and longitude – this way, it's more likely that nearby devices will have the same bits for the beginning of the address.

- The remaining 48 bits can be used to differentiate between many devices that are close to one another. It's a rather large number: it's more than the entire space of IPv4 addresses, for a volume of less than one cubic meter. If we leave the first 16 bits with their original meaning, we allow this form of addressing to co-exist with standard Internet IPv6 addressing (as it will be a simple /8 subnet of the full IPv6 address set), and we still have 32 bits for device numbering.

- The geographical coordinates of each device can either be entered manually or from an embedded GPS => GPS is useful for moving devices.

- Routing consists simply on relaying the packet to the router's neighbor which is closest to the final destination of the packet.



- To avoid bottlenecks, traffic metrics can be used to distribute network traffic evenly. Every router has a periodically updated measure of its current traffic load. Routers decide to relay the packet not simply to the closest geographical neighbor, but to the closest neighbor which is not overloaded.

- This load measure is propagated by a router to its neighbors. Upon receiving this information, the neighbors recalculate their own traffic load as a weighed sum of its own load and its neighbor's load (and vice-versa) => Leads to a very dynamic mesh metric, somewhat similar to heat propagation on a surface => medium- to long-range congestion detection and avoidance by naturally choosing paths which are less loaded

- To deal with moving devices, Mobility IPv6 can be used, adapting the addressing scheme to be geographical.

- This can be eventually expanded as an architecture for the whole Internet to become a wireless ad-hoc mesh on IPv6.