Directionless Home Router

This application describes a home router which does not have pre-defined WAN/Internet and LAN ports, but rather can be attached to the home network in any manner and then autodiscover its alignment within the network.

This application is for a home router that can automatically determine its Internet/WAN facing interface and therefor can be plugged into the home network in any way and still work properly. This directionless home router (DHR) is the foundation for a complex autoconfiguring home network.

The DHR will typically be equipped with a number of Ethernet ports and often a Wi-Fi radio. None of the Ethernet ports will be marked or distinguished in any way, they will all be the same color, etc.

Part 1 – Up Detection

When the DHR is plugged into a home network and powered on, it sends out DHCPv6 Solicit messages on all of its Ethernet and/or MOCA ports (by default, any Wi-Fi interfaces are not eligible to become Internet/WAN facing ports, manual configuration is required to enable this). In the simplest case, the DHR determines its Internet/WAN facing interface based on the first DHCPv6 Advertise message containing a Global Unicast Address (GUA) IP address and prefix (IA_PD) received from an eligible DHCPv6 server.

This is effective because in home networks, eligible DHCPv6 servers will actually be other home routers and IPv6 home routers will only advertise GUA addresses and prefixes that they have received on their own Internet/WAN facing interface (RFC6204). In other words, a valid DHCPv6 server with a valid GUA prefix can be assumed to have a route to the Internet. While this method may not result in shortest path routing, home networks are not believed to need the most optimal routing due to their constrained size.

It is also possible for a DHR to apply additional logic to its Internet/WAN facing interface selection procedure. Additional metrics such as link speed and prefix size may be used as tie breakers or in place of the first-received method. E.g. a DHR may send its Solicit messages and then wait a specified or random period of time for responses. Once collecting all responses, the DHR could choose between the received Advertise messages based on the amount of bandwidth available on the receiving link (preference for higher BW), the size of the prefix offered in the message (preference for larger), or some combination of the two. Other metrics may be used as well; there are potentially many different selection algorithms that could be used by the DHR.

Part 2 – ULA Selection

A DHR may be used in a network without Internet connectivity. In this case, basing the "up detection" on the availability of a GUA prefix will not work, as there will be no GUA prefixes available. In networks without GUA available, Unique Local Addresses (ULA) can be used for internal communication.

In order to use ULA in a DHR-based home network, every DHR will autogenerate a pseudo-random ULA prefix as per RFC 4193 and advertise that network to all of its neighboring routers. The DHR will also accept Advertise messages from neighboring routers. When the DHR receives an Advertise message with a ULA prefix that is numerically higher than the one it generated and is advertising, it revokes that prefix, adopts the numerically higher one, and assigns the Ethernet port on which it was received as the ULA "up" port. Likewise, once the DHR has accepted a prefix from one neighbor, it will discard that prefix and shift its ULA "up" port if it receives an Advertise for a numerically higher prefix from any other neighbor. In this way, the entire home network converges on a single ULA prefix and builds a working ULA topology.

Note: A DHR network can use both ULA and GUA in the manner described in this application simultaneously. Specifically, if the home network were provisioned before GUA addresses were available, and Internet access was established subsequently, a second tree could be constructed for GUA addresses. As the first router receives a DHCPv6 prefix, it generates an RA on its LAN interfaces; routers hearing the RA submit a DHCP request per Part 1. Routing for the GUA and ULA network(s) need not be the same. However, if GUA addresses are available at turn-up, the ULA "tree" could be made to mirror the GUA routing, rather than being created using the steps listed in part 2 of this invention disclosure. Also, if the ULA routing is established first, it could be made to change to reflect the GUA "tree" once established.

Some home routers contemplated by this application may have a defined Internet/WAN port and the remaining interfaces are designated as LAN ports. This means that the router functions in a very rigid manner and must be physically connected properly in order for the home network to operate properly. As home networks become more and more sophisticated, the burden of proper cabling will become even more onerous than it is today. Most people who own a home network are not network engineers and do not want to be troubled with network configuration – it needs to just work. Indeed, MSOs have indicated an increase in the number of trouble calls due to subscribers attaching their routers "upside down". The DHR allows a home network to be physically cabled completely arbitrarily and still form a functioning network.

This application may use a routing protocol in the home for up-detection and loop-prevention but the above process may solve similar problems in a much simpler and more elegant fashion – much less likely to break, and requiring fewer computational resources.

The DHR has the potential to usurp all current home router sales. A router that can be plugged in any way and still form a functioning home network with no user intervention is a radical step forward in home networking.

Some home routers are physically bound and must be cabled properly to work. The DHR auto-discovers its connectivity, eliminating this need and simplifying home networking dramatically.