

NetFPGA – Programmable Hardware for high-speed network prototypes



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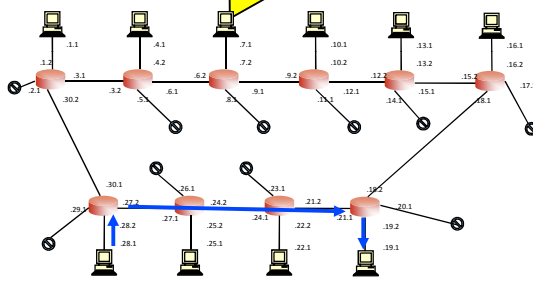
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Internet routing in action – a simple example

The NetFPGA platform provides a flexible teaching and research tool – permitting instrumentation and prototyping of real router functionality at real network speeds.

In this example we demonstrate the router, using OSPF, recovering from a broken link.

Any PC can stream traffic through multiple NetFPGA routers in the ring topology to any other PC



The routing table has converged to the routing path with a minimum number of hops

Router Quickstart
Configuration | Statistics | Details

Router Configuration

Interface Configuration

Port Number	MAC Address	IP Address
0:00:00:00:19:01	192.168.27.1	
1:00:00:00:19:02	192.168.26.2	
2:00:00:00:19:03	192.168.25.2	
3:00:00:00:19:04	192.168.24.2	

Routing Table

Modified	Index	Destination IP	Subnet Mask	Next Hop IP	MAC0	CPU0	MAC1	CPU1	MAC2	CPU2	MAC3	CPU3
	0	192.168.30.0	255.255	192.168.2...								
	1	192.168.29.0	255.255	192.168.2...								
	2	192.168.28.0	255.255	192.168.2...								
	3	192.168.27.0	255.255	0.0.0.0								
	4	192.168.26.0	255.255	0.0.0.0								
	5	192.168.25.0	255.255	0.0.0.0								
	6	192.168.24.0	255.255	0.0.0.0								
	7	192.168.23.0	255.255	192.168.2...								
	8	192.168.22.0	255.255	192.168.2...								
	9	192.168.21.0	255.255	192.168.2...								
	10	192.168.20.0	255.255	192.168.2...								

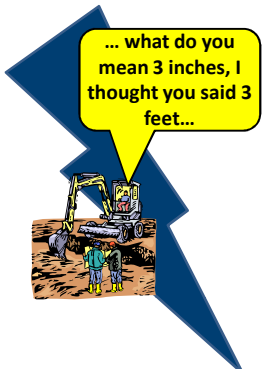
ARP Table

Modified	Index	IP Address	Next Hop MAC Address
	0	192.168.27.2	00:00:00:00:1c:04
	1	192.168.24.1	00:00:00:00:16:01
	2	20.0.0.0	00:00:00:00:00:00
	3	30.0.0.0	00:00:00:00:00:00
	4	40.0.0.0	00:00:00:00:00:00
	5	50.0.0.0	00:00:00:00:00:00
	6	60.0.0.0	00:00:00:00:00:00
	7	70.0.0.0	00:00:00:00:00:00
	8	80.0.0.0	00:00:00:00:00:00
	9	90.0.0.0	00:00:00:00:00:00

Here is a small part of that route table

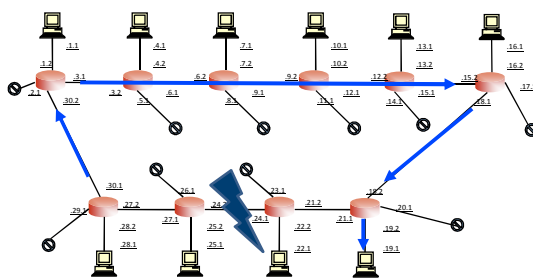
Traceroute shows the path

```
traceroute to 192.168.19.2 (192.168.19.2), 30 hops max, 40 byte packets
 1 192.168.25.2  0.393 ms  0.352 ms  0.387 ms
 2 192.168.24.1  0.380 ms  0.383 ms  0.469 ms
 3 192.168.19.2  0.403 ms  0.443 ms  0.189 ms
```



We break the link

More than 90% of physical link failures in the US are caused by farmers with backhoes
- Informal survey of nanog 2006



Routers re-route traffic around the broken link and traffic keeps moving

Routing Table

Modified	Index	Destination IP	Subnet Mask	Next Hop IP	MAC0	CPU0	MAC1	CPU1	MAC2	CPU2	MAC3	CPU3
	0	192.168.30.0	255.255	192.168.2...								
	1	192.168.29.0	255.255	192.168.2...								
	2	192.168.28.0	255.255	192.168.2...								
	3	192.168.27.0	255.255	0.0.0.0								
	4	192.168.26.0	255.255	0.0.0.0								
	5	192.168.25.0	255.255	0.0.0.0								
	6	192.168.24.0	255.255	0.0.0.0								
	7	192.168.23.0	255.255	192.168.2...								
	8	192.168.22.0	255.255	192.168.2...								
	9	192.168.21.0	255.255	192.168.2...								
	10	192.168.20.0	255.255	192.168.2...								

traceroute to 192.168.19.2 (192.168.19.2), 30 hops max, 40 byte packets

```
 1 192.168.25.2  0.290 ms  0.241 ms  0.308 ms
 2 192.168.27.2  0.111 ms  0.125 ms  0.127 ms
 3 192.168.30.2  0.123 ms  0.193 ms  0.200 ms
 4 192.168.3.2  0.101 ms  0.173 ms  0.178 ms
 5 192.168.6.2  0.145 ms  0.159 ms  0.160 ms
 6 192.168.9.2  0.140 ms  0.094 ms  0.085 ms
 7 192.168.12.2  0.137 ms  0.136 ms  0.131 ms
 8 192.168.15.2  0.128 ms  0.124 ms  0.160 ms
 9 192.168.19.2  0.103 ms  0.105 ms  0.128 ms
```

The new path is shown here



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