

实验四实验报告

实现节点广播网络

实验过程与代码细节

实验结果

探究广播网络的效率

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组建环形拓扑并观察数据环路

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1 实现节点广播网络

阅读代码框架，实现其中的broadcast_packet函数，并验证两个节点可以通过hub相连并 ping

1.1 实验过程与代码细节

- 调用链表相关函数，值得注意的是，这种链表实现的优势在于
 - 各种数据结构都可以复用，这是与C++等语言中已有的封装。
 - 同一个数据结构可以同时多个链表中。

同时，不方便的地方在于，为了创建一个链表，我们需要同时在链表元素的数据结构中定义，并在函数中定义链表。即便他们可以使用相同的名字来使逻辑更加清晰，但为了实现一个功能而在两个位置进行修改引入了复杂性，理想的情况是指在函数中定义便可使用。

- 广播时注意不要向发送方广播。
- 补全 `./lab4/src/main.c`

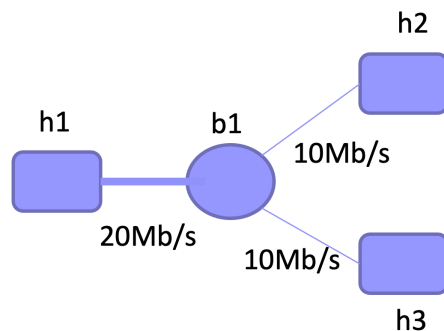
1.2 实验结果

ping 的调用在 `./lab4/mininet/three_nodes_bw.py` 中，结果保存到 `./lab4/result/STEP1-pingSuccess.log` 中

2 探究广播网络的效率

在如下图的网络结构和带宽限制下，对比两种负载时的最大传输效率。

- h1同时向h2、h3发送不同的数据
- h2、h3同时向h1发送数据



2.1 实验结果

在 `./lab4/mininet/three_nodes_bw.py` 中完成实验脚本、进行10Mb传输，结果保存到 `./lab4/result/STEP2-*.log` 中，下面的表格汇总了结果。

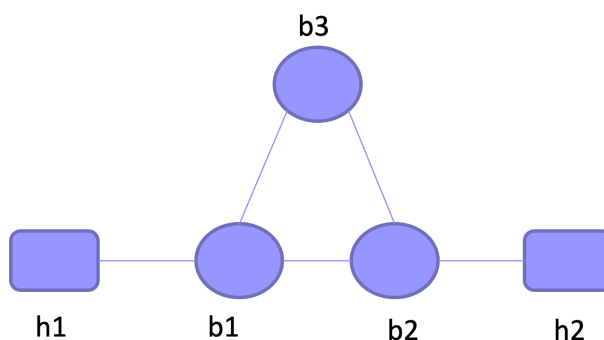
	h1与h2间速率	h1与h3间速率
h1同时向h2、h3发送数据	3.13 Mb/s	3.20 Mb/s
h2、h3同时向h1发送数据	6.09 Mb/s	6.13 Mb/s

可以看到第一种情况下速率更低，这是因为，以h1与h2之间传输为例，h2为了收到数据，不得不同时接收两份数据，抛弃一半而只接受属于自己的数据。

而对于第二种情况，同样以h1与h2之间传输为例，虽然h1发出的数据仍然被广播了两份，但其中一份发向h3，并不会影响任何数据的正常传输。

3 组建环形拓扑并观察数据环路

在python中实现如下图的网络结构，观察h1向h2发包时，数据包在三个hub间产生环路。



3.1 实验结果

在 `./lab4/mininet/hub_loop.py` 中实现结构，运行 `ping -c 1` 发送一个包，并调用 `tshark -c 10000`，发现可以连续抓取10K个数据包，生成的wireshark输出片段如下：

Wireshark network traffic capture showing ARP and ICMP messages between 10.0.0.1 and 10.0.0.2. The capture is filtered by 'Apply a display filter: <Ctrl-F>'. The packet list shows 436 to 489 packets, all of which are ARP or ICMP Echo (ping) replies. The packet details pane shows the structure of the selected packet (Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0).

No.	Time	Source	Destination	Protocol	Length	Info
436	0.002329269	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
437	0.002333608	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
438	0.002337233	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
439	0.002341614	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
440	0.002345124	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
441	0.002349627	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
442	0.002352998	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
443	0.002357515	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
444	0.002360932	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
445	0.002365272	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
446	0.002369630	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
447	0.002373124	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
448	0.002376602	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
449	0.002380970	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
450	0.002384411	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
451	0.002388750	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
452	0.002393218	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
453	0.002396688	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
454	0.002401182	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
455	0.002404628	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
456	0.002408963	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
457	0.002412405	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
458	0.002415983	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
459	0.002420337	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
460	0.002423750	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
461	0.002428107	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
462	0.002431472	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
463	0.002435814	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
464	0.002439403	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
465	0.002443795	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
466	0.002447288	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
467	0.002451607	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
468	0.002455203	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
469	0.002459550	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
470	0.002463907	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
471	0.002467348	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
472	0.002470752	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
473	0.002475150	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
474	0.002478712	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
475	0.002482981	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
476	0.002486485	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
477	0.002489975	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
478	0.002494176	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
479	0.002498514	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
480	0.002501998	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
481	0.002506422	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
482	0.002509801	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
483	0.002513167	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
484	0.002517467	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
485	0.002521947	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
486	0.002525312	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
487	0.002529769	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce
488	0.002533363	10.0.0.1	10.0.0.2	ICMP	98	Echo (ping) reply 1d=0xb20, seq=1/256, ttl=64
489	0.002537441	d6:36:a9:dd:5c:ce	de:ca:a2:19:ed:4d	ARP	42	10.0.0.1 is at d6:36:a9:dd:5c:ce

Frame 1: 98 bytes on wire (784 bits), 98 bytes captured (784 bits) on interface 0
Ethernet II, Src: de:ca:a2:19:ed:4d (de:ca:a2:19:ed:4d), Dst: d6:36:a9:dd:5c:ce (d6:36:a9:dd:5c:ce)
Internet Protocol Version 4, Src: 10.0.0.2, Dst: 10.0.0.1
Internet Control Message Protocol