pathchar — a tool to infer characteristics of Internet paths

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April 21, 1997

Some history

1980 ping (Mills, et.al) — measure source–destination round-trip-time.

1985 tcp tuning (Karels & Jacobson) — measure bottleneck bandwidth.

1987 snmp (Case) — intra-domain router monitoring.

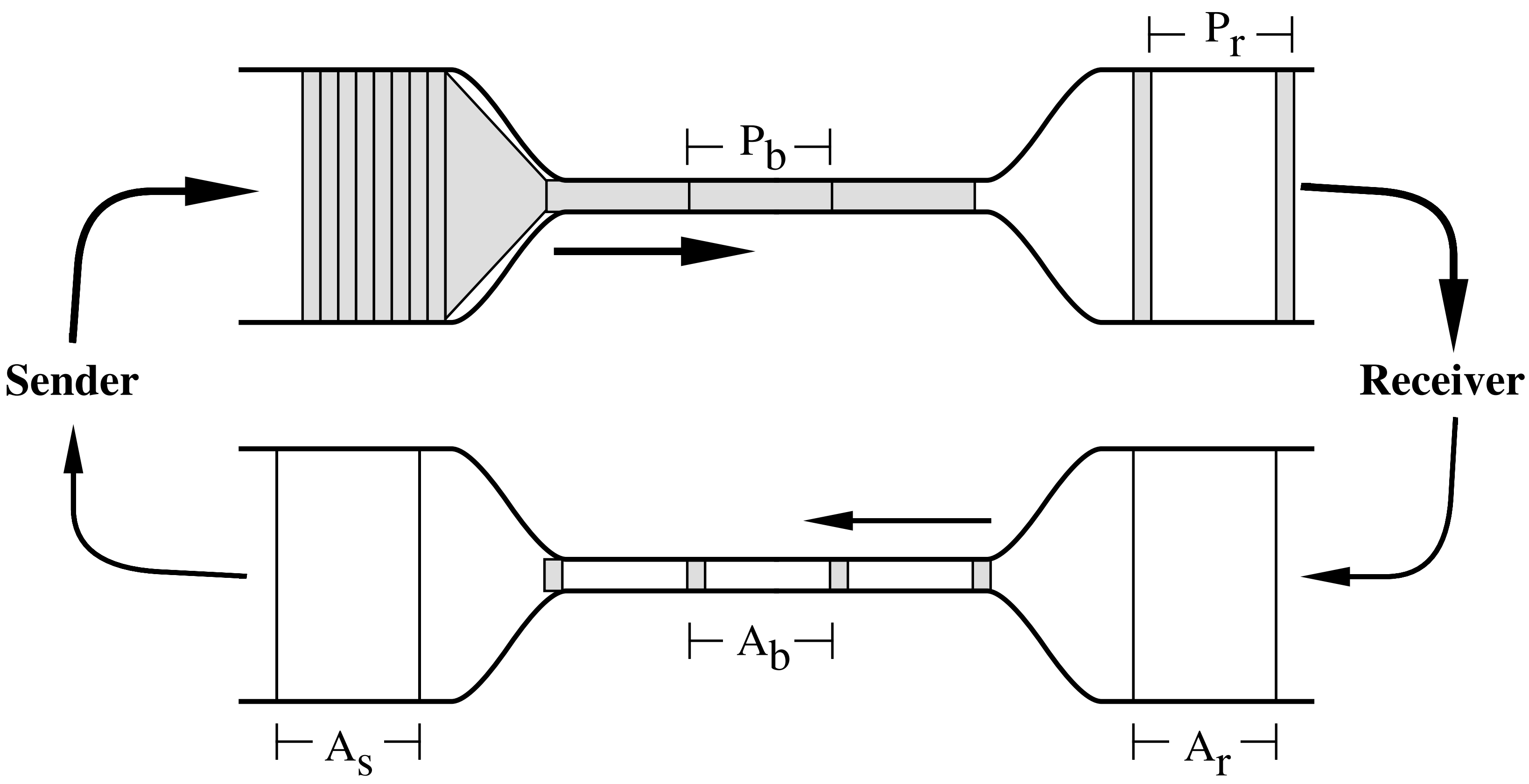
1988 traceroute (Jacobson) — enumerate source–destination path.

1991 first working version of pathchar.

1996 tcpanaly (Paxson) — measure characteristics of selected paths.

1997 first pathchar release.

Bottleneck bandwidth estimation
(and why it doesn't generalize)



Path discovery - traceroute

```
% traceroute ka9q.ampr.org
 1  ir40gw.lbl.gov (131.243.1.1)  1.773 ms  1.371 ms  1.096 ms
 2  er1gw.lbl.gov (131.243.128.11)  2.355 ms  1.649 ms  1.503 ms
 3  lbl-lc1-1.es.net (198.128.16.11)  2.628 ms  2.501 ms  1.897 m
 4  gac-atms.es.net (134.55.24.6)  151.258 ms  150.189 ms  147.58
 5  CERFNETGWY.GAT.COM (192.73.7.163)  143.865 ms  147.481 ms  14
 6  * sdsc-ga.cerf.net (134.24.20.15)  139.885 ms  173.316 ms
 7  mobydick-fddi.cerf.net (134.24.252.3)  156.924 ms *  287.051
 8  qualcomm-sdsc-ds3.cerf.net (134.24.47.200)  136.821 ms *  147
 9  * krypton-e2.qualcomm.com (192.35.156.2)  148.756 ms  131.125
10  ascend-max.qualcomm.com (129.46.54.31)  158.475 ms  143.450 m
11  karnp50.qualcomm.com (129.46.90.33)  3435.416 ms *  173.813 m
12  unix.ka9q.ampr.org (129.46.90.35)  196.909 ms  176.182 ms  18
```

How does traceroute work?

IP packets contain a *time-to-live* field that is initialized by the original sender then decremented by one at each intermediate router. If the field is decremented to zero, the packet is discarded and an error indication packet (an ICMP “time exceeded”) is sent back to the original sender.

The source address of the ICMP “time exceeded” identifies the router that discarded the data packet. So if packets are sent to the final destination but with the ttl set to n, the router n hops along the path is forced to identify itself.