4）AS级拓扑测量

代表性研究机构与项目包括：(1)南加州大学资讯科学研究院[1]在1997年最先使用BGP信息来绘制AS级拓扑图。 (2)Mao等人[2]在2003年开发了BGP Beacons作为网络上的路由器来主动地广播和撤销前缀，并观察从不同的路由收集器获得的结果，来推断一些BGP总体行为；Bush等人[3]在2009年使用这个技术来测量互联网上默认路由的流行性，并在AS级拓扑上解释了从控制测量和数据层测量中获得的数据的不同性。(3)Zhang等人[4]在2005年收集RouteViews和RIPE RIS的BGP数据，并积累来自路由更新的拓扑信息，来绘制AS级拓扑图。(4)以色列特拉维夫大学[5]在2005年开发了DIMES。DIMES是一个高度分布式的全球互联网测量基础设施，使用大量相互交互的测量代理来测量互联网结构和演化，并以此数据来绘制AS级拓扑。(5)西北大学和AT&T实验室[6]在2009年使用Traceroute获取路径信息，之后通过IP-to-AS映射从Traceroute数据中推断AS层路径，特性化新发现的连接并找出链接丢失的根本原因，从而揭露互联网拓扑中的隐藏区域。

主要技术进展包括：(1)使用BGP信息来绘制AS级拓扑图[1][4][7]。(2)使用Traceroute测量IP级拓扑，并将测量数据转换为AS级数据。[8][9]。(3)使用观察的路由路径并假设信息是正确的，来推断AS间关系[10][11][12]。(4)研究当前推断的AS级拓扑结构是否完整，并绘制更完整的AS拓扑[13][14]。

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POP级别的拓扑测量主要通过有聚合低级别拓扑：

(1)华盛顿大学的Neil Spring最早关注POP级别的拓扑研究，2002年提出RocketFuel系统，使用Ally的共同ip分片id计数器的方法进行别名解析，使用UNDNS工具通过反向解析出的DNS信息确定POP的地理位置。[1]

(2)Harsha V. Madhyastha等人在2006年提出了iplane平台，iplane作为一个分布式服务的数据平面，扩展了RocketFuel的方法，使用了iffinder别名解析方法，用DNS域名信息确定POP地理位置。

(3)东京大学的K. Yoshida等在2009年提出了基于延迟的POP级拓扑测量技术，利用ping更可靠的rtt，通过延迟的关系来推断PoP拓扑。[3]

(4)中科大的田渊栋在2012年提出了一种方法使用geo-IP数据库，使用启发式方法对集中的接口进行重新标注[4]

(5)德州大学的John A. Pearce等在2008年提出了一种更加自动化的方法，利用PoP中的接口间通信延迟较小且结构雷同的特点，在接口拓扑中，寻找基本图形，并忽略高延迟链接。从而得到候选PoP。[5]

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路由器级拓扑测量主要有别名解析和递归路由器发现两个方向：

别名解析：

(1)法国斯特拉斯堡大学(University of Strasbourg)的Jean-Jacques PANSIOT在1998年[1]提出了同源地址探测，其思想是在解析ip地址别名时，向该ip发送一个端口不可达的包，在回复中如果源地址不同于该ip，则认为二者是别名。

(2)华盛顿大学(University of Washington)的Neil Spring等在2002年提出了RocketFuel系统，并使用了同ip分片id计数器的方法进行别名解析。[2]

(3)华盛顿大学的Neil Spring在2004年提出了用DNS域名的相似性来推断ip别名。在同一篇论文中还提出了一种基于图的启发式方法用来做别名解析。[3]

(4)美国德州大学(University of Texas)的Mehmet Gunes等在2006年提出一种利用ip分配机制的特征，进行ip别名解析的一种分析方法。[4]

(5)马里兰大学(University of Maryland)的Rob Sherwood等在2008年提出了一种利用ip选项的record route字段结合traceroute并利用析取逻辑规划解决约束求解问题，对traceroute的数据进行别名解析。[5]

渐进路由器发现：

(1) 加拿大滑铁卢大学(University of Waterloo)的R. Siamwalla等在1998年提出使用SNMP，利用路由器的MIB表保存的邻居列表来进行路由器拓扑递归发现。[6]

(2) 法国斯特拉斯堡大学的Jean-Jacques PANSIOT等在2010年提出使用mrinfo，利用IGMP在路由器间进行组播发消息，进行递增的路由器级拓扑发现。

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