Growth of ISPs after 1989 following BGP and ASNs

BGP offered multiple pathways in 1989, EGP always limited to a single pathway

Go to ASNs (Autonomous System Numbers) launched the same year

Yes, that is a precise and accurate distinction between how the two protocols handled network routing during that pivotal era of internet history.

In 1989—the year the very first version of BGP (BGP-1) was defined in RFC 1105—the transition from EGP to BGP was driven specifically by this limitation.

Why EGP Was Limited to a Single Pathway

Exterior Gateway Protocol (EGP), designed in the early 1980s (RFC 904), was built for a **hierarchical, tree-structured internet** topology.

- **Core-Centric Model:** The internet at the time relied on a central backbone (like the ARPANET or early NSFNET). EGP assumed there was a single, central core system and that all traffic moved up to the core and back down to the branches.
- **No Loop Prevention:** EGP did not have a mechanism to detect routing loops if paths crossed horizontally between branches. To avoid devastating loops, network administrators had to artificially restrict EGP to a **single pathway** (a strict tree structure with no multi-homing or redundant paths between independent networks).

How BGP Offered Multiple Pathways

Border Gateway Protocol (BGP) was created to support a **mesh topology**, allowing the internet to scale into a decentralized, complex web of interconnected commercial networks.

- **The Path-Vector Mechanism:** Instead of just looking at a destination, BGP explicitly list the exact sequence of Autonomous Systems (the "AS-Path") a route takes to reach a network.
- **Loop Prevention and Redundancy:** By looking at the AS-Path, a router can instantly see if its own system is already in the list. If it is, it **rejects the route** because it detects a loop. This single innovation allowed BGP to safely process **multiple alternative pathways** between networks, paving the way for multi-homing, backup links, and modern internet redundancy.

The growth of ISPs in US, UK, and Australia after 1989

Following the introduction of BGP-1 in 1989, the commercialisation of the internet triggered an explosion of Internet Service Providers (ISPs) across the globe. The transition from heavily restricted academic networks to a booming consumer market in the United States, United Kingdom, and Australia followed unique regional pathways before undergoing major corporate consolidation.

A comparison of how the ISP landscapes transformed across the three countries throughout the 1990s and early 2000s illustrates this rapid development:

United States: The Wild West of "Mom and Pop" ISPs

The US landscape shifted rapidly due to the decommissioning of the federal NSFNET backbone in 1995, which formally handed the internet infrastructure over to commercial network operators.

- **The Fragmentation Explosion:** By 1996, the US had roughly 1,400 ISPs, a figure that exploded to **4,500 local and regional ISPs by 1998**. Many of these were local "mom and pop" dial-up operations operating out of garages and small offices, reselling capacity from backbone carriers.
- **The Early Giants:** Alongside regional dial-up providers, massive national networks like **Netcom** (which pioneered flat-rate consumer pricing) and **UUNET** emerged, alongside tech giants like **AOL** and **EarthLink**.
- **Consolidation Era:** As the dial-up market matured and high-speed broadband (cable and DSL) took off in the late 1990s, small independent ISPs could no longer compete with the massive infrastructure costs. Telecom and cable giants like AT&T, Comcast, Verizon, and Charter systematically acquired smaller providers, transforming the fragmented landscape into a tightly controlled oligopoly.

United Kingdom: From Telecom Monopolies to Local Loop Unbundling

In the UK, early consumer internet was heavily tied to the infrastructure of British Telecom (BT), requiring unique regulatory interventions to spark true market competition.

- **Early Pioneers:** Commercial dial-up internet in the UK kicked off in earnest in 1992 with **Pipex**, quickly followed by providers like Demon Internet.
- **The "Free" Internet Phenomenon:** In 1998, the electrical retailer Dixons launched **Freeserve**, which disrupted the global market by offering internet access with no monthly subscription fee—users paid only for the local phone calls made while online. This caused a massive surge in consumer adoption.
- **The Broadband Shift and LLU:** As the market transitioned to broadband in 2000, BT initially controlled the physical copper lines. To fuel competition, telecom regulators enforced **Local Loop Unbundling (LLU)** in 2001. This forced BT to allow rival companies (like TalkTalk, Sky, and Easynet) to place their own equipment inside BT exchanges, sparking a fierce price and speed war that rapidly expanded broadband access.

Australia: Academic Roots to the Bigpond Monopoly

Australia's isolated geography and unique domestic pricing models shaped a highly distinct ISP trajectory, transitioning from public university projects to corporate juggernauts.

- **The Early Frontiers:** In June 1989, **Pegasus Networks** became Australia’s first public internet provider. The academic network **AARNet** served as the nation's gateway to the US. In 1994, AARNet introduced a "Value Added Reseller" program, giving life to early iconic Australian ISPs like **connect.com.au**, **OzEmail**, and **iiNet**.
- **The Telstra Acquisition:** Seeing the commercial potential, the state-owned telecom provider Telstra acquired AARNet's commercial assets in 1995 to form **Telstra Internet**. While US

providers were moving toward flat-rate pricing, Telstra introduced a world-first model: **charging by megabits downloaded**. This established a long-standing Australian precedent of strict data quotas and "traffic shaping".

- **Broadband & The NBN Prelude:** By the early 2000s, Telstra's **BigPond** and competitor Optus dominated consumer broadband through ADSL and regional hybrid-fibre coaxial (HFC) cable networks. Telstra's tight grip on the wholesale copper network eventually frustrated both competitors and the government, directly paving the way for the creation of the government-funded National Broadband Network (NBN) in 2009 to level the playing field.

The gradual growth of separate networks that led to ASNs in 1989, from ALOHANET and SATNET linking Hawaii and London in 1973, CYCLADES and CSNET linking US and Paris and Germany and China in 1980s, finally OTC linking Melbourne to Hawaii in 1989.

The timeline highlights the shift from experimental, isolated networks to a unified, global internetwork. The milestone **1989 introduction of Autonomous System Numbers (ASNs)** via BGP was the direct consequence of bridging these disparate networks into a single, cohesive topology.

The evolution from early transoceanic experiments to a fully routed Australian connection follows a structured historical trajectory:

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[1973: Experimental Packets] ──> [1980s: Global Fragmentation] ──> [1989: The ASN
Consolidation]
   ALOHANET & SATNET                CYCLADES & CSNET                 OTC (Melbourne to
Hawaii)
   (Radio & Sat Prototypes)         (Protocol Wars & Silk Roads)     (The Final
Transpacific Plug-In)
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1. 1973: The Prototypes (ALOHANET and SATNET)

Before the internet was global, it was a series of localized experiments trying to solve the problem of distance using non-traditional media.

- **ALOHANET (Hawaii):** Developed at the University of Hawaii, this was the world's first wireless packet data network. Instead of using copper telephone lines, it used UHF radio waves to link campuses across the Hawaiian islands. Its breakthrough "random access" protocol proved that computers could transmit data over a shared medium whenever they needed to, laying the foundation for Ethernet and Wi-Fi. In 1973, ALOHANET was officially wired into the US mainland's ARPANET via a satellite link.
- **SATNET (The Atlantic):** In the same year, the Atlantic Packet Satellite Network (SATNET) was launched to link the US ARPANET to Europe (specifically University College London and NORSAR in Norway). SATNET was crucial because it was the first international testbed for **TCP/IP** over satellite links.

2. 1980s: The Fragmented Silk Roads (CYCLADES and CSNET)

The 1980s were defined by the "Protocol Wars"—a battle between the open TCP/IP standard and proprietary or state-sponsored protocols (like X.25 and OSI). National networks grew independently, often acting as isolated "islands."

- **CYCLADES (France):** A pioneering French network that created the concept of the **datagram**—forcing the host computers, rather than the network itself, to be responsible for data delivery. While CYCLADES was eventually defunded by the French government in favour of X.25 networks, its architectural philosophy deeply influenced the design of TCP/IP.
- **CSNET (Computer Science Network):** Launched in 1981, CSNET was built to connect US universities that lacked the funding or military clearance to join ARPANET. By 1984, CSNET went international, establishing paths to Israel, France, and Germany.
- **The China & Global Gateways:** Throughout the late 1980s, these academic networks acted as the initial gateways for developing nations. These connections did not resemble the modern internet; they were mostly asynchronous, message-forwarding bridges (using UUCP protocol) where international emails were queued up and batched out via costly dial-up or X.25 lines once or twice a day.

3. 1989: The Final Transpacific Plug-In (OTC Melbourne to Hawaii)

Up until mid-1989, Australia relied on a localized network called **ACSnet** (Australian Computer Science Network). Like its international counterparts, it was a message-based store-and-forward system utilizing a `.oz` domain. If a researcher in Melbourne wanted to email someone in the US, the mail had to wait for a scheduled, expensive international phone call to dial out and dump the data queue.

- **The 23 June 1989 Link:** Under the coordination of the Australian Vice-Chancellors' Committee (AVCC) and technical pioneers like **Robert Elz** and **Geoff Huston**, a permanent, continuous circuit was commissioned.
- **The Infrastructure:** Funded by Australian universities and NASA, a **56 Kbps satellite circuit** was established. The route ran from an earth station in Hawaii, across an Intelsat spacecraft, down to the **Overseas Telecommunications Commission (OTC)** earth station at Oxford Falls in Sydney. From Sydney, domestic land segments carried the continuous TCP/IP connection directly into Robert Elz's lab at the University of Melbourne.

When Elz brought that link live, Australia shifted overnight from an isolated network into a fully routed node of the global internet infrastructure.

Why this led directly to ASNs in 1989

By 1989, networks like the NSFNET (US), AARNet (Australia), JANET (UK), and WIDE (Japan) were all permanently stitching themselves together.

Because these networks were managed by entirely different entities (governments, university consortiums, and early commercial carriers), **no single authority controlled the global routing table**. Furthermore, the old Exterior Gateway Protocol (EGP) could not handle a web of interconnected networks without creating catastrophic loops.

To solve this, the internet architecture was formalized into **Autonomous Systems (AS)**. Each independent network network or country cluster was given an **ASN (Autonomous System Number)**—a unique identifier that acted like a digital passport. When BGP-1 was rolled out in 1989,

it used these ASNs to track exactly which networks a piece of data passed through. If a network saw its own ASN in the data's travel history, it knew a routing loop had occurred and dropped the packet.

The convergence of ALOHANET, CSNET, and the OTC transpacific link didn't just expand the internet's physical reach—it fundamentally forced the invention of the ASN structure to prevent the global network from collapsing under its own scale.

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