



CUSTOMER DATA FORMAT REQUIREMENTS

AT&T Switched Ethernet ServiceSM

AT&T strives to provide a reliable installation and networking experience for our customers. We will do all that we can to ensure the project is completed on time and exceeds our Customer's expectations. This document describes the specific recommendations, requirements and limitations associated with formatting the Customer data signal so that it can be transported successfully by the AT&T Network.

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1. Customer network interface:

- 1.1. AT&T Switched Ethernet Service will be terminated according to the guidelines contained in **AT&T Switched Ethernet Service - Customer Site Preparation Requirements** document. Service will be terminated at the demarcation point and will be either a RJ-45 patch panel for a 100/1000 Base T connection or a fiber patch panel for a 1 Gbps, 10 Gbps, or 100 Gbps optical connection¹. The network interface is available in the following choices that need to be selected prior to firm pricing / design: Note all 10G interfaces are Native LAN PHY; we do not support WAN PHY with this service offer.

Interface	Capacity	Media	Connector	Distance Limit ²
100BASE-T	100 Mbps	UTP electrical (>=CAT5e)	RJ-45	100 meters / 328 feet
1000BASE-T ³	1000 Mbps (1G)	UTP electrical (>=CAT5e)	RJ-45	100 meters / 328 feet
1000BASE-SX	1000 Mbps (1G)	50/125 micron multi-mode fiber (850nm)	SC	550 meters / 1803 feet
1000BASE-LX/LH	1000 Mbps (1G)	9/125 micron single-mode fiber (1310 nm)	SC	10 kilometers / 6.2 miles
10GBASE-SR	10000 Mbps (10G)	50/125 micron multi-mode fiber (850 nm)	SC	300 meters / 980 feet
10GBASE-LR	10000 Mbps (10G)	9/125 micron single-mode fiber (1310 nm)	SC	10 kilometers / 6.2 miles
100GBASE-LR4	100000 Mbps (100G)	4 x 25G, WDM single-mode fiber (1310 nm)	SC	10 kilometers / 6.2 miles

- 1.2. AT&T Switched Ethernet Service **does not offer 100 Base FX (optical) interfaces**. **Optical interfaces are only offered at 1G, 10G or 100G**. Customers may order 1G port and a port CIR at 100M or below, if desired. Alternatively, a customer may order 100 Mbps port with 100BaseT interface terminated on RJ45 and customer may use a media converter (customer provided equipment) to convert the signal to fiber within the customer's building.
- 1.3. AT&T has standardized on SC connectors for optical service due to the prevalence of existing patch panels that use SC connections. Customer uses an inexpensive patch cord to connect the patch panel to their equipment. For customers that use LC connectors on their switch or router, the customer can use a patch cord which is SC on the end connecting to the AT&T demark and LC on the end connecting to their equipment.

NOTE: In December 2018, as part of AT&T's effort to smooth installation issues, AT&T technicians began stocking "media converters" to be used when the customer's desired interface and/or intra-building cabling requirements cause the need for an interface different from that ordered. In such cases, when requested by the site contact, the technician may provide the media converter at no additional cost to the customer. Such conversions may allow electric to optical, single mode to multimode, vice versa and etc. The converter will not change a port speed (i.e. from 100M to 1G). Customers and AT&T ordering personnel should still strive to order the correct customer desired interface according to the above chart so the correct one is ordered originally. Introducing a media converter should only be used to account for on-site discrepancies during first installation.

¹ The Ciena 3903, 3911 and 3931 are wall mounted and do not require a separate patch-panel, but the associated connectors are consistent with the table above.

² Limits refer to the distance from/to the AT&T network equipment, located on the network side of the demarcation point to the customer CPE and are based on official standards; AT&T recommends shorter distances when possible.

³ 1000BASE-T is not available on Network Terminating Equipment (NTE) models 311v and 3911.



2. Customer Provided Equipment (CPE) choices

2.1. The Customer may use a switch, bridge or router to connect to AT&T Switched Ethernet Service. This equipment is a Customer responsibility and Customer can choose from many Ethernet-compatible equipment suppliers. A router is highly recommended in order to maximize the performance and integration with AT&T Switched Ethernet Service. Rate shaping functions will ensure the router sends data at a rate aligned with the subscribed Port Committed Information Rate (CIR). Routers also limit the number of MAC addresses presented to AT&T Switched Ethernet Service, which is important when multipoint service is requested due to MAC limits. CPE should be configured in advance of the scheduled test and turn-up date.

3. CPE port settings

- All ports set to “full duplex”
- All 100BaseT ports set to 100 Mbps speed and “no auto-negotiation”
- All 1,000 Mbps (1G) ports (electrical or optical) set to 1000 Mbps speed
 1. 1,000BaseT (electrical) ports set to “auto-negotiation on”
 2. 1,000 Mbps (optical) ports set to “no auto-negotiation”
- All 10,000 Mbps (10G) ports set to 10000 Mbps speed and “no auto-negotiation”
- All 100,000 Mbps (100G) ports set to 100000 Mbps speed and “no auto-negotiation”
- Frame size limits:
 1. 100 Gbps and 10 Gbps ports will allow up to 9126 MTU
 2. All 1 Gbps ports and 100 Mbps ports installed after July 2013 will allow up to 9126 MTU unless the port is provisioned over copper loop media (EoCu).
 3. Ports provisioned over copper loop media (EoCu) will allow up to 1526 MTU

4. “VLAN-Based” ports: configuration and limitations¹

AT&T Switched Ethernet Service ports can be ordered in either of two configurations:

- VLAN-Based or “Service Multiplexed” (described in in this section)
- Port-based or “all-to-one bundling” (described in section 5)

Virtual Local Area Network (VLAN) based port configuration provides “service multiplexing” where the port carries multiple Ethernet Virtual Connections (EVCs) that are identified and switched according to the VLAN ID on the Ethernet Frame. Each EVC may connect to a different (or same) destination and may have different (or same) class of service and bandwidth (Committed Information Rate or CIR).

- Customer will assign VLAN Identifiers (CVLAN IDs) to the Ethernet frame and AT&T will route the frame accordingly
- Customer may use any CVLAN value from 0002-4089. VLANs 1 and 4090-4095 will be reserved for AT&T use.



- Customers may utilize a “double tag” or QinQ if supported by their CPE and AT&T will route on the first tag while ignoring the 2nd tag
- There is a maximum number of EVCs associated with each port type:
 1. Up to 8 EVCs per 100M Port
 2. Up to 64 EVCs per 1 GigE Port
 3. Up to 508 EVCs per 10 GigE Port
 4. Up to 4089 EVCs per 100 GigE Port

5. “Port-Based” ports: configuration and limitations

AT&T Switched Ethernet Service ports can be ordered in either of two configurations:

- Port-based or “all-to-one bundling” (described in this section)
- VLAN-Based or “Service Multiplexed” (described in section 4)

Port-based refers to an “all to one bundling arrangement” where all of the customer’s traffic (within proscribed limits) is delivered to a single service instance, either an E-Line (point to point) or E-LAN (Multipoint). Traffic is delivered to the distant port(s) without regard to VLAN—AT&T will pass either “tagged” or “untagged” traffic, referring to Ethernet frames that have or do not have VLAN IDs. Even if VLAN IDs are present, AT&T will not route based on those tags.

6. MAC (Media Access Control) address limitations

AT&T Switched Ethernet Service uses Ethernet Virtual Connections (EVCs) to connect ports in either point-to-point “E-line” (including point-to-multipoint) or multipoint “E-LAN” arrangements. These ports may be in the same or different LATAs. For point-to-point EVCs between two ports, there are no associated MAC limits. If the EVC is a multipoint EVC arrangement (whether the port is VLAN-based or port-based), the MAC limits specified below will apply.

6.1. MAC Address Limits applicable to multipoint EVC configurations:

- Each multipoint EVC on a given port is limited to 250 MAC addresses in the standard configuration. This limit refers to the “source” MAC addresses presented to the port / EVC at this location and does NOT count the destination MACs that are associated with other ports on the multipoint EVC.
- A VLAN based port may have multiple multipoint EVCs and each will be allowed up to 250 MAC addresses.
- Customers that need to allow for more than 250 MAC addresses per multipoint EVC may subscribe to an optional feature for the port that raises the limit to 500 MACs per multipoint EVC. This feature is subscribed once “per port” and raises the limit on all multipoint EVCs present on that port.
- Overflowing MAC Limits: When a frame with an unknown MAC address (caused by exceeding the MAC limits of 250 default or 500 if ordered) arrives, it will not be dropped but will be treated as an Unknown Unicast frame. As such it becomes part of BUM traffic and it will be sent to all the endpoints of the Multi-Point EVC including the endpoint for which it was intended. Such frames are subject to the



2 Mbps BUM traffic limit described in Section 7. If the frame will exceed the 2 Mbps BUM limit associated with the sending EVC, it will be dropped.

- Using a router instead of a switch will usually limit the number of MAC addresses presented to the AT&T Switched Ethernet Service port, thereby avoiding issues with MAC limits.

7. Broadcast, Unicast unknown and Multicast (BUM) limitations

Broadcast, Unicast unknown and Multicast (BUM) traffic cause a single frame to be replicated to all ports in the associated EVC.

- **Broadcast Traffic** – refers to Ethernet frames that are forwarded to all nodes on the network using the broadcast Ethernet address
- **Unicast unknown** - Unknown unicast traffic consists of unicast packets with unknown destination MAC addresses. By default, the switch floods these unicast packets to all ports that are members of the EVC.
- **Multicast Traffic** – refers to Ethernet frames that are forwarded, in a point to multipoint fashion, across the network to multiple recipients that belong to groups that are identified using any of the multicast Ethernet addresses defined by the Internet Assigned Numbers Authority (IANA) as Internet Multicast.

BUM traffic can cause problems in the customer and/or the AT&T network if not limited appropriately. Continuous and unpredicted floods of BUM traffic can use substantial network bandwidth to the point of overloading the network or port's capacity and is a significant security risk. Therefore AT&T limits BUM traffic as follows:

- 7.1. **Point to point EVCs** will have no limits associated with BUM traffic; BUM traffic can go up to the specified EVC CIR
- 7.2. **Multipoint EVCs** will be limited to two (2) Mbps of combined BUM traffic on each multipoint EVC on a given port. Note that this limit applies to the port originating the BUM traffic, not the ports receiving the BUM traffic. Customer should enable BUM controls in their router to avoid unexpected dropped packets due to AT&T enforcement of this limit.
- 7.3. **Enhanced Multicast** is a per-port feature that allows for higher BUM limits to be set on the EVC(s) associated with that port.

8. Traffic shaping

AT&T Switched Ethernet Service offers flexible configuration options including the ability to set bandwidth (Committed Information Rate or CIR) according to the needs of the applications using the connection. The CIR is specified in two related ways:

Port CIR: The CIR set for the physical port is referred to as Port CIR and a variety of CIR choices are offered per port size, ranging from 2 Mbps to 10 Gbps. The Port CIR can never exceed the physical port capacity (i.e., a 100 Mbps port can have a maximum 100 Mbps CIR, and a 1 Gbps port can have up to 1 Gbps CIR, etc.).



EVC CIR: There is also a CIR associated with the Ethernet Virtual Connection(s) (EVCs) associated with each port which can be any increment of 1 Mbps up to the maximum available Port CIR. For “port-based” ports, there is only one EVC. For “VLAN-Based” ports there may be multiple EVCs (see EVC limits section). The sum of the EVC CIRs cannot exceed the Port CIR.

AT&T 4-byte overhead: AT&T adds a 4 byte “S-tag” to all Ethernet frames at network ingress. This tag is used to route traffic in the AT&T network and is removed by AT&T at the egress. These 4 bytes per frame should be included when calculating the required CIR for the connection and associated rate shaping and can be especially significant when small frame sizes are transmitted.

- 8.1. AT&T Switched Ethernet Service will enforce these CIR limits on bandwidth entering and exiting the network. Packets presented in excess of the CIR for that connection will be dropped randomly.
- 8.2. Customer should enable Traffic Shaping on the Customer Provided Equipment (CPE) switch or router to ensure maximum throughput efficiency by avoiding dropped packets due to AT&T Switched Ethernet Service CIR enforcement. Most routers on the market should support traffic shaping and AT&T representatives may be able to recommend such routers available for purchase from AT&T family of companies.
- 8.3. Traffic shaping is especially critical whenever the CIR is lower than the physical interface. For example, a 100 Mbps port may subscribe to a 50 Mbps CIR. Without rate shaping, the CPE will generate traffic at the rate of 100 Mbps. Therefore, customers that do not use rate shaping should subscribe to CIR rates that match the port speed (100 Mbps, 1 Gbps and 10 Gbps).

NOTE: The settings for Broadband Ports are detailed in section 12 and may be different from those above.

9. IP Configuration and limitations

- 9.1. AT&T Switched Ethernet Service will not:
 - Assign an Internet Protocol (IP) address as part of the AT&T Switched Ethernet Service
 - Enable Cisco Discovery Protocol (CDP) to or from the AT&T Switched Ethernet Service port
 - Enable UniDirectional Link Detection (UDLD)
 - Enable keep-alive

10. Layer 2 protocol handling

- Port-based service: L2 protocols will be carried transparently.
- VLAN-based service: L2 protocols will be carried transparently as long as they are tagged with the agreed to CVLAN (customer VLAN ID); otherwise they will be dropped.

Specific protocols and handling are described in the table below:



MAC Address:	Protocol Name	Port-based Port (tagged & untagged)	VLAN-based Port (tagged with valid ID)	VLAN-based Port (untagged or invalid ID)
01:80:C2:00:00:00	aka "Bridge Block" range	Fwd	Fwd	Drop
01:80:C2:00:00:0F				
01:80:C2:00:00:10	aka "All Bridge Block" range	Fwd	Fwd	Drop
01:80:C2:00:00:1F				
01:80:C2:00:00:00	Bridge Protocol Data Unit BPDU	Fwd	Fwd	Drop
01:00:0C:CC:CC:CD	BPDU for Cisco PVST			
01:80:c2:00:00:08	Spanning Tree Protocol STP	Fwd	Fwd	Drop
01:80:C2:00:00:00	RSTP	Fwd	Fwd	Drop
01:80:C2:00:00:02	OAM, LACP, LACP Marker, etc.	Fwd	Fwd	Drop
01:80:C2:00:00:03	802.1x	Fwd	Fwd	Drop
01:80:C2:00:00:0E	LLDP	Fwd	Fwd	Drop
	GARP*	Fwd	Fwd	Drop
01:80:C2:00:00:2F	GARP-Block range*	Fwd	Fwd	Drop
01:80:C2:00:00:20	GMRP*	Fwd	Fwd	Drop
01:80:C2:00:00:21	GVRP*	Fwd	Fwd	Drop
* Multiple Registration Protocol (MRP) was introduced in order to replace GARP, with the IEEE 802.1ak amendment in 2007. The two GARP applications were also modified in order to use MRP. GMRP was replaced by Multiple MAC Registration Protocol (MMRP) and GVRP was replaced by Multiple VLAN Registration Protocol (MVRP) .				
	MRP, MMRP, MVRP	Fwd	Fwd	Drop
01:00:0C:CC:CC:CC	CISCO PAGP	Fwd	Fwd	Drop
01:CC:CC:CC:CC:CC	CISCO UDLD	Fwd	Fwd	Drop
01:00:0C:CC:CC:CC	CISCO CDP	Fwd	Fwd	Drop
01:00:0C:CC:CC:CC	CISCO DTP	Fwd	Fwd	Drop
01:00:0C:CC:CC:CC	CISCO VTP	Fwd	Fwd	Drop
01:00:0C:CD:CD:CD	CISCO PVST	Fwd	Fwd	Drop
01:00:0C:CD:CD:CD	CISCO-VLAN BRDG	Fwd	Fwd	Drop
01:00:0C:CD:CD:CD	CISCO-UPL FST	Fwd	Fwd	Drop
01:00:5E:00:01:28	IGMP Internet Group Management Protocol	Fwd	Fwd	Drop
01:00:5E:00:00:02	Protocol Independent Multicast	Fwd	Fwd	Drop

Note: Protocols / Address that trigger broadcast or multicast Ethernet frames are subject to limits on AT&T Switched Ethernet multipoint EVCs. Combined Broadcast, Unidentified unicast or Multicast (BUM) packets originating from one port cannot exceed 2 Mbps (standard) or up to 30 Mbps with the feature, Enhanced Multicast. EVCs configured as a point-to-point between two ports only have no BUM limits.

11. Changes to design / requirements

If the Customer makes changes to the interface types, quantities, or locations this would invalidate the network design agreed upon between AT&T and the Customer. This change could delay service turn-up and impact the applicable charges.