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Distributed Denial-of-Service Open Threat Signaling (DOTS) Signal Channel Call Home

~~draft-ietf-dots-signal-call-home-04~~
draft-ietf-dots-signal-call-home-05

Abstract

This document specifies the DOTS signal channel Call Home service, which enables a DOTS server to initiate a secure connection to a DOTS client, and to receive the attack traffic information from the DOTS client. The DOTS server in turn uses the attack traffic information to identify the compromised devices launching the outgoing DDoS attack and takes appropriate mitigation action(s).

The DOTS Call Home service is not specific to the home networks; the solution targets any deployment which requires to block DDoS attack traffic closer to the source(s) of a DDoS attack.

Editorial Note (To be removed by RFC Editor)

Please update these statements within the document with the RFC number to be assigned to this document:

- "This version of this YANG module is part of RFC XXXX;"
- "RFC XXXX: Distributed Denial-of-Service Open Threat Signaling (DOTS) Signal Channel Call Home";
- "| [RFCXXXX] |"
- reference: RFC XXXX

Please update this statement with the RFC number to be assigned to the following documents:

- "RFC YYYY: Distributed Denial-of-Service Open Threat Signaling (DOTS) Signal Channel Specification (used to be I-D.ietf-dots-signal-channel)

Please update TBD statements with the assignment made by IANA to DOTS Signal Channel Call Home.

Also, please update the "revision" date of the YANG module.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on January ~~26,~~ **27,** 2020.

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1. Introduction

1.1. The Problem

The DOTS signal channel protocol [I-D.ietf-dots-signal-channel] is used to carry information about a network resource or a network (or a part thereof) that is under a Distributed Denial of Service (DDoS) attack. Such information is sent by a DOTS client to one or multiple DOTS servers so that appropriate mitigation actions are undertaken on traffic deemed suspicious. Various use cases are discussed in [I-D.ietf-dots-use-cases].

Internet of Things (IoT) devices are becoming more and more prevalent in home networks, and with compute and memory becoming cheaper and cheaper, various types of IoT devices become available in the consumer market at affordable prices. But on the downside, the main threat being most of these IoT devices are bought off-the-shelf and most manufacturers haven't considered security in the product design. IoT devices deployed in home networks can be easily compromised, they do not have an easy mechanism to upgrade, and IoT manufactures may cease manufacture and/or discontinue patching vulnerabilities on IoT devices (Sections 5.4 and 5.5 of [RFC8576]). However, these vulnerable and compromised devices will continue to be used for a long period of time in the home, and the end-user does not know that IoT devices in his/her home are compromised. The compromised IoT devices are typically used for launching DDoS attacks (Section 3 of [RFC8576]) on victims while the owner/administrator of the home network is not aware about such misbehaviors. Similar to other DDoS attacks, the victim in this attack can be an application server, a host, a router, a firewall, or an entire network.

Nowadays, network devices in a home network offer network security (e.g., firewall or Intrusion Protection System (IPS) service on a home router) to protect the devices connected to the home network from both external and internal attacks. Over the years several techniques have been identified to detect DDoS attacks, some of these techniques can be enabled on home network devices but most of them are used in the Internet Service Provider (ISP)'s network. The ISP offering DDoS mitigation service can detect outgoing DDoS attack traffic originating from its subscribers or the ISP may receive filtering rules (e.g., using BGP flowspec [RFC5575]) from a downstream service provider to filter, block, or rate-limit DDoS attack traffic originating from the ISP's subscribers to a downstream target.

Some of the DDoS attacks like spoofed RST or FIN packets, Slowloris, and Transport Layer Security (TLS) re-negotiation are difficult to detect on a home network device without adversely affecting its performance. The reason is typically home devices such as home routers have fast path to boost the throughput. For every new TCP/UDP flow, only the first few packets are punted through the slow path. Hence, it is not possible to detect various DDoS attacks in the slow path, since the attack payload is sent to the target server after the flow is switched to fast path. Deep Packet Inspection (DPI) of all the packets of a flow would be able to detect some of the attacks. However, a full-fledged DPI to detect these type of DDoS attacks is functionally or operationally not possible for all the devices attached to the home network owing to the memory and CPU

limitations of the home routers. Further, for certain DDoS attacks the ability to distinguish legitimate traffic from attacker traffic on a per packet basis is complex. This complexity is due to that the packet itself may look "legitimate" and no attack signature can be identified. The anomaly can be identified only after detailed statistical analysis.

The ISP on the other hand can detect some DDoS attacks originating from a home network (e.g., Section 2.6 of [RFC8517]), but the ISP does not have a mechanism to detect which device in the home network is generating the DDoS attack traffic. The primary reason being that devices in an IPv4 home network are typically behind a Network Address Translation (NAT) border. Even in case of an IPv6 home network, although the ISP can identify the infected device in the home network launching the DDoS traffic by tracking its unique IPv6 address, the infected device can easily change its IPv6 address to evade remediation.

Existing approaches are still suffering from misused access network resources by abusing devices; the support of means for blocking such attacks close to the sources are missing. In particular, the DOTS signal protocol does not discuss cooperative DDoS mitigation between the network hosting an attack source and the ISP to the suppress the outbound DDoS attack traffic originating from that network.

1.2. The Solution

This specification addresses the problems discussed in Section 1.1 and presents the DOTS signal channel Call Home extension, which enables the DOTS server to initiate a secure connection to the DOTS client, and the DOTS client then conveys the attack traffic information to the DOTS server.

The basic high-level Call Home functional architecture is shown in Figure 1. Attack source(s) are within the DOTS server domain.

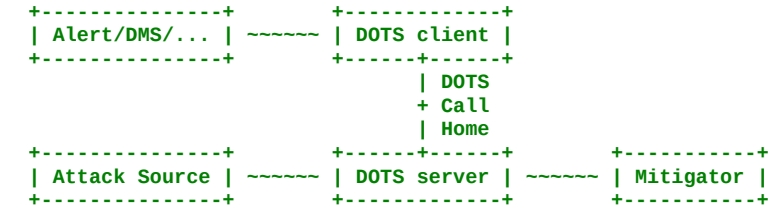


Figure 1: Basic Call Home Functional Architecture

A DOTS client relies upon a variety of triggers to make use of the Call Home function (e.g., scrubbing the traffic from the attack source, receiving an alert from an attack target, a peer DDoS Mitigation System (DMS), or a transit provider). The definition of these triggers is deployment-specific. It is therefore out of the scope of this document to elaborate on how these triggers are made available to a DOTS client.

In a typical deployment scenario, the **Call Home** DOTS server is enabled on a Customer Premises Equipment (CPE), which is aligned with recent trends to enrich the CPE with advanced security features. Unlike classic DOTS deployments [I-D.ietf-dots-use-cases], such DOTS server maintains a single DOTS signal channel session for each ~~DOTS-capable~~ **DOTS-capable** upstream provisioning domain [I-D.ietf-dots-multihoming].

For instance, the **Call Home** DOTS server in the home network initiates the **signal channel** Call Home in 'idle' time and then subsequently the **Call Home** DOTS client in the ISP environment can initiate a mitigation request whenever the ISP detects there is an attack from a compromised device in the DOTS server domain (i.e., from within the home network).

The **Call Home** DOTS server uses the DDoS attack traffic information to identify the compromised device in its domain that is responsible for launching the DDoS attack, optionally notifies a network administrator, and takes appropriate mitigation action(s). A mitigation action can be to quarantine the compromised device or block its traffic to the attack target(s) until the mitigation request is withdrawn.

Other motivations for introducing the Call Home function are discussed in Section 1.1 of [RFC8071].

This document assumes that **Call Home** DOTS servers are provisioned with a way to know how to reach the upstream **Call Home** DOTS client(s), which could occur by a variety of means (e.g., [I-D.ietf-dots-server-discovery]). The specification of such means are out of scope of this document.

More information about the applicability scope of the DOTS signal channel Call Home extension is provided in Section 1.3.

1.3. Applicability Scope

The aforementioned problems may be encountered in other deployments than those discussed in Section 1.1 (e.g., data centers, enterprise networks). The solution specified in this document can be used for those deployments to block DDoS attack traffic closer to the source(s) of the attack. ~~The~~ **An instantiation of the** Call Home ~~reference~~ **functional** architecture is ~~shown~~ **depicted** in Figure ~~1.~~ **2.**

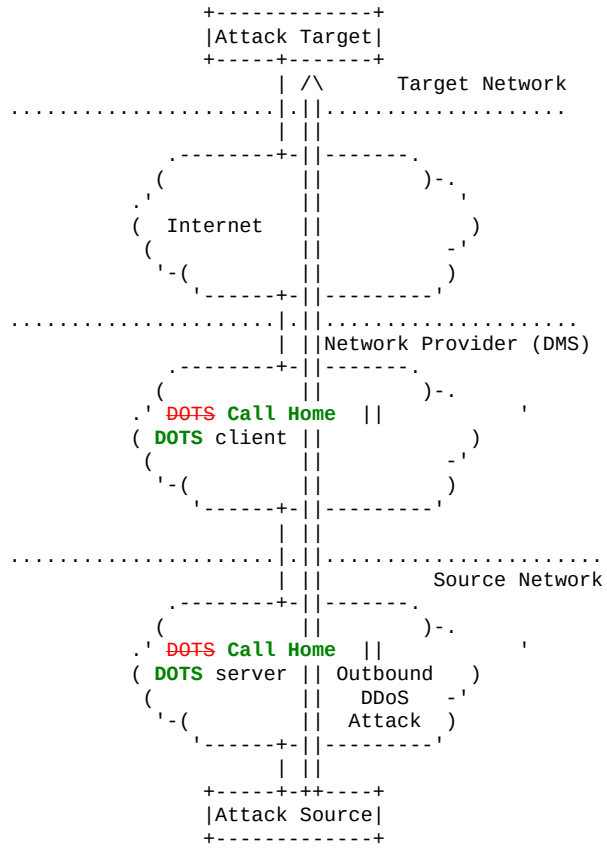


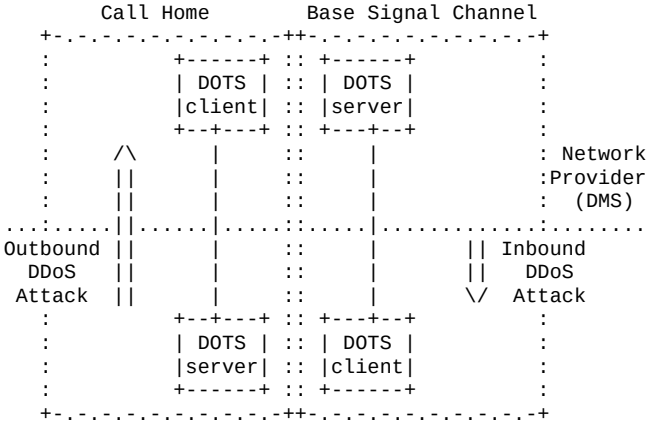
Figure ~~1:~~ **2:** Call Home Reference Architecture

It is out of the scope of this document to identify an exhaustive list of such deployments.

1.4. Co-existence of Base DOTS Signal Channel & DOTS Call Home

The DOTS Call Home does not require nor preclude the activation of the base DOTS signal ~~channel.~~ **channel [I-D.ietf-dots-signal-channel].** Some sample deployment schemes are discussed in this section for illustration purposes.

The network that hosts an attack source may also be subject to inbound DDoS attacks. In that case, both the base DOTS signal channel and DOTS Call Home may be enabled as shown in Figure ~~3~~ **4** (Same DMS provider) or Figure ~~2~~ **3** (Distinct DMS providers).



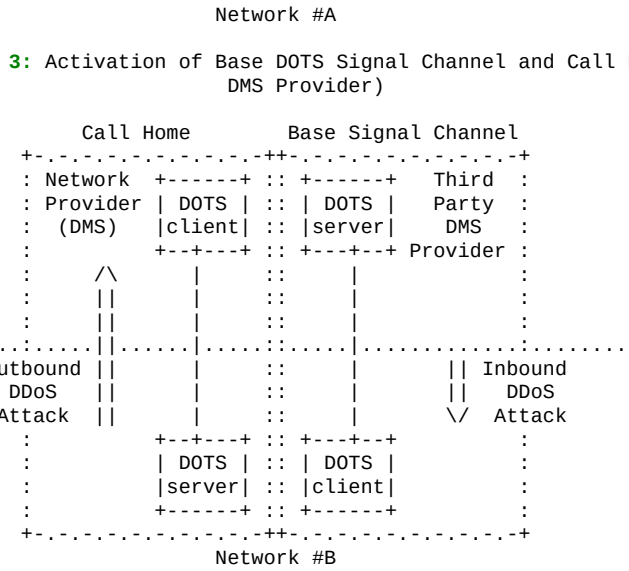


Figure ~~2:~~ **3:** Activation of Base DOTS Signal Channel and Call Home (Same DMS Provider)

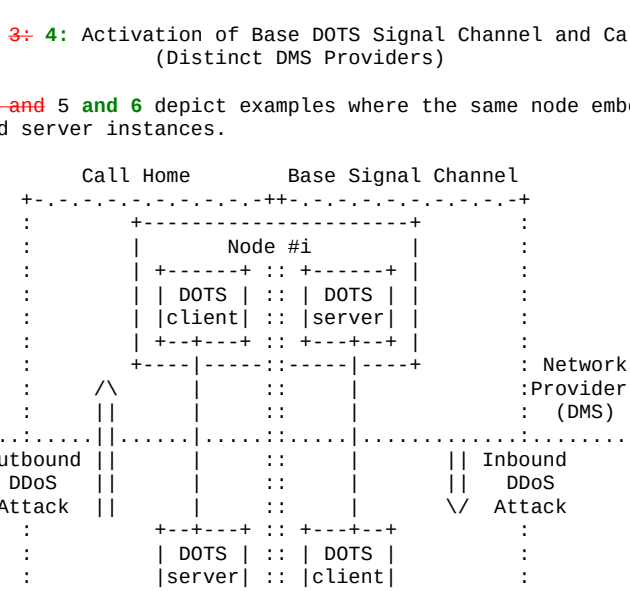


Figure ~~3:~~ **4:** Activation of Base DOTS Signal Channel and Call Home (Distinct DMS Providers)

Figures ~~4 and~~ 5 **and 6** depict examples where the same node embeds both DOTS client and server instances.

Figure ~~4:~~ **5:** Example of the Same Node Embedding both DOTS Client and Server Instances at the Network Provider's Side

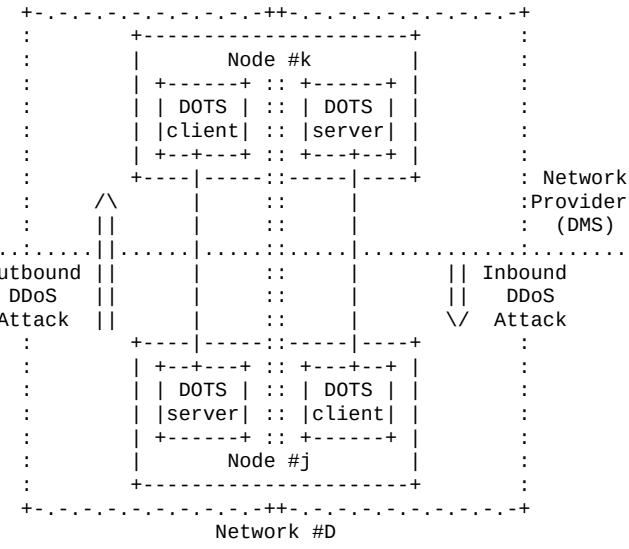


Figure ~~5:~~ **6:** Another Example where the Same Node Embeds both DOTS Client and Server Instances

Appendix A elaborates on the considerations to unambiguously distinguish DOTS messages which belong to each of these channels.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.

The reader should be familiar with the terms defined in [RFC8612].

DOTS agents involved in the DOTS Call Home adhere to the DOTS roles as defined in [RFC8612]. For clarity, this document uses "Call Home DOTS client" (or "Call Home DOTS server") to refer to a DOTS client (or DOTS server) deployed in a Call Home scenario.

The meaning of the symbols in YANG tree diagrams is defined in [RFC8340].

(D)TLS is used for statements that apply to both Transport Layer Security (TLS) [RFC8446] and Datagram Transport Layer Security (DTLS) [RFC6347]. Specific terms are used for any statement that applies to either protocol alone.

3. DOTS Signal Channel Call Home

3.1. Procedure

The DOTS signal channel Call Home extension preserves all but one of the DOTS client/server roles in the DOTS protocol stack, as compared to DOTS client-initiated DOTS signal channel protocol [I-D.ietf-dots-signal-channel]. The role reversal that occurs is at the (D)TLS layer; that is, (1) the **Call Home** DOTS server acts as a DTLS client and the **Call Home** DOTS client acts as a DTLS server or (2) the **Call Home** DOTS server acts as a TLS client initiating the underlying TCP connection and the **Call Home** DOTS client acts as a TLS server. The **Call Home** DOTS server initiates (D)TLS handshake to the **Call Home** DOTS client.

For example, a home network element (e.g., home router) co-located with a **Call Home** DOTS server ~~(likely, a client-domain DOTS gateway)~~ is the (D)TLS server. However, when calling home, the DOTS server initially assumes the role of the (D)TLS client, but the network element's role as a DOTS server remains the same. Furthermore, existing certificate chains and mutual authentication mechanisms between the DOTS agents are unaffected by the Call Home function. This Call Home function enables the DOTS server co-located with a network element (possibly behind NATs and firewalls) reachable by only the intended **Call Home** DOTS client and hence the **Call Home** DOTS server cannot be subjected to **these** DDoS attacks.

Figure ~~6~~ **7** illustrates a sample Call Home flow exchange:

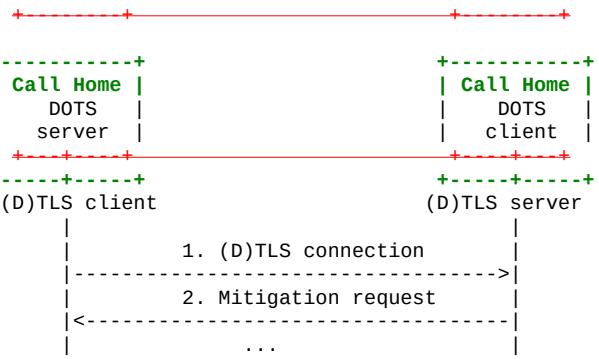


Figure ~~6:~~ **7:** DOTS Signal Channel Call Home Sequence Diagram

The DOTS signal channel Call Home procedure is as follows:

1. If UDP transport is used, the **Call Home** DOTS server begins by initiating a DTLS connection to the **Call Home** DOTS client.

   If TCP is used, the **Call Home** DOTS server begins by initiating a TCP connection to the **Call Home** DOTS client. Using this TCP connection, the **Call Home** DOTS server initiates a TLS connection to the **Call Home** DOTS client.

   In some cases, ~~a~~ **peer** DOTS ~~client and server~~ **agents** may have mutual agreement to use a specific port number, such as by explicit configuration or dynamic discovery [I-D.ietf-dots-server-discovery]. Absent such mutual agreement, the DOTS signal channel call home MUST run over port number TBD (that is, **Call Home** DOTS clients must support

accepting DTLS (or TCP) connections on TBD) as defined in Section 4.1, for both UDP and TCP. The interaction between the base DOTS signal channel and the ~~call home~~ **Call Home** is discussed in Appendix A.

The Happy Eyeballs mechanism explained in Section 4.3 of [I-D.ietf-dots-signal-channel] can be used for initiating (D)TLS connections.

2. Using this (D)TLS connection, the **Call Home** DOTS client may request, withdraw, or retrieve the status of mitigation requests.

3.2. Heartbeat Mechanism

The Heartbeat mechanism used for the Call Home deviates from the one defined in Section 4.7 of [I-D.ietf-dots-signal-channel]. This section specifies the behavior to be followed by DOTS agents for the Call Home.

Once the (D)TLS section is established between the DOTS agents, the **Call Home** DOTS client contacts the **Call Home** DOTS server to retrieve the session configuration parameters (Section 4.5 of [I-D.ietf-dots-signal-channel]). The **Call Home** DOTS server adjusts the 'heartbeat-interval' to accommodate binding timers used by ~~on-path~~ **on-path** NATs and firewalls. Heartbeats will be then exchanged by the DOTS agents following the instructions retrieved using the signal channel session configuration exchange.

It is the responsibility of **Call Home** DOTS servers to ensure that ~~on-path~~ **on-path** translators/firewalls are maintaining a binding so that the same external IP address and/or port number is retained for the DOTS signal channel session. A **Call Home** DOTS client MAY trigger their heartbeat requests immediately after receiving heartbeat probes from its peer **Call Home** DOTS server.

When an outgoing attack that saturates the outgoing link from the **Call Home** DOTS server is detected and reported by a **Call Home** DOTS client, the latter MUST continue to use the signal channel even if no traffic is received from the **Call Home** DOTS server.

If the **Call Home** DOTS server receives traffic from the **Call Home** DOTS client, the **Call Home** DOTS server MUST continue to use the **DOTS** signal channel even if the missing heartbeat allowed threshold is reached.

If the **Call Home** DOTS server does not receive any traffic from the peer **Call Home** DOTS client, the **Call Home** DOTS server sends heartbeat requests to the **Call Home** DOTS client and after maximum ~~'missing-hb-allowed'~~ **'missing-hb-allowed'** threshold is reached, the **Call Home** DOTS server concludes the session is disconnected. Then, the **Call Home** DOTS server MUST try to resume the (D)TLS session.

3.3. DOTS Signal Channel Extension

3.3.1. Mitigation Request

This specification extends the mitigation request defined in Section 4.4.1 of [I-D.ietf-dots-signal-channel] to convey the attacker source prefixes and source port numbers. The DOTS client conveys the following new parameters in the CBOR body of the mitigation request:

source-prefix: A list of attacker prefixes used to attack the target. Prefixes are represented using Classless Inter-Domain Routing (CIDR) notation [RFC4632].

As a reminder, the prefix length MUST be less than or equal to 32 (or 128) for IPv4 (or IPv6).

The prefix list MUST NOT include broadcast, loopback, or multicast addresses. These addresses are considered as invalid values. In addition, the DOTS client MUST validate that attacker prefixes are within the scope of the DOTS server domain.

This is an optional attribute for the base DOTS signal channel operations [I-D.ietf-dots-signal-channel].

source-port-range: A list of port numbers used by the attack traffic flows.

A port range is defined by two bounds, a lower port number (lower-port) and an upper port number (upper-port). When only 'lower-port' is present, it represents a single port number.

For TCP, UDP, Stream Control Transmission Protocol (SCTP) [RFC4960], or Datagram Congestion Control Protocol (DCCP)

[RFC4340], a range of ports can be any subrange of 0-65535, for example, 0-1023, 1024-65535, or 1024-49151.

This is an optional attribute for the base DOTS signal channel operations [I-D.ietf-dots-signal-channel].

source-icmp-type-range: A list of ICMP types used by the attack traffic flows. An ICMP type range is defined by two bounds, a lower ICMP type (lower-type) and an upper ICMP type (upper-type). When only 'lower-type' is present, it represents a single ICMP type.

This is an optional attribute for the base DOTS signal channel operations [I-D.ietf-dots-signal-channel].

The 'source-prefix' parameter is a mandatory attribute when the attack traffic information is signaled by a **Call Home** DOTS client ~~in~~ **(i.e., the Call Home scenario ~~(depicted~~ depicted in Figure ~~6).~~ 7).** The ~~'target-uri' or~~ 'target-~~fqdn'~~ **uri' or 'target-fqdn'** parameters can be included in a mitigation request for diagnostic purposes to notify the **Call Home** DOTS server domain administrator, but SHOULD NOT be used to determine the target IP addresses. Note that 'target-prefix' becomes a mandatory attribute in the mitigation request signaling the attack information because 'target-uri' and 'target-fqdn' are optional attributes and 'alias-name' will not be conveyed in a mitigation request.

In order to help attack source identification by a **Call Home** DOTS server, the **Call Home** DOTS client SHOULD include in its mitigation request additional information such as 'source-port-range' or 'source-icmp-type-range'. The **Call Home** DOTS client may not include such information if 'source-prefix' conveys an IPv6 address/prefix.

Only immediate mitigation requests (i.e., 'trigger-mitigation' set to 'true') are allowed; **Call Home** DOTS clients MUST NOT send requests with 'trigger-mitigation' set to 'false'. Such requests MUST be discarded by the **Call Home** DOTS server with a 4.00 (Bad Request).

The **Call Home** DOTS server MUST check that the 'source-prefix' is within the scope of the ~~DOTS server domain in the~~ Call Home ~~scenario.~~ **DOTS server domain.** Note that in ~~such~~ **a Call Home** scenario, the **Call Home** DOTS server considers, by default, that any routeable IP prefix enclosed in 'target-prefix' is within the scope of the **Call Home** DOTS client. Invalid mitigation requests are handled as per Section 4.4.1 of [I-D.ietf-dots-signal-channel].

The **Call Home** DOTS server domain administrator consent MAY be required to block the traffic from the compromised device to the attack target. An implementation MAY have a configuration knob to block the traffic from the compromised device to the attack target with or without DOTS server domain administrator consent. If the attack traffic is blocked, the **Call Home** DOTS server informs the **Call Home** DOTS client that the attack is being mitigated.

If the attack traffic information is identified by the **Call Home** DOTS server or the **Call Home** DOTS server domain administrator as legitimate traffic, the mitigation request is rejected, and 4.09 (Conflict) is returned to the **Call Home** DOTS client. The ~~conflict-clause~~ **conflict-clause** (defined in Section 4.4.1 of [I-D.ietf-dots-signal-channel]) indicates the cause of the conflict. The following new value is defined:

4: Mitigation request rejected. This code is returned by the DOTS server to indicate the attack traffic has been classified as legitimate traffic.

Once the request is validated by the **Call Home** DOTS server, appropriate actions are enforced to block the attack traffic within the source network. The **Call Home** DOTS client is informed about the progress of the attack mitigation following the rules in [I-D.ietf-dots-signal-channel]. For example, if the **Call Home** DOTS server is embedded in a CPE, it can program the packet processor to punt all the traffic from the compromised device to the target to slow path. The CPE inspects the punted slow path traffic to detect and block the outgoing DDoS attack traffic or quarantine the device (e.g., using MAC level filtering) until it is remediated, and notifies the CPE administrator about the compromised device.

3.3.2. Address Sharing Considerations

If a Carrier Grade NAT (CGN, including NAT64) is located between the DOTS client domain and DOTS server domain, communicating an external IP address in a mitigation request is likely to be discarded by the **Call Home** DOTS server because the external IP address is not visible locally to the **Call Home** DOTS server (see Figure ~~7).~~ **8).** The **Call Home** DOTS server is only aware of the internal IP addresses/prefixes bound to its domain. Thus, the **Call Home** DOTS client MUST NOT include the

external IP address and/or port number identifying the suspect attack source, but MUST include the internal IP address and/or port number. To that aim, the **Call Home** DOTS client SHOULD rely on mechanisms, such as [RFC8512] or [RFC8513], to retrieve the internal IP address and port number which are mapped to an external IP address and port number.

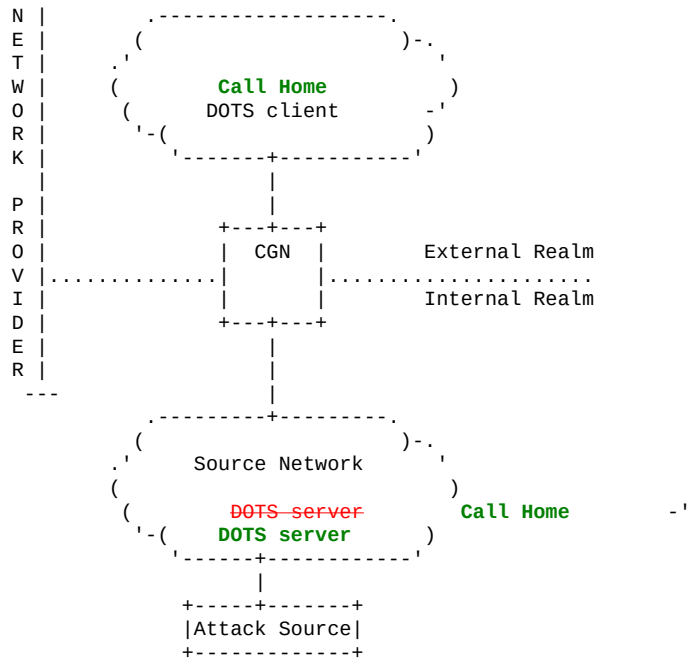


Figure ~~7:~~ **8:** Example of a CGN between DOTS Domains

If a MAP Border Relay [RFC7597] or lwAFTR [RFC7596] is enabled in the provider's domain to service its customers, the identification of an attack source bound to an IPv4 address/prefix MUST also rely on source port numbers because the same IPv4 address is assigned to multiple customers. The port information is required to unambiguously identify the source of an attack.

If a translator is enabled on the boundaries of the domain hosting the **Call Home** DOTS server (e.g., a CPE with NAT enabled as shown in Figures ~~8~~ **9** and ~~9),~~ **10),** the **Call Home** DOTS server uses the attack traffic information conveyed in a mitigation request to find the internal source IP address of the compromised device and blocks the traffic from the compromised device traffic to the attack target until the mitigation request is withdrawn. Doing so allows to isolate the suspicious device while avoiding to disturb other services.

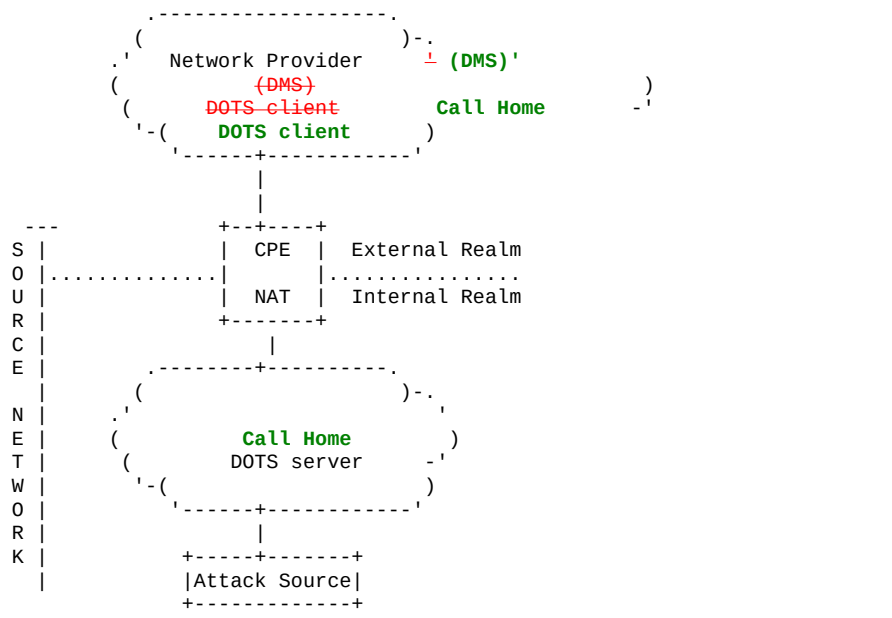


Figure ~~8:~~ **9:** Example of a DOTS Server Domain with a NAT Embedded in a CPE

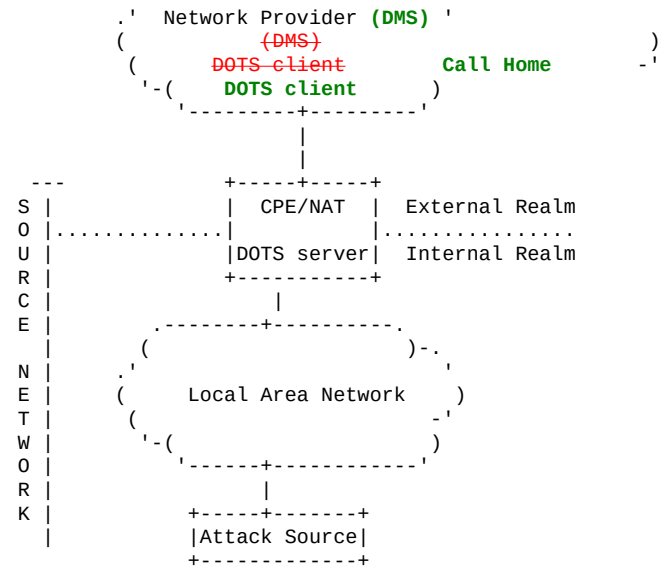


Figure ~~9:~~ **10:** Example of a DOTS Server and a NAT Embedded in a CPE

3.3.3. DOTS Signal Call Home YANG Module

3.3.3.1. Tree Structure

This document augments the "dots-signal-channel" DOTS signal YANG module defined in [I-D.ietf-dots-signal-channel] for signaling the attack traffic information. This document defines the YANG module "ietf-dots-call-home", which has the following tree structure:

```
module: ietf-dots-call-home
  augment /ietf-signal:dots-signal/ietf-signal:message-type
          /ietf-signal:mitigation-scope/ietf-signal:scope:
    +--rw source-prefix*     inet:ip-prefix {source-signaling}?
    +--rw source-port-range* [lower-port] {source-signaling}?
    |  +--rw lower-port    inet:port-number
    |  +--rw upper-port?   inet:port-number
    +--rw source-icmp-type-range*
       |                    [lower-type] {source-signaling}?
       +--rw lower-type    uint8
       +--rw upper-type?   uint8
```

3.3.3.2. YANG Module

This module uses the common YANG types defined in [RFC6991].

<CODE BEGINS> file "ietf-dots-call-home@2019-04-25.yang"

```
module ietf-dots-call-home {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-dots-call-home";
  prefix call-home;

  import ietf-inet-types {
    prefix inet;
    reference
      "Section 4 of RFC 6991";
  }
  import ietf-dots-signal-channel {
    prefix ietf-signal;
    reference
      "RFC YYYY: Distributed Denial-of-Service Open Threat
                 Signaling (DOTS) Signal Channel Specification";
  }

  organization
    "IETF DDoS Open Threat Signaling (DOTS) Working Group";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/dots/>
     WG List:  <mailto:dots@ietf.org>

     Author:  Konda, Tirumaleswar Reddy
              <mailto:TirumaleswarReddy_Konda@McAfee.com>;

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              <mailto:mohamed.boucadair@orange.com>;

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```

```
  description
    "This module contains YANG definitions for the signaling
     messages exchanged between a DOTS client and a DOTS server
     for the Call Home deployment scenario.

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     authors of the code.  All rights reserved.

     Redistribution and use in source and binary forms, with or
     without modification, is permitted pursuant to, and subject
     to the license terms contained in, the Simplified BSD License
     set forth in Section 4.c of the IETF Trust's Legal Provisions
     Relating to IETF Documents
     (http://trustee.ietf.org/license-info).

     This version of this YANG module is part of RFC XXXX; see
     the RFC itself for full legal notices.";

  revision 2019-04-25 {
    description
      "Initial revision.";
    reference
      "RFC XXXX: Distributed Denial-of-Service Open Threat
                 Signaling (DOTS) Signal Channel Call Home";
  }

  feature source-signaling {
    description
      "This feature means that source-related information
       can be supplied in mitigation requests.";
  }

  augment "/ietf-signal:dots-signal/ietf-signal:message-type/"
        + "ietf-signal:mitigation-scope/ietf-signal:scope" {
    if-feature source-signaling;
    description "Attacker source details.";

    leaf-list source-prefix {
      type inet:ip-prefix;
      description
        "IPv4 or IPv6 prefix identifying the attacker(s).";
    }
    list source-port-range {
      key "lower-port";
      description
        "Port range. When only lower-port is
         present, it represents a single port number.";
      leaf lower-port {
        type inet:port-number;
        mandatory true;
        description
          "Lower port number of the port range.";
      }
      leaf upper-port {
        type inet:port-number;
        must ". >= ../lower-port" {
           error-message
             "The upper port number must be greater than
              or equal to lower port number.";
        }
        description
          "Upper port number of the port range.";
      }
    }
    list source-icmp-type-range {
      key "lower-type";
      description
        "ICMP type range. When only lower-type is
         present, it represents a single ICMP type.";
      leaf lower-type {
        type uint8;
        mandatory true;
        description
          "Lower ICMP type of the ICMP type range.";
      }
      leaf upper-type {
        type uint8;
        must ". >= ../lower-type" {
           error-message
             "The upper ICMP type must be greater than
             or equal to lower ICMP type.";
        }
        description
          "Upper type of the ICMP type range.";
      }
    }
```

```
  }
}
<CODE ENDS>
```

4. IANA Considerations

4.1. DOTS Signal Channel Call Home UDP and TCP Port Number

IANA is requested to assign the port number TBD to the DOTS signal channel Call Home protocol for both UDP and TCP from the "Service Name and Transport Protocol Port Number Registry" available at: https://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.xhtml.

Service Name:	dots-call-home
Port Number:	TBD
Transport Protocol(s):	TCP/UDP
Description:	DOTS Signal Channel Call Home
Assignee:	IESG <iesg@ietf.org>
Contact:	IETF Chair <chair@ietf.org>
Reference:	RFC XXXX

The assignment of port number 4647 is strongly suggested (DOTS signal channel uses port number 4646).

4.2. DOTS Signal Channel CBOR Mappings Registry

This specification registers the 'source-prefix', 'source-port-range', and 'source-icmp-type-range' parameters in the IANA "DOTS Signal Channel CBOR Key Values" registry established by [I-D.ietf-dots-signal-channel] (Figure ~~10).~~ **11).**

The 'source-prefix', 'source-port-range', and 'source-icmp-type-range' are comprehension-optional parameters.

- Note to the RFC Editor: Please delete (TBD1)-(TBD5) once CBOR keys are assigned from the 0x8000 - 0xBFFF range.

Parameter Name	YANG Type	CBOR Key	CBOR Major Type & Information	JSON Type
source-prefix	leaf-list inet: ip-prefix	0x8000 (TBD1)	4 array 3 text string	Array String
source-port-range	list	0x8001 (TBD2)	4 array	Array
source-icmp-type-range	list	0x8002 (TBD3)	4 array	Array
lower-type	uint8	0x8003 (TBD4)	0 unsigned	Number
upper-type	uint8	0x8004 (TBD5)	0 unsigned	Number

Figure ~~10:~~ **11:** Assigned DOTS Signal Channel CBOR Key Values

4.3. New DOTS Conflict Cause

This document requests IANA to assign a new code from the "DOTS Signal Channel Conflict Cause Codes" registry:

Code	Label	Description	Reference
4	request-rejected-legitimate-traffic	Mitigation request rejected. This code is returned by the DOTS server to indicate the attack traffic has been classified as legitimate traffic.	[RFCXXXX]

4.4. DOTS Signal Call Home YANG Module

This document requests IANA to register the following URI in the "ns" subregistry within the "IETF XML Registry" [RFC3688]:

```
URI: urn:ietf:params:xml:ns:yang:ietf-dots-call-home
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.
```

This document requests IANA to register the following YANG module in the "YANG Module Names" subregistry [RFC7950] within the "YANG Parameters" registry:

```
name: ietf-call-home
namespace: urn:ietf:params:xml:ns:yang:ietf-dots-call-home
maintained by IANA: N
prefix: call-home
reference: RFC XXXX
```

5. Security Considerations

This document deviates from classic DOTS signal channel usage by having the DOTS server initiate the (D)TLS connection. DOTS signal channel related security considerations discussed in Section 10 of [I-D.ietf-dots-signal-channel] MUST be considered. DOTS agents MUST authenticate each other using (D)TLS before a DOTS signal channel session is considered valid.

An attacker may launch a DoS attack on the DOTS client by having it perform computationally expensive operations, before deducing that the attacker doesn't possess a valid key. For instance, in TLS 1.3 [RFC8446], the ServerHello message contains a Key Share value based on an expensive asymmetric key operation for key establishment. Common precautions mitigating DoS attacks are recommended, such as temporarily blacklisting the source address after a set number of unsuccessful authentication attempts.

Call Home DOTS servers may not blindly trust mitigation requests from **Call Home** DOTS clients. For example, DOTS servers can use the attack flow information in a mitigation request to enable full-fledged packet inspection function to inspect all the traffic from the compromised device to the target or to re-direct the traffic from the compromised device to the target to a DDoS mitigation system to scrub the suspicious traffic. **Call Home** DOTS servers can also seek the consent of DOTS server domain administrator to block the traffic from the compromised device to the target (see Section 3.3.1).

6. Privacy Considerations

The considerations discussed in [RFC6973] were taken into account to assess whether the DOTS Call Home extension introduces privacy threats.

Concretely, the protocol does not leak any new information that can be used to ease surveillance. In particular, the **Call Home** DOTS server is not required to share information that is local to its network (e.g., internal identifiers of an attack source) with the **Call Home** DOTS client.

The DOTS Call Home extension does not preclude the validation of mitigation requests received from a **Call Home** DOTS client. For example, a security service running on the CPE may require administrator's consent before the CPE acts upon the mitigation request indicated by the **Call Home** DOTS client. How the consent is obtained is out of scope of this document.

Note that a **Call Home** DOTS server can seek for an administrator's consent, validate the request by inspecting the traffic, or proceed with both.

The DOTS Call Home extension is only advisory in nature. Concretely, the DOTS Call Home extension does not impose any action to be enforced within the ~~home network;~~ **network hosting an attack source;** it is up to the **Call Home** DOTS server (and/or network administrator) to decide whether and which actions are required.

Moreover, the DOTS Call Home extension avoids misattribution by appropriately identifying the network to which a suspect attack source belongs to (e.g., address sharing issues discussed in Section 3.3.1).

Triggers to send a DOTS mitigation request to a **Call Home** DOTS server are deployment-specific. For example, a **Call Home** DOTS client may rely on the output of some DDoS detection systems deployed within the DOTS client domain to detect potential outbound DDoS attacks or on abuse claims received from remote victim networks. Such DDoS detection and mitigation techniques are not meant to track the activity of users, but to protect the Internet and avoid altering the

IP reputation of the DOTS client domain.

7. Contributors

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8. Acknowledgements

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Appendix A. Disambiguate Base DOTS Signal vs. Call Home

With the call home extension, there is a chance that two DOTS agents can simultaneously establish two DOTS signal channels with different directions (base DOTS signal channel and DOTS signal channel call home). Here is one example drawn from the home network. Nevertheless, the outcome of the discussion is not specific to these networks, but applies to any DOTS ~~call home~~ **Call Home** scenario.

In the ~~call home~~ **Call Home** scenario, the DOTS server in, for example, the home network can mitigate the DDoS attacks launched by the compromised

device in its domain by receiving the mitigation request sent by the **Call Home** DOTS client in the ISP environment. In addition, the DOTS client in the home network can initiate a mitigation request to the DOTS server in the ISP environment to ask for help when the home network is under a DDoS attack. Such DOTS server and DOTS client in the home network can co-locate in the same home network element (e.g., the Customer Premises Equipment). In this case, with the same peer at the same time the home network element will have the basic DOTS signal channel defined in [I-D.ietf-dots-signal-channel] and the ~~call home~~ DOTS signal channel **Call Home** defined in this specification. ~~Thus~~ **Thus,** these two signal channels need to be distinguished when they are both supported. Two approaches have been considered for distinguishing the two DOTS signal channels, but only the one that using the dedicated port number has been chosen as the best choice.

By using a dedicated port number for each, these two signal channels can be separated unambiguously and easily. For example, the CPE uses the port number 4646 ~~defined~~ **allocated** in [I-D.ietf-dots-signal-channel] to initiate the basic signal channel to the ISP when it acts as the DOTS client, and uses the port number TBD to initiate the ~~call home~~ signal ~~channel.~~ **channel Call Home.** Based on the different ~~ports,~~ **port numbers,** the ISP can directly decide which kind of procedures should follow immediately after it receives the DOTS messages. This approach just requires two (D)TLS sessions to be established respectively for the basic signal channel and ~~call home~~ **Call Home** signal channel.

The other approach is signaling the role of each DOTS agent (e.g., by using the DOTS data channel). For example, the DOTS agent in the home network first initiates a DOTS data channel to the peer DOTS agent in the ISP environment, at this time the DOTS agent in the home network is the DOTS client and the peer DOTS agent in the ISP environment is the DOTS server. After that, the DOTS agent in the home network retrieves the DOTS call home capability of the peer DOTS agent. If the peer supports the call home extension, the DOTS agent needs to subscribe to the peer to use this extension. ~~Then~~ **Then,** the reversal of DOTS role can be recognized as done by both DOTS agents. When the DOTS agent in the ISP environment, which now is the DOTS client, wants to filter the attackers' traffic, it requests the DOTS agent in the home network, which now is the DOTS server, for help.

Signaling the role will complicate the DOTS protocol, and this complexity is not required in context where ~~call home~~ **the Call Home** extension is not required or only when ~~call home~~ **the Call Home** extension is needed. Besides, the DOTS data channel may not work during attack time. Even if changing the above example from using the DOTS data channel to the DOTS signal channel, the more procedures will still reduce the efficiency. Using the dedicated port number is much easier and more concise compared to the second approach, and its cost that establishing two (D)TLS sessions is much less. So, using a dedicated port number for the ~~call home~~ **Call Home** extension is chosen in this specification.

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