SIEMENS
Ingenuity for life

Supporting IP-Multicast based on OSPF and PIM SM

SCALANCE

Siemens
Industry
Online
Support

Legal information

Use of application examples

Application examples illustrate the solution of automation tasks through an interaction of several components in the form of text, graphics and/or software modules. The application examples are a free service by Siemens AG and/or a subsidiary of Siemens AG ("Siemens"). They are non-binding and make no claim to completeness or functionality regarding configuration and equipment. The application examples merely offer help with typical tasks; they do not constitute customer-specific solutions. You yourself are responsible for the proper and safe operation of the products in accordance with applicable regulations and must also check the function of the respective application example and customize it for your system.

Siemens grants you the non-exclusive, non-sublicensable and non-transferable right to have the application examples used by technically trained personnel. Any change to the application examples is your responsibility. Sharing the application examples with third parties or copying the application examples or excerpts thereof is permitted only in combination with your own products. The application examples are not required to undergo the customary tests and quality inspections of a chargeable product; they may have functional and performance defects as well as errors. It is your responsibility to use them in such a manner that any malfunctions that may occur do not result in property damage or injury to persons.

Disclaimer of liability

Siemens shall not assume any liability, for any legal reason whatsoever, including, without limitation, liability for the usability, availability, completeness and freedom from defects of the application examples as well as for related information, configuration and performance data and any damage caused thereby. This shall not apply in cases of mandatory liability, for example under the German Product Liability Act, or in cases of intent, gross negligence, or culpable loss of life, bodily injury or damage to health, non-compliance with a guarantee, fraudulent non-disclosure of a defect, or culpable breach of material contractual obligations. Claims for damages arising from a breach of material contractual obligations shall however be limited to the foreseeable damage typical of the type of agreement, unless liability arises from intent or gross negligence or is based on loss of life, bodily injury or damage to health. The foregoing provisions do not imply any change in the burden of proof to your detriment. You shall indemnify Siemens against existing or future claims of third parties in this connection except where Siemens is mandatorily liable.

By using the application examples you acknowledge that Siemens cannot be held liable for any damage beyond the liability provisions described.

Other information

Siemens reserves the right to make changes to the application examples at any time without notice. In case of discrepancies between the suggestions in the application examples and other Siemens publications such as catalogs, the content of the other documentation shall have precedence.

The Siemens terms of use (https://support.industry.siemens.com) shall also apply.

Security information

Siemens provides products and solutions with Industrial Security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at: https://www.siemens.com/industrialsecurity.

Table of contents

1 Introduction

1.1 Intention

In modern networks IP multicast becomes more and more important. Especially when it comes to video applications like CCTV, IP multicast is used to decrease the load on the cameras and the networks. This paper describes a basic configuration of an IP network, supporting IP multicast based on OSPF and PIM Sparse Mode (short: PIM-SM).

The intention is to give the network designer an example configuration as introduction and as a starting point for application specific configuration. It's assumed, that the audience is aware of IP networking, OSPF and IP Multicast concepts including PIM.

1.2 Example Network

The example network consists of SCALANCE Layer 3 switches interconnected using single port VLANs. As end systems, three cameras are connected as multicast sources and four PCs as multicast receivers.

Figure 1-1
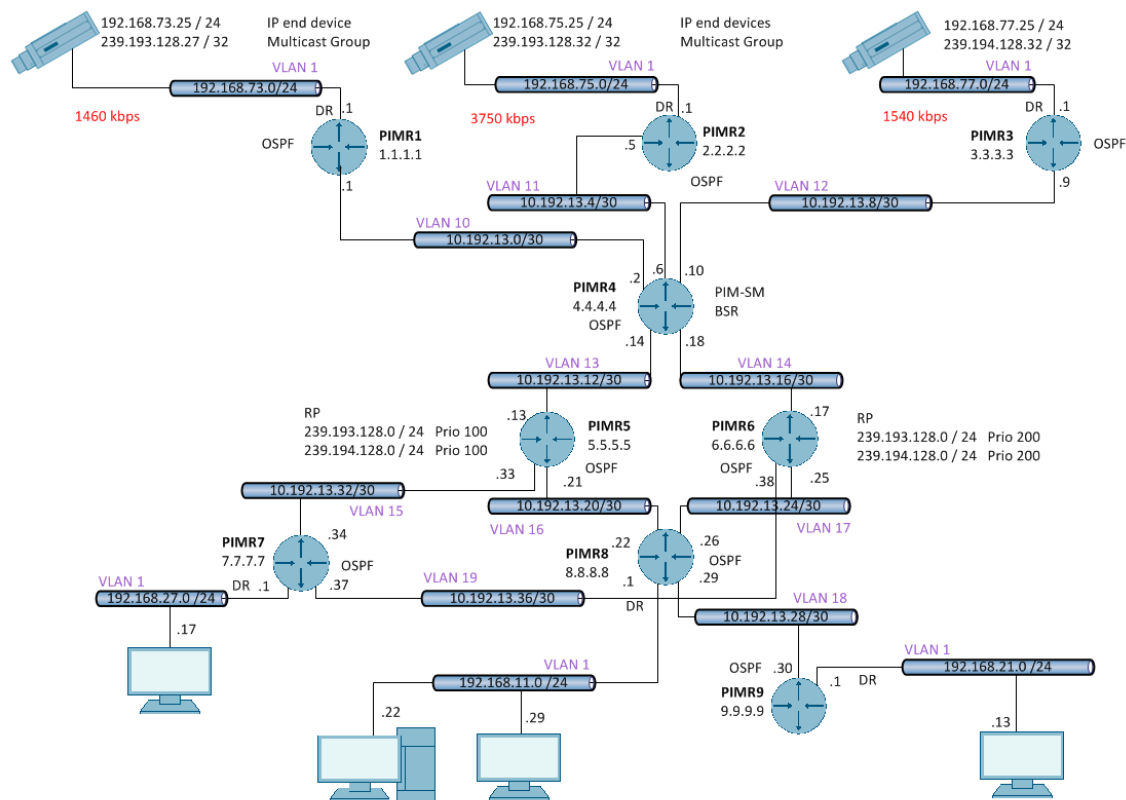
2 Configuration

2.1 Basic Layer 3 configuration

Transfer Networks

PIM is only supported on VLAN interfaces but not on router ports. Therefore the transfer networks between the routers are realized with single port VLANs using /30 subnets of the private network 10.0.0.0/8.

It's important, that this VLAN is configured only at one port in order to avoid black holing in case of a link failure.

In the following you see an example configuration for transfer network 10.192.13.0/30 (VLAN 10) at router PIMR1:

```
vlan 10
 ports gigabitethernet 1/1 untagged gigabitethernet 1/1
!
interface gigabitethernet 1/1
 switchport pvid 10
!
interface vlan 10
 ip address  10.192.13.1 255.255.255.252
```

Loopback interfaces

In order to provide an always reachable IP interface, a loopback interface is configured at all routers. With SCALANCE X, the loopback interface is configured based on VLAN interfaces.

In the following you see an example configuration for loopback interface of router PIMR1:

```
vlan 110
!
interface vlan 110 loopback
 ip address 1.1.1.1 255.255.255.255
!
```

User Networks

The cameras and PCs are connected to the user networks. In this example all user networks are realized in VLAN1 using a /24 IP subnet of the private network 192.168.0.0/16. In order to keep the example simple, there are no redundancies implemented here.

In the following you see an example configuration for user network 192.168.73.0/24 (VLAN 1) at router PIMR1:

```
vlan 1
 ports gigabitethernet 1/2-8,2/1-8,3/1-8 untagged gigabitethernet 1/2-8,2/1-
8,3/1-8
!
interface vlan 1
 no ip address
 ip address  192.168.73.1 255.255.255.0
```

2.2 Unicast Routing

For unicast IP routing, a single area OSPF concept has been chosen. This is also a valid option for most of real networks. All transfer networks are configured as member of the OSPF area 0.0.0.0. The user networks are configured as passive members of area 0.0.0.0 which avoids the need for ASBR and external routes in area 0.0.0.0.

According to best practice, the loopback IP address is used as router ID. This simplifies the diagnostics of OSPF.

In the following you see an example OSPF configuration at router PIMR1:

```
ip routing
!
router ospf
 router-id 1.1.1.1
 network 1.1.1.1 area 0.0.0.0
 network 10.192.13.1 area 0.0.0.0
 network 192.168.73.1 area 0.0.0.0
 passive-interface vlan 1
```

2.3 IP Multicast Routing

2.3.1 IGMP

In this example, IGMP is needed for the end systems in order to join a specific multicast group. Therefore IGMP has to be enabled globally and at all user network interfaces. It's not necessary or recommended, to enable IGMP at the transfer networks between the routers.

In the following you see an example IGMP configuration at router PIMR1:

```
ip igmp
!
interface vlan 1
 ip igmp
!
```

2.3.2 PIM configuration

Basic PIM configuration

PIM has to be enabled at all routers globally and all IP interfaces. At user networks, where multiple PIM routers could be connected, it's recommended to define, which router becomes the PIM Designated Router (short: DR) for that segment. Therefore the PIM DR-priority is set to 255 in user networks.

In the following you see an example basic PIM configuration at router PIMR1:

```
ip pim routing
!
interface vlan 1
 ip pim
 ip pim dr-priority 255
!
interface vlan 10
 ip pim
!
interface vlan 100 loopback
 ip pim
```

PIM Bootstrap Router

In the example network, PIMR4 is defined as PIM Bootstrap Router (short: BSR). All Rendezvous Points (short: RP) register their multicast ranges and their IP address at the BSR. The BSR informs all PIM routers about the RPs and their multicast ranges. In order to improve the availability of the BSR IP address, the loopback interface of PIMR4 is used as PIM source.

In the following you see a PIM BSR configuration at router PIMR4

```
interface vlan 100 loopback
 ip address  4.4.4.4 255.255.255.255
 ip pim bsr-candidate 100
 ip pim
```

PIM Rendezvous Point configuration

For PIM SM, a rendezvous point is required to register multicast sources in the network. Each PIM router registers it multicast sources to the RP.

In the example, PIMR5 and PIMR6 are configured as RP candidates. At both routers, the same multicast ranges are configured in order to provide a basic redundancy. At PIMR5 a lower priority has been set. Since PIM routers select the RP with the lower priority, the router PIMR5 will be used as RP for both ranges. In case of a failure of PIMR5, all PIM routers will select PIMR6 as RP.

In the following you see a PIM RP configuration at router PIMR5

```
router pim
 rp-candidate rp-address 239.193.128.0 255.255.255.0 5.5.5.5 120
 rp-candidate rp-address 239.194.128.0 255.255.255.0 5.5.5.5 120
!
```

In the following you see a PIM RP configuration at router PIMR6

```
router pim
 rp-candidate rp-address 239.193.128.0 255.255.255.0 6.6.6.6 200
 rp-candidate rp-address 239.194.128.0 255.255.255.0 6.6.6.6 200
!
```

NOTE	The router PIMR6 receives, during the redundancy switchover phase, "PIM Register Messages" this may increase the load of the CPU. These "PIM Register Messages" are sent from the multicast sources to be registered at the new rendezvous point.

3 Additional Information

3.1 Diagnostics

In this chapter you see the CLI commands for diagnostics.

show ip pim

```
PIMR8# show ip pim

PIM Routing Information
-------------------------
  PIM Mode: sparse,   PIM Version: 2
  Elected BSR: 4.4.4.4
  Candidate RP Holdtime: 0
```

show ip pim interface

```
PIMR8# show ip pim interface

PIM is globally enabled

Address         IfName/IfId Ver/Mode  Nbr   Qry      DR-Address    DR-Priority
                                      Count Interval
-------         ----------- --------  ----- -------- ----------    ---------
192.168.11.1     vlan1/62   2/Sparse  0     30       192.168.11.1  255
10.192.13.22    vlan16/63   2/Sparse  1     30       10.192.13.22  1
10.192.13.26    vlan17/64   2/Sparse  1     30       10.192.13.26  1
10.192.13.29    vlan18/65   2/Sparse  1     30       10.192.13.30  1
8.8.8.8         vlan100/66  2/Sparse  0     30       8.8.8.8       1
```

show ip pim neighbor

```
PIMR8# show ip pim neighbor

Neighbour       IfName/IfId Uptime/Expiry Ver/Mode  DR-Priority OverRide Lan   CompId
Address                                                         Interval Delay
---------       ----------- ------------- --------  ----------- -------- ----- ------
10.192.13.21    vlan16/63   00:50:55/88   2/Sparse  1           0        0     1
10.192.13.25    vlan17/64   00:50:54/90   2/Sparse  1           0        0     1
10.192.13.30    vlan18/65   00:50:51/89   2/Sparse  1           0        0     1
```

show ip pim bsr

```
PIMR8# show ip pim bsr

PIMv2 Bootstrap Configuration
-----------------------------
Elected BSR
  BSR Address : 4.4.4.4
  BSR Priority : 100, Hash Mask Length : 30
BSR UpTime: 00:49:56
```

show ip pim rp-hash

```
PIMR8# show ip pim rp-hash

Component 1
-----------
Group Address/Network Mask: 239.193.128.0/255.255.255.0
RP Address: 5.5.5.5
Priority: 120, Hold Time: 150

Group Address/Network Mask: 239.194.128.0/255.255.255.0
RP Address: 5.5.5.5
Priority: 120, Hold Time: 150
```

show ip pim rp-set

```
PIMR8# show ip pim rp-set

PIM Group-to-RP mappings
-----------------------
Group Address : 239.193.128.0 Group Mask : 255.255.255.0
   RP: 5.5.5.5
    Hold Time : 150, Expiry Time : 00:01:39

Group Address : 239.193.128.0 Group Mask : 255.255.255.0
   RP: 6.6.6.6
    Hold Time : 150, Expiry Time : 00:01:39

Group Address : 239.194.128.0 Group Mask : 255.255.255.0
   RP: 5.5.5.5
    Hold Time : 150, Expiry Time : 00:01:39

Group Address : 239.194.128.0 Group Mask : 255.255.255.0
   RP: 6.6.6.6
    Hold Time : 150, Expiry Time : 00:01:39
```

show ip pim mroute

```
PIMR8# show ip pim mroute

IP Multicast Routing Table
--------------------------
Route Flags S: SPT Bit W: Wild Card Bit R: RPT Bit
IIF State P: Pruned F: Forwarding A: Graft Ack Pending
Timers: Uptime/Expires
Interface State: Interface, State/Mode

PIM Multicast Routing Table

Total number of Multicast Routes is 6

(*, 239.193.128.27) ,00:22:27/--- ,RP : 5.5.5.5
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : WR
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:22:27/---

(192.168.73.25,239.193.128.27) ,00:22:27/00:33:47
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : S
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:22:27/---

(*, 239.193.128.32) ,00:22:06/--- ,RP : 5.5.5.5
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : WR
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:22:06/---

(192.168.75.25,239.193.128.32) ,00:22:06/01:09:17
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : S
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:22:06/---

(*, 239.194.128.32) ,00:21:43/--- ,RP : 5.5.5.5
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : WR
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:21:43/---

(192.168.77.25,239.194.128.32) ,00:21:43/01:45:50
  Incoming Interface : vlan16 ,RPF nbr : 10.192.13.21 ,Route Flags : S
  Outgoing InterfaceList :
    vlan1, Forwarding/Sparse ,00:21:43/---
```

3.2 Configuration Scripts

In this chapter you can see the complete configuration script.

```
system name "PIMR1"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 1/2-8,2/1-8,3/1-8 untagged
gigabitethernet 1/2-8,2/1-8,3/1-8
!
vlan 10
 ports gigabitethernet 1/1 untagged gigabitethernet 1/1
!
vlan 100
!
interface gigabitethernet 1/1
 switchport pvid 10
!
interface vlan 1
 no ip address
 ip address  192.168.73.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 10
 ip address  10.192.13.1 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  1.1.1.1 255.255.255.255
 ip pim
!
router ospf
 router-id 1.1.1.1
 network 1.1.1.1 area 0.0.0.0
 network 10.192.13.1 area 0.0.0.0
 network 192.168.73.1 area 0.0.0.0
 passive-interface vlan 1
!
end
```

```
system name "PIMR2"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 1/2-16,2/1-8 untagged gigabitethernet
1/2-16,2/1-8
!
vlan 11
 ports gigabitethernet 1/1 untagged gigabitethernet 1/1
!
vlan 110
!
interface gigabitethernet 1/1
 switchport pvid 11
!
interface vlan 1
 no ip address
 ip address  192.168.75.1 255.255.255.0
 ip igmp
!
interface vlan 1
 ip pim
 ip pim dr-priority 255
!
interface vlan 11
 ip address  10.192.13.5 255.255.255.252
 ip pim
!
interface vlan 110 loopback
 ip address  2.2.2.2 255.255.255.255
 ip pim
!
router ospf
 router-id 2.2.2.2
 network 2.2.2.2 area 0.0.0.0
 network 10.192.13.5 area 0.0.0.0
 network 192.168.75.1 area 0.0.0.0
 passive-interface vlan 1
!
end
```

```
system name "PIMR3"
!
ip routing
ip pim routing
ip igmp
!
vlan 1
 ports gigabitethernet 1/1-3,1/5-8,2/1-8,3/1-8 untagged
gigabitethernet 1/1-3,1/5-8,2/1-8,3/1-8
!
vlan 12
 ports gigabitethernet 1/4 untagged gigabitethernet 1/4
!
vlan 100
!
interface gigabitethernet 1/4
 switchport pvid 12
!
interface vlan 1
 no ip address
 ip address  192.168.77.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 12
 ip address  10.192.13.9 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  3.3.3.3 255.255.255.255
 ip pim
!
router ospf
 router-id 3.3.3.3
 network 3.3.3.3 area 0.0.0.0
 network 10.192.13.9 area 0.0.0.0
 network 192.168.77.1 area 0.0.0.0
!
exit
```

```
system name "PIMR4"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 1/6-8,2/1-8,3/1-8 untagged
gigabitethernet 1/6-8,2/1-8,3/1-8
!
vlan 10
 ports gigabitethernet 1/1 untagged gigabitethernet 1/1
!
vlan 11
 ports gigabitethernet 1/2 untagged gigabitethernet 1/2
!
vlan 12
 ports gigabitethernet 1/3 untagged gigabitethernet 1/3
!
vlan 13
 ports gigabitethernet 1/4 untagged gigabitethernet 1/4
!
vlan 14
 ports gigabitethernet 1/5 untagged gigabitethernet 1/5
!
vlan 100
!
interface gigabitethernet 1/1
 switchport pvid 10
!
interface gigabitethernet 1/2
 switchport pvid 11
!
interface gigabitethernet 1/3
 switchport pvid 12
!
interface gigabitethernet 1/4
 switchport pvid 13
!
interface gigabitethernet 1/5
 switchport pvid 14
!
interface vlan 1
 no ip address
 ip address  192.168.4.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 10
 ip address  10.192.13.2 255.255.255.252
 ip pim
!
interface vlan 11
 ip address  10.192.13.6 255.255.255.252
 ip pim
!
interface vlan 12
 ip address  10.192.13.10 255.255.255.252
 ip pim
!
interface vlan 13
 ip address  10.192.13.14 255.255.255.252
 ip ospf cost 3
 ip pim
!
interface vlan 14
 ip address  10.192.13.18 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  4.4.4.4 255.255.255.255
```

```
 ip pim bsr-candidate 100
 ip pim
!
router ospf
 router-id 4.4.4.4
 network 4.4.4.4 area 0.0.0.0
 network 10.192.13.2 area 0.0.0.0
 network 10.192.13.6 area 0.0.0.0
 network 10.192.13.10 area 0.0.0.0
 network 10.192.13.14 area 0.0.0.0
 network 10.192.13.18 area 0.0.0.0
 network 192.168.4.1 area 0.0.0.0
 passive-interface vlan 1
!
end
```

```
system name "PIMR5"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 0/2-10,0/13-24 extreme-ethernet
0/25-26 untagged gigabitethernet 0/2-10,0/13-24 extreme-
ethernet 0/25-26
!
vlan 13
 ports gigabitethernet 0/12 untagged gigabitethernet 0/12
!
vlan 15
 ports gigabitethernet 0/1 untagged gigabitethernet 0/1
!
vlan 16
 ports gigabitethernet 0/11 untagged gigabitethernet 0/11
!
vlan 100
!
vlan 111
!
interface gigabitethernet 0/1
 switchport pvid 15
!
interface gigabitethernet 0/11
 switchport pvid 16
!
interface gigabitethernet 0/12
 switchport pvid 13
!
interface vlan 1
 no ip address
 ip address  192.168.5.1 255.255.255.0
!
interface vlan 13
 ip address  10.192.13.13 255.255.255.252
 ip pim
!
interface vlan 15
 ip address  10.192.13.33 255.255.255.252
 ip pim
!
interface vlan 16
 ip address  10.192.13.21 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  5.5.5.5 255.255.255.255
 ip pim
!
router ospf
 router-id 5.5.5.5
 network 5.5.5.5 area 0.0.0.0
 network 10.192.13.13 area 0.0.0.0
 network 10.192.13.21 area 0.0.0.0
 network 10.192.13.33 area 0.0.0.0
 network 192.168.5.1 area 0.0.0.0
 passive-interface vlan 1
!
router pim
 rp-candidate rp-address 239.193.128.0 255.255.255.0
5.5.5.5 120
 rp-candidate rp-address 239.194.128.0 255.255.255.0
5.5.5.5 120
!
end
```

```
system name "PIMR6"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 0/1,0/3-10,0/13-24 untagged
gigabitethernet 0/1,0/3-10,0/13-24
!
vlan 14
 ports gigabitethernet 0/12 untagged gigabitethernet
0/12
!
vlan 17
 ports gigabitethernet 0/11 untagged gigabitethernet
0/11
!
vlan 19
 ports gigabitethernet 0/2 untagged gigabitethernet
0/2
!
vlan 100
!
interface gigabitethernet 0/2
 switchport pvid 19
!
interface gigabitethernet 0/11
 switchport pvid 17
!
interface gigabitethernet 0/12
 switchport pvid 14
!
interface vlan 1
 no ip address
 ip address  192.168.6.1 255.255.255.0
!
interface vlan 14
 ip address  10.192.13.17 255.255.255.252
 ip pim
!
interface vlan 17
 ip address  10.192.13.25 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  6.6.6.6 255.255.255.255
 ip pim
!
interface vlan 19
 ip address  10.192.13.38 255.255.255.252
 ip pim
!
router ospf
 router-id 6.6.6.6
 network 6.6.6.6 area 0.0.0.0
 network 10.192.13.17 area 0.0.0.0
 network 10.192.13.25 area 0.0.0.0
 network 10.192.13.38 area 0.0.0.0
 network 192.168.6.1 area 0.0.0.0
 passive-interface vlan 1
!
router pim
 rp-candidate rp-address 239.193.128.0 255.255.255.0
6.6.6.6 200
 rp-candidate rp-address 239.194.128.0 255.255.255.0
6.6.6.6 200
!
end
```

```
system name "PIMR7"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 1/3-16,2/1-8 untagged
gigabitethernet 1/3-16,2/1-8
!
vlan 15
 ports gigabitethernet 1/1 untagged gigabitethernet
1/1
!
vlan 19
 ports gigabitethernet 1/2 untagged gigabitethernet
1/2
!
vlan 100
!
interface gigabitethernet 1/1
 switchport pvid 15
!
interface gigabitethernet 1/2
 switchport pvid 19
!
interface vlan 1
 no ip address
 ip address  192.168.27.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 15
 ip address  10.192.13.34 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  7.7.7.7 255.255.255.255
 ip pim
!
interface vlan 19
 ip address  10.192.13.37 255.255.255.252
 ip pim
!
router ospf
 router-id 7.7.7.7
 network 7.7.7.7 area 0.0.0.0
 network 10.192.13.34 area 0.0.0.0
 network 10.192.13.37 area 0.0.0.0
 network 192.168.27.1 area 0.0.0.0
 passive-interface vlan 1
!
end
```

```
system name "PIMR8"
!
no spanning-tree
!
ip routing
ip pim routing
ip igmp
!
vlan 1
 ports gigabitethernet 1/3-4,1/6-8,2/1-8,3/1-8 untagged
gigabitethernet 1/3-4,1/6-8,2/1-8,3/1-8
!
vlan 16
 ports gigabitethernet 1/1 untagged gigabitethernet 1/1
!
vlan 17
 ports gigabitethernet 1/2 untagged gigabitethernet 1/2
!
vlan 18
 ports gigabitethernet 1/5 untagged gigabitethernet 1/5
!
vlan 100
!
interface gigabitethernet 1/1
 switchport pvid 16
!
interface gigabitethernet 1/2
 switchport pvid 17
!
interface gigabitethernet 1/5
 switchport pvid 18
!
router ospf
 router-id 8.8.8.8
 network 8.8.8.8 area 0.0.0.0
 network 10.192.13.22 area 0.0.0.0
 network 10.192.13.26 area 0.0.0.0
 network 10.192.13.29 area 0.0.0.0
 network 192.168.11.1 area 0.0.0.0
passive-interface vlan 1
!
interface vlan 1
 no ip address
 ip address  192.168.11.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 16
 ip address  10.192.13.22 255.255.255.252
 ip pim
!
interface vlan 17
 ip address  10.192.13.26 255.255.255.252
 ip pim
!
interface vlan 18
 ip address  10.192.13.29 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  8.8.8.8 255.255.255.255
 ip pim
!
end
```

```
system name "PIMR9"
!
ip routing
ip pim routing
ip igmp
!
no spanning-tree
!
vlan 1
 ports gigabitethernet 1/2-8,2/1-8,3/1-8 untagged
gigabitethernet 1/2-8,2/1-8,3/1-8
!
vlan 18
 ports gigabitethernet 1/1 untagged gigabitethernet
1/1
!
vlan 100
!
interface gigabitethernet 1/1
 switchport pvid 18
!
interface vlan 1
 no ip address
 ip address  192.168.21.1 255.255.255.0
 ip igmp
 ip pim
 ip pim dr-priority 255
!
interface vlan 18
 ip address  10.192.13.30 255.255.255.252
 ip pim
!
interface vlan 100 loopback
 ip address  9.9.9.9 255.255.255.255
 ip pim
!
router ospf
 router-id 9.9.9.9
 network 9.9.9.9 area 0.0.0.0
 network 10.192.13.30 area 0.0.0.0
 network 192.168.21.1 area 0.0.0.0
 passive-interface vlan 1
!
exit
```

4 Appendix

4.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
https://support.industry.siemens.com/

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:
https://www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:
https://www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

4.2 Links and literature

Table 4-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to this entry page of this application example https://support.industry.siemens.com/cs/ww/en/view/109758722
\3\	

4.3 Change documentation

Table 4-2

Version	Date	Modifications
V1.0	07/2018	First version