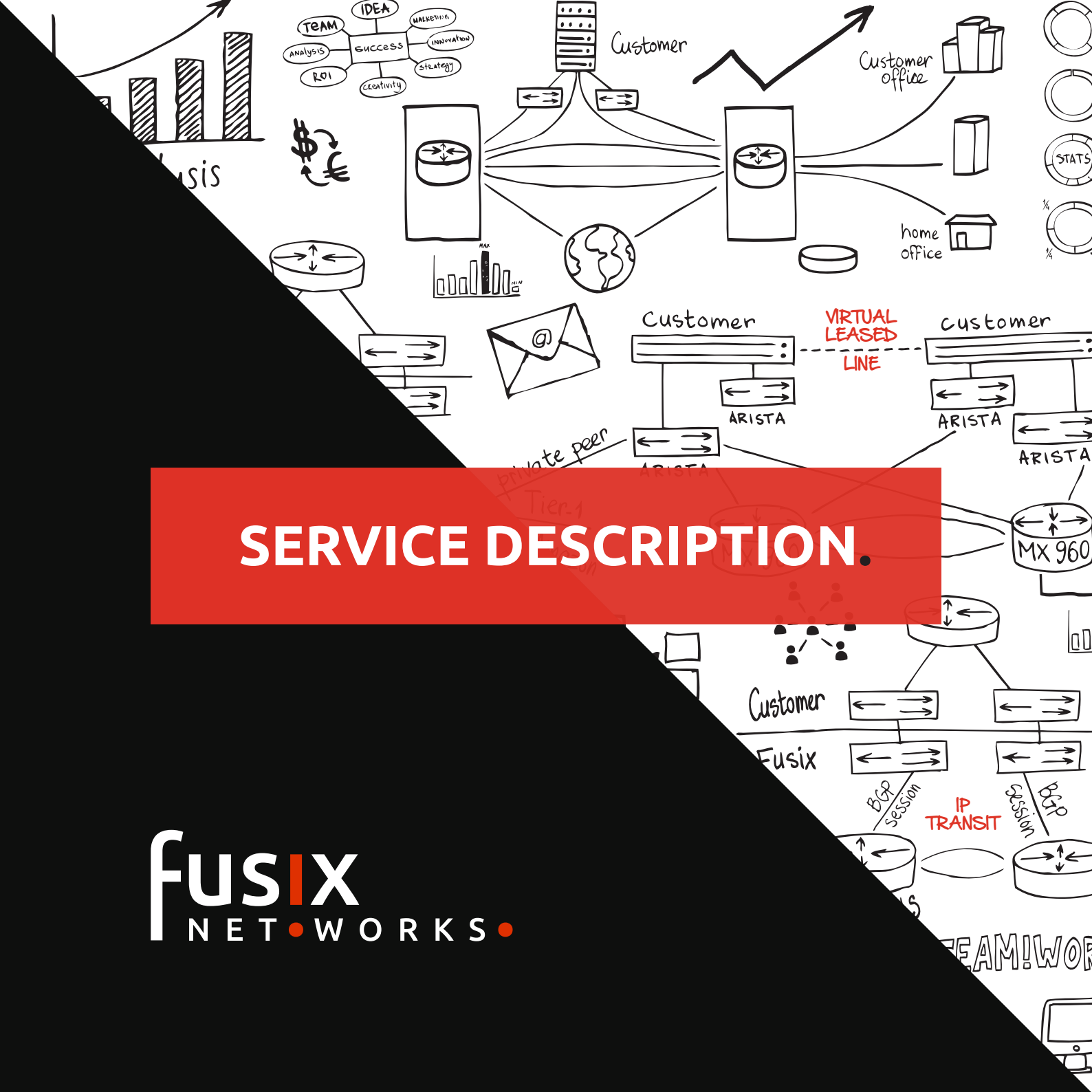


SERVICE DESCRIPTION.

FUSIX NETWORKS

Yulia Makhlin
CEO
yulia@fusix.nl



Niels Raijer
CTO
niels@fusix.nl



1. SERVICE DELIVERY BACKBONE
2. INTERNET ACCESS
3. CARRIER SERVICES
4. NETWORK CONSULTANCY

FUSIX NETWORKS

WWW.FUSIX.NL
T: +31 (0) 85 401 4441
OFFICE@FUSIX.NL

The Fusix network, AS57866, has uplinks to multiple Tier-1 networks, strategic private peering partners and selected Internet Exchanges. It delivers **non-overbooked, high performance access to the Internet** as well as dedicated connections to the major cloud providers: Amazon, Azure and Google.

In our backbone's double star-design, all physical components are deployed redundantly to reduce service impact due to any sort of maintenance, both planned and unplanned. Customers receive **two active-active Internet uplinks as a standard** service configuration at no additional cost.

As a result, the uptime of the customer's Internet uplinks does not depend on the uptime of any of the physical components of the backbone, and the guaranteed service availability level is as high as 99.99%. Also, **the amount of planned maintenance works with service impact is zero.**

The physical components of the backbone are Juniper routers, Arista edge switches and leased dark fiber and optical links. Each on-net data center is equipped with a pair of physical switches, each of which is connected to a core router by fiber connection. The two fiber connections follow different physical paths.

99.99% SERVICE UPTIME IN A STANDARD SERVICE CONFIGURATION

Our customers

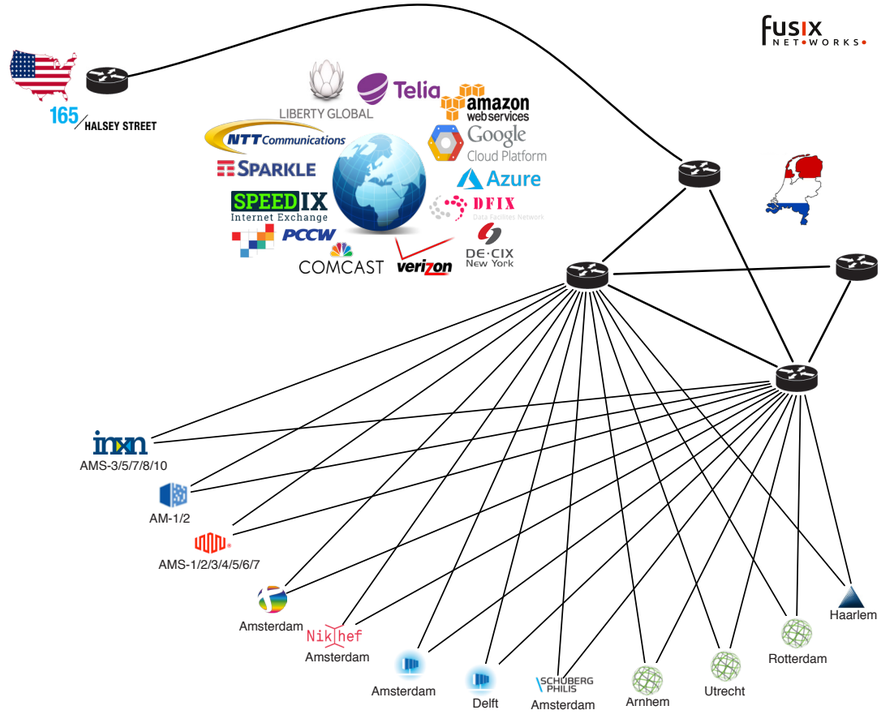
If your company provides Internet-based products, its presence on the Internet is a must, and you will find working with Fusix a great experience. **We go beyond the line where other ISPs stop,** helping you to pinpoint a problem by troubleshooting your network together with you. This approach meets the requirements of hosting, cloud, VoIP, office automation and IT providers, as well as enterprises of any size whose business depends on their Internet presence.



On-net datacenter locations

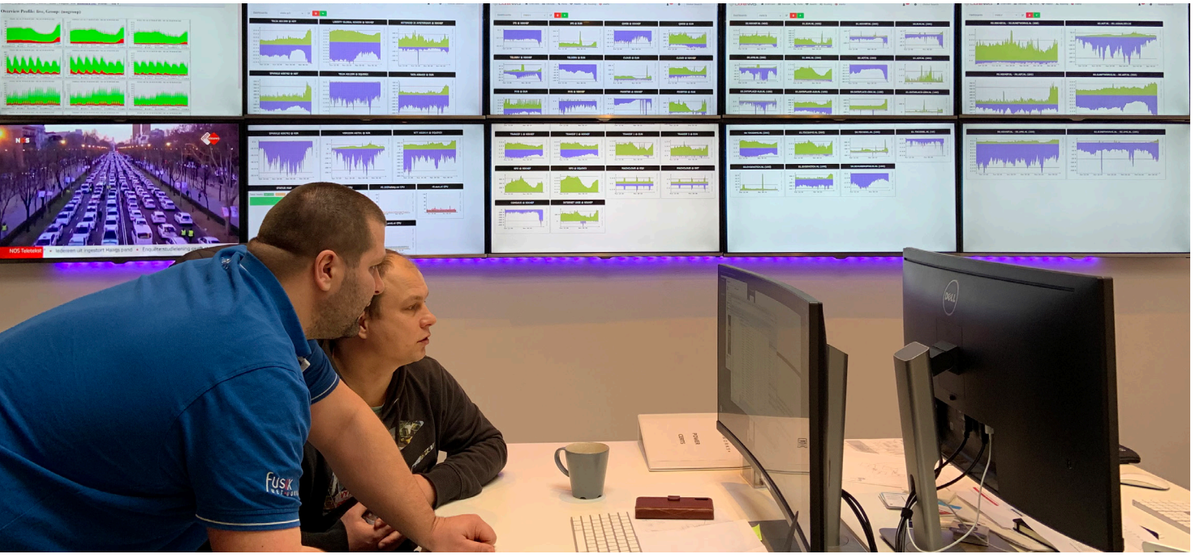
- Digital Realty AMS 1, Amsterdam
- Digital Realty AMS 2, Amsterdam
- NIKHEF, Amsterdam
- Equinix AM1/2, Amsterdam
- Equinix AM3, Amsterdam
- Equinix AM4, Amsterdam
- Equinix AM5, Amsterdam
- Equinix AM6, Amsterdam
- Equinix AM7, Amsterdam
- The Data Center Group, Amsterdam
- euNetworks, Amsterdam
- Iron Mountain, Haarlem
- Interxion AM-3, Schiphol-Rijk
- Interxion AM-5, Schiphol-Rijk
- Interxion AM-7, Schiphol-Rijk
- Interxion AM-8, Schiphol-Rijk
- Interxion AM-10, Schiphol-Rijk
- Dataplace, Rotterdam
- Dataplace, Utrecht
- Dataplace, Arnhem
- The Data Center Group, Delft
- Schuberg Philis, Schiphol-Rijk
- 165/Halsey Street, New Jersey, USA

IN 2019 WE PLAN TO ADD A POP IN STOCKHOLM AND 3 MORE IN AMSTERDAM



Nikhef
interxion
DIGITAL REALTY
EQUINIX
THE DATACENTERGROUP
data place
euNetworks
IRON MOUNTAIN
SCHUBERG PHILIS

24/7 Network Operations Center



Management of the backbone is performed by the Fusix Network Operations Center in The Netherlands. The network management platform Team!works is deployed redundantly and most of the routine configuration tasks are automated and secured by the in-house developed software, which allows the NOC staff to perform most of the actions swiftly and without possibility for human errors.

Continuity, integrity, scalability and security of the backbone are ensured by using **the best ISP industry practices** that are selected and adopted by Fusix in line with the standards and requirements of ISO 27001 for Information Security Management Systems and ISO 20000 for Information Technology Service Management.

Automated network management

Supervisory activities are also performed by the consolidated diagnostic tools of the Team!works platform and include statistics, fault reporting, monitoring of routing behaviors of the users and proactive monitoring of the key components: routers, switches and connectivity links.

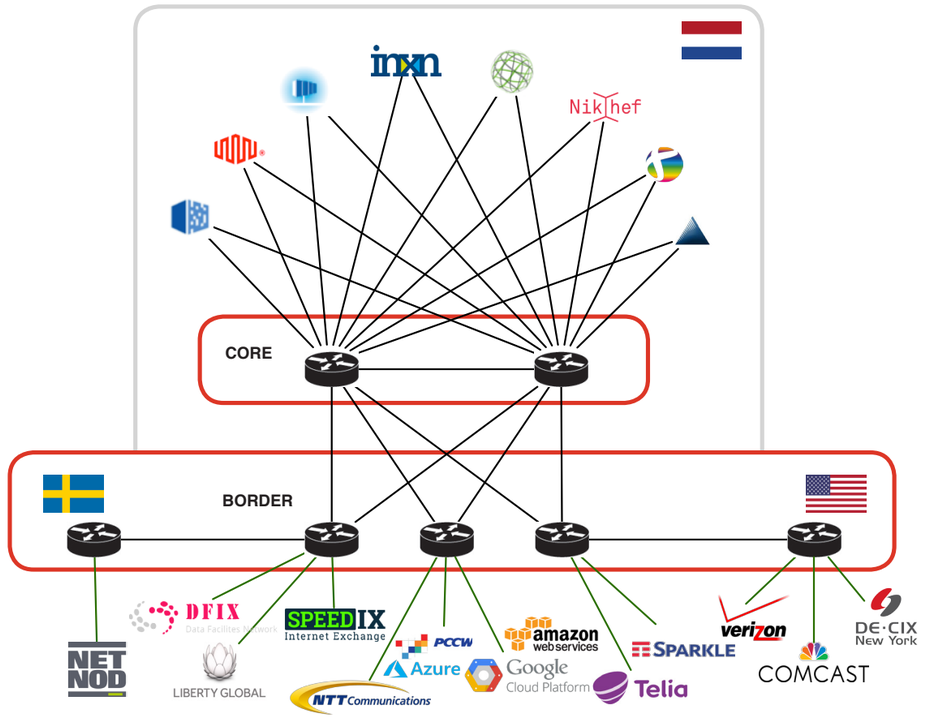
Routing security

Before accepting the routs that will send out your IP packets, the Fusix backbone verifies in the Resource Public Key Infrastructure that the destination network has a valid certificate for its BGP announcements. Invalid BGP announcements are disregarded, so **you can be sure that your traffic is not sent to a hijacked network.**

SECURITY POLICY:
INVALID = REJECT

ACCURATE DECISIONS ABOUT ROUTE QUALITY

After the security check, our core routers calculate the shortest route to where your traffic needs to be sent. We connect our uplinks to our border routers, which means that a core router does not just send the traffic to an uplink that is directly connected to it, but makes a knowledgeable and accurate decision on the length of the routes. Deployment of the border routers is the best ISP industry practice that provides a **measurable improvement of the routing quality.**



Internet service configurations

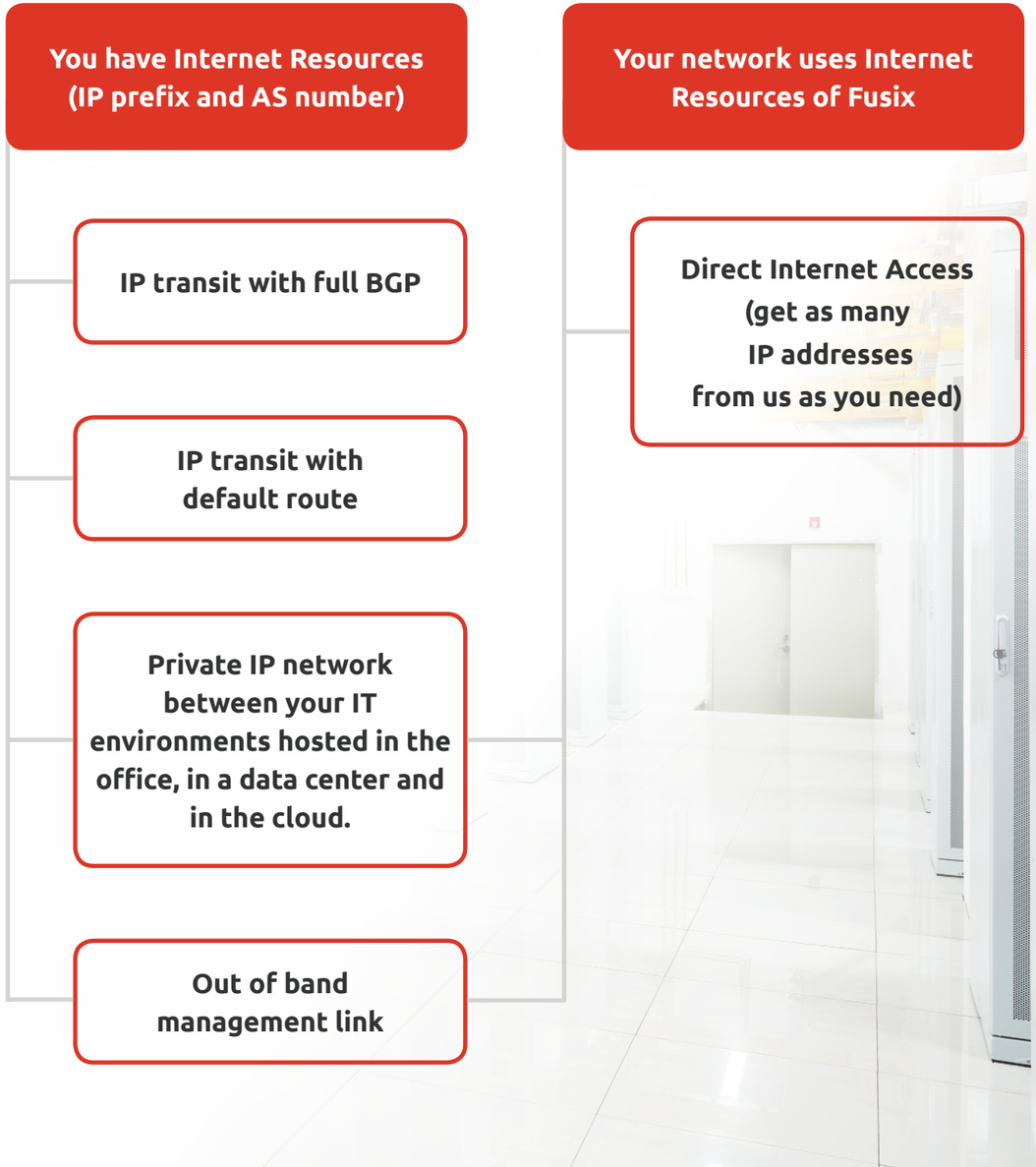
Direct Internet Access connects your Internet applications to the public Internet without the need to deploy and maintain your own Internet resources. It is an "off the shelf" service that can be delivered on the same day because all service components are provided to you by Fusix.

IP transit with full BGP means that your network receives and processes a full global Internet routing table. It is connected to multiple IP transit providers and chooses routes according to the preference rules that are defined by you. Your IP transit providers have no say in your routing policies. This configuration requires powerful routers and experience with BGP. Fusix can assist you with both: we sell network equipment and love to share our BGP knowledge!

IP transit with default route. If you have routers capable to process a limited number of routes (a partial BGP table), a default route to Fusix will provide all the routes that we have on our network. A link to a second IP transit provider can be added for Internet service redundancy and better reachability of your network. Both providers will deliver IP packets coming into your network, while the outgoing packets will be sent out via Fusix.

Out of band network management link is a low-bandwidth connection used to access the management interfaces of your network. It ensures that the management interfaces remain reachable in the unfortunate event of outage on your network.

Private network between all your IT environments guarantees that internal IP data does not travel on the public Internet. Under one contract (if required) you receive a fiber line to the office, **dedicated access to the cloud network where you host your applications** (AWS, Azure, Google), a private network between all your internal applications, and public Internet Access for your public applications. For all these services, Fusix will be **your single point of contact** to answer any questions and solve any technical issue.
We deliver Internet to the office on a footprint that combines of the networks of A-FIBER, KPN, EuroFiber, Ziggo, Tele2, Relined and BBNed.



Our standard for delivery of Internet Access services

- Redundant service delivery paths (2 active-active uplinks) at no additional cost;
- Deployed BGP security mechanism: verify validity of BGP announcements before accepting them;
- 24/7 available, easy to use DDoS mitigation tools for your IP network;
- Zero service impact during planned maintenance works;
- Flexible Internet bandwidth commitments from 100Mbps.
- Aggregated bandwidth billing for all ports in all service locations, also for customers with a multi data center environment;
- Access to Team!works: 24/7 online Internet monitoring and troubleshooting tools;
- Any service configuration can be done;
- We always listen to your requirements, then we configure your Internet Access both on your and on our side.



Managed Internet Access Package (MIAP)

Add to your Internet Access a guaranteed availability of our NOC to help you with management and troubleshooting of YOUR IP network

CREATE YOUR OWN MIAP. ALL COMBINATIONS ARE POSSIBLE

	MIAP 500 Mbps	MIAP 1 Gbps
BASIC availability SLA: response by a qualified network engineer within 4 hours 24/7 to urgent troubleshooting requests; and within 3 working days during Business Hours to non-urgent requests about network management	✓	premium
PREMIUM availability SLA: response by a qualified network engineer within 2 hours 24/7 to urgent troubleshooting requests; and within 2 working days during Business Hours to non-urgent requests about network management	n/a	✓
BASIC DDoS mitigation: Fusix will identify which IP address of your network is the target of a DDoS attack and blackhole all IP data traffic for this IP address. The blackholing will remove congestion and allow all your other service operate normally again. During the blackholing the target IP address will remain isolated from the Internet.	✓	✓
ADVANCED DDoS mitigation: an experienced NOC engineer will make the best effort to filter the malicious traffic. Successful filtering will not only remove the network congestion but will also bring up the services of the target IP address of the attack	n/a	✓
Monitoring of your IP network performance: we will add your routers and switches to our network monitoring systems and make regular backups of the network configurations. When our input is needed, we will have all technical information available and can help to restore your network functionality very fast	✓	✓
Network management consultancy: you can reach out to the Fusix specialists for any question related to management or a change of your network. Consultancy hours per month. Hours included	1	3

This table is an example. You may create your own MIAP package by combining any Internet Access service with any of the IP management assistance options mentioned in the CONSULTANCY section.

Carrier Services

We lease dark fiber lines to connect our on-net data centers. On this dark fiber infrastructure, we offer point to point 10Gbit optical transmission using **wavelength-division multiplexing (WDM).**

WDM transmission uses a physical fiber path, therefore it cannot be redundant. If your critical services rely on WDM, you would consider to use 2 WDM links, each of which uses a separate fiber path. In this case, one of the waves will remain up in the unfortunate event of a problem with one of the fiber paths.

WE CAN DELIVER WDM LINKS ON REGULAR SM/MM TRANCEIVERS. YOU WILL NEED ONLY ONE CROSS-CONNECT FOR MULTIPLE WDM LINKS

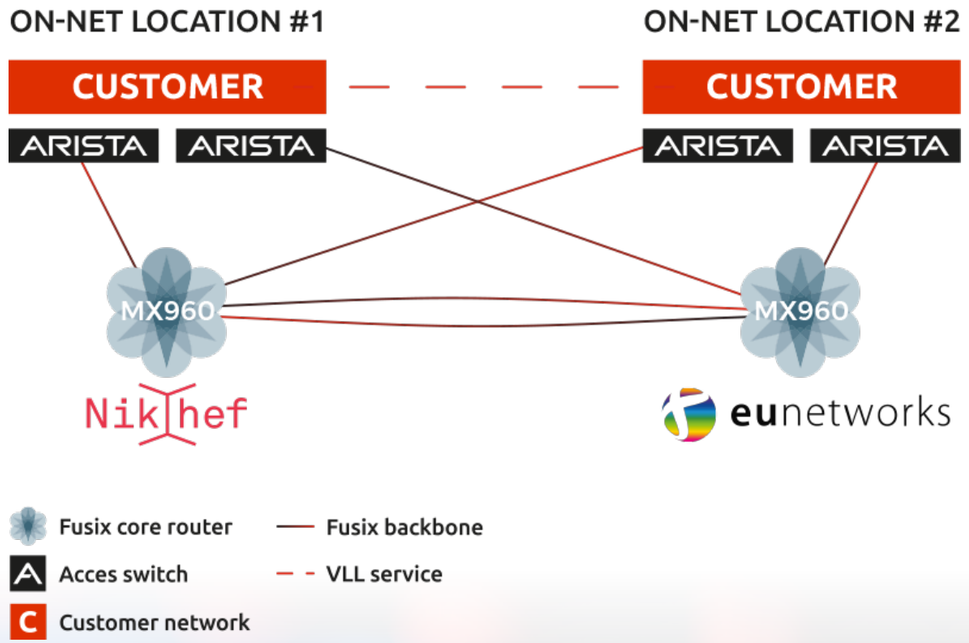
WDM transmission requires the use of WDM transceivers and one cross connect to the WDM provider per WDM link. To reduce your setup cost, we offer delivery of WDM transmission with a regular multi-mode or single mode (LR/SR) transceiver, so you can use a less expensive transceiver on your side.

WE OFFER FIXED OR DYNAMIC VLL CAPACITY WITH Q-IN-Q AND JUMBO FRAME CAPABILITIES (MAXIMUM TRANSFER UNIT AT LEAST 9000 BYTES)

Virtual Leased Line (VLL) is a data transmission service delivered on an Ethernet interface. It is a virtual layer 2 connection between two (or more) network nodes, also often referred to as "VLAN". It is useful, if you have network nodes at multiple data centers, wishing to consolidate them into one network with the same security, reliability, and manageability requirements of a private network. Using VLL, you avoid a cost of building and maintaining a fiber-optical network between your network nodes, while the main goal of a consolidated secure network is achieved.

A VLL can connect 2 data center locations point-to-point or one data center to multiple data centers point-to-multipoint. Each setup has the best practice configuration, however your specific use case may require a tailored solution, which we will be happy to offer. Make sure to call us and tell about your case. T: 0031 85 401 4441.

Further, VLL Service can have **redundancy**, meaning that we deliver 2 active VLLs, each of which uses a separate (redundant regarding each other) fiber path inside our backbone. Both VLLs are configured to behave as a single data transmission service with a double throughput.



Redundant fiber links (black) carry a point to point VLL service between two data centers

Projects

We have a dialog about your requirements, make a network design, suggest the right network equipment, configure and document your network. You can purchase network equipment from us to leverage our special discounts. Also, we assist you with receiving IP addresses from the Regional Internet Registry “RIPE NCC”, make an IP address plan and file your BGP policies with the Registry.

MAKE SURE TO TELL US ABOUT YOUR NETWORK PROJECT. TEL: 0031 85 401 4441

BGP policies define how your network responds to the users of the services that it offers on the Internet. Fusix consultants are BGP professionals, widely recognized in the Internet Service Provider community. They make sure that your business requirements are translated to the BGP language with nuances.

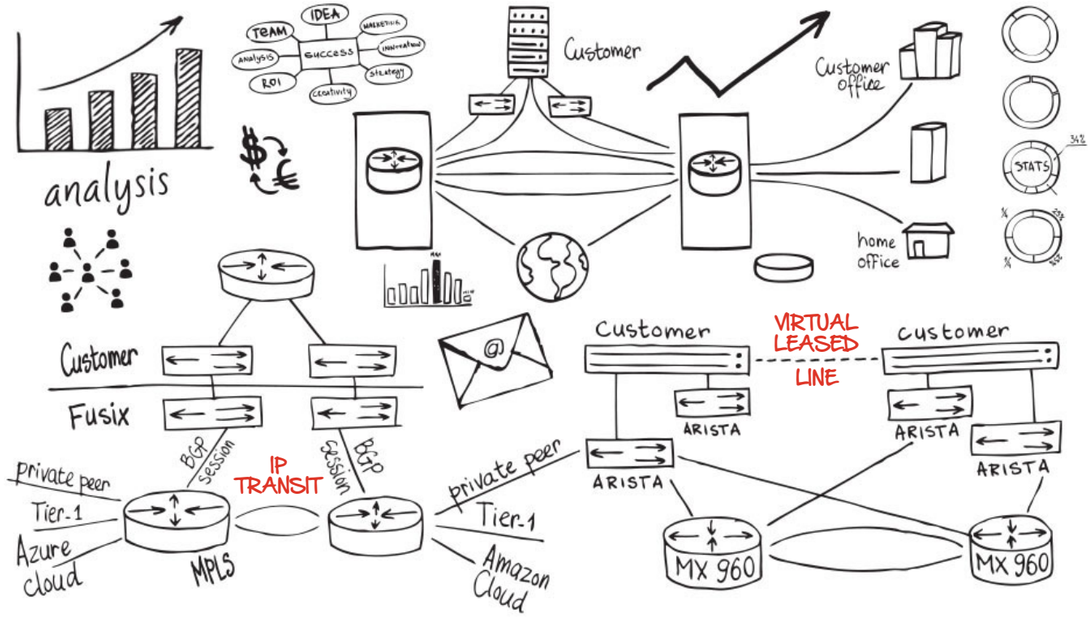
New IP network design and implementation

BEST-SELLER CONSULTANCY PROJECT

- IP network design:
  - ✓ address technical, business and budget requirements;
  - ✓ propose matching best practices for the network availability, integrity, scalability and security;
  - ✓ IP address plan;
  - ✓ network hardware and internal connectivity proposal;
  - ✓ optional quote for leasing network components;
  - ✓ assistance with registration of your business entity with the “RIPE NCC”, receiving IPv4 and IPv6 blocks and an AS number, filing of BGP policies
- detailed technical session with your technical team:
  - ✓ present a draft of your network design;
  - ✓ Q&A, joint brainstorming;
  - ✓ follow up adjustments of the design
- Design-implementation plan.
- Configuration of your core network (routers and switches);
- hands-on installation of your network in a data center;
- Network documentation.

We can also assist you with

- temporary connectivity or equipment lease for a migration project;
- a second consultant review of existing plans;
- the best industry practice layout for your infrastructure hosted in a data center;
- install and connect your IT infrastructure in a data center;
- 24/7 smart hands and eyes in any data center in the Netherlands;
- receiving hardware shipments in the Netherlands, intelligent unpacking with a video recording to control any damages on delivery;
- prepare your network hardware for installation in a data center, install and make it reachable for your team to configure remotely.



24/7 stand-by assistance with troubleshooting of your IP network

If anything goes wrong with your uplinks to the Internet or your private network, you would call your providers to make sure that the problem is not with the services that they deliver to you.

We suggest that you call us 24/7 also for assistance with troubleshooting your own network. **We help you to solve a problem regardless of where the source of the problem is.**

WE KNOW YOUR IP NETWORK AND CAN HELP QUICKLY

We add your routers and switches to our network monitoring systems, so when you need our assistance, we already have all technical information available. Also, our network management system will regularly backup the configuration of your routers and switches, so we can restore the config or roll it back to the previous version.

The Fusix NOC will help you as soon as possible 24/7. Competent troubleshooting of your network will start within a guaranteed response time:

BASIC: a qualified NOC engineer will start troubleshooting your IP network within 4 hours

PREMIUM: a qualified NOC engineer will start troubleshooting your IP network within 2 hours

GUARANTEED 24/7 STAND-BY

Consult with us about management of your IP network. We are glad to share our knowledge and experience and grow together. Ask us any question about network monitoring solutions, BGP security, configuration change, tuning of BGP policies, DDoS mitigation, adding another Internet uplink to your network, network equipment that meets the requirements of your next project and more. **We are here for your network.**

Our consultants are recognized and well know enthusiasts within the Internet Service Provider community. Among the recent activities is the book of our CTO Niels Raijer written together with Melchior Aelmans (Juniper Networks). Niels has also the role of Vice President at the Netherlands Network Operations Group (www.nlnog.net) and regularly shares his thoughts with the Group members. Use the QR-code to view Niels talking about BGP routing security decisions for managers and read his networking blog at https://fusix.nl/category/blog-from-niels/.



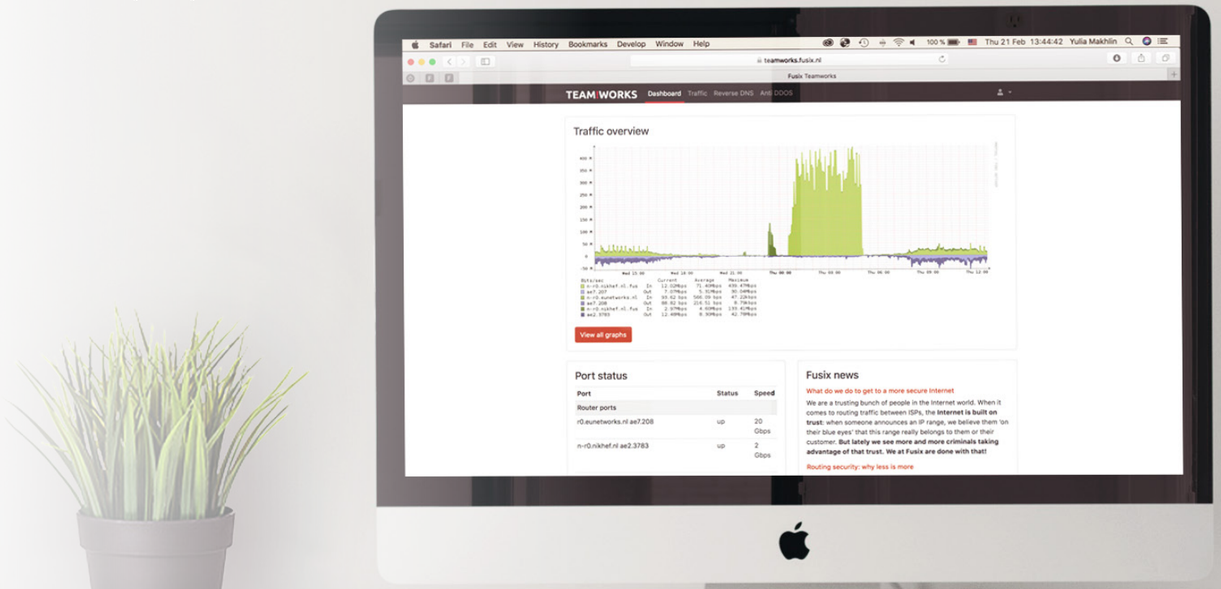
Team!Works

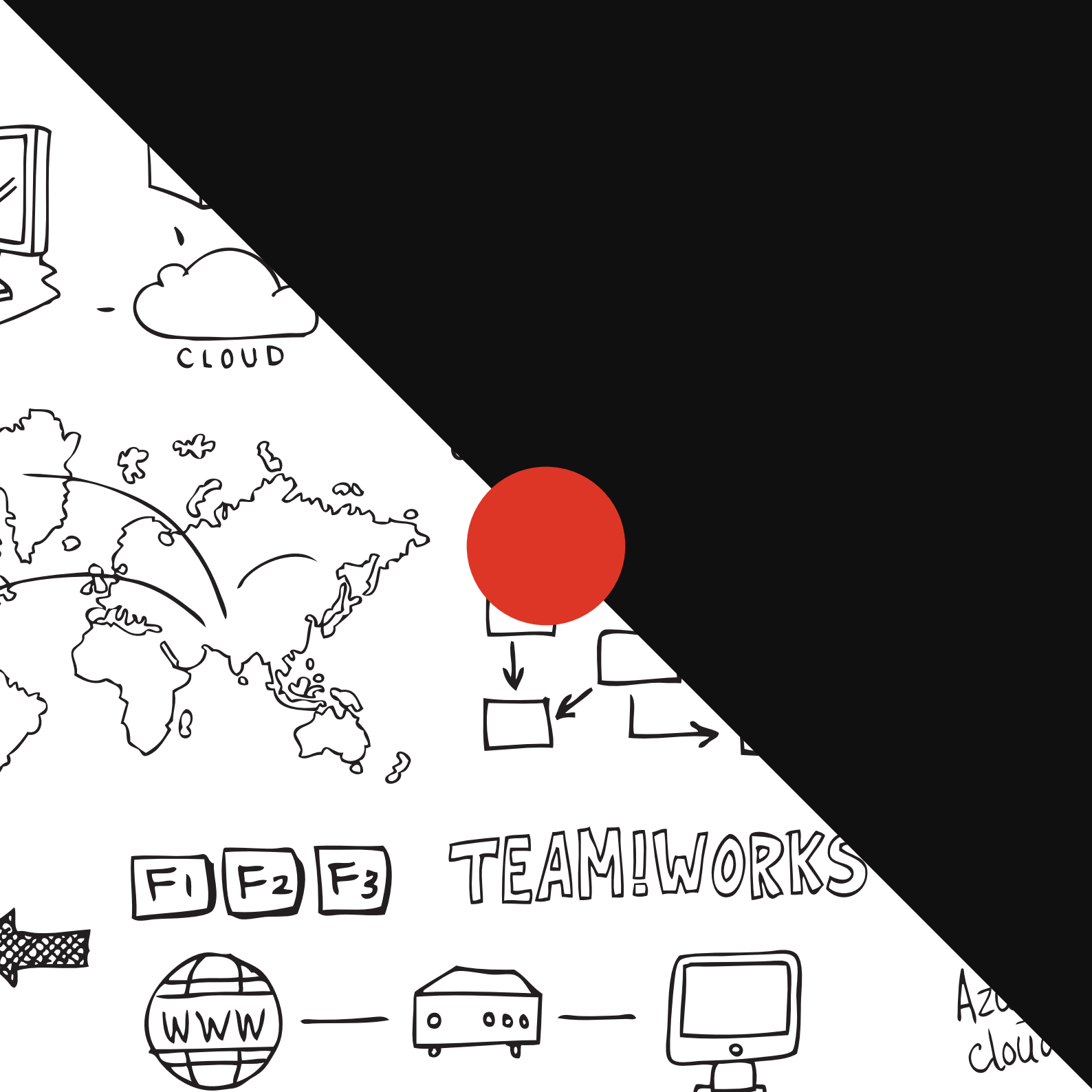
Team!works is our customer portal where we share our networking expertise.
The portal provides **real-time information** and self-service tools for routine management and troubleshooting of your connections to the Fusix backbone. The tools are fully integrated with the management platform of the Fusix backbone, which guarantees that you have 24/7 immediate access to relevant information and can respond to network security threats, such as DDoS attack without any delay.

In a snapshot, the portal provides (in January 2019):

- Bandwidth usage statistics;
- Network flow statistics;
- Status of your Internet service delivery ports;
- Pro-active alert by e-mail and by sms on the status of your BGP sessions;
- Automated processing of your IP-prefix changes;
- Reverse DNS;
- DDoS mitigation tools:
  - ✓ global blackholing;
  - ✓ blackholing outside Netherlands;
  - ✓ preventive blocking: ICMP and UDP traffic filtering.

New features are added regularly!




CLOUD
F1 F2 F3
TEAM!WORKS
WWW