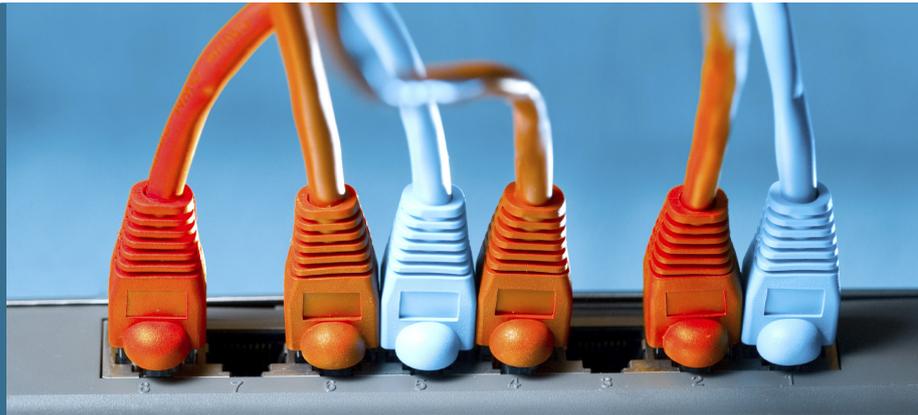


**SOLUTION BRIEF**

## Adding LTE/4G access to Ethernet



Carrier Ethernet services provide a scalable and flexible way to carry any type of data traffic over Wide Area Networks and is often selected as technology of choice for building corporate networks or for interconnecting datacentres. Most often fiber is used to carry Ethernet traffic although DSL connections are still used for establishing access to remote sites where fiber is not yet available. 4G/LTE is best known for providing data connectivity to smartphones, but it can also be used for temporary or permanent connections for enterprise connectivity. Despite the fact that the technology is not optimized for carrying Ethernet traffic, it can bring real added value as alternative access technology and provides connectivity where fixed networks cannot be made available in the short term.

### Network Resilience



As more and more business-critical applications require uninterrupted network connectivity 24 by 7, special care needs to be taken to ensure connectivity at all times, even if failures occur in some parts of the network. This is also the case for the access network, bridging between the core of the network and the actual customer premises. End-to-end backup in Carrier-Ethernet networks can be implemented using G.8031, selecting an alternative transmission path when the main link is broken or unavailable. This alternative connectivity can be provided by LTE/4G and although the bandwidth of the backup medium might not be sufficient for a 1-to-1 backup it is still possible to reschedule priorities to support most business-critical applications.

### Temporary or Permanent Connections



There are many examples of temporary network setups which can benefit from the advantages of Carrier Ethernet to justify the use of 4G/LTE as main data carrier. Construction sites, large entertainment events and mobile events are examples of situations where large and diverse data volumes need to be exchanged with datacentres.

Carrier Ethernet networks can also extend connectivity over 4G/LTE to places where no or limited fixed networks are available. This is especially the case for large countries where rural areas are often underserved in terms of network connectivity. In these cases 4G connectivity can be a valid alternative to extend Carrier Ethernet to these places.

### Ethernet over 4G/LTE



4G networks do not provide native Ethernet connectivity and Ethernet traffic has to be encapsulated in IP frames before being able to be carried over the 4G network. The preferred encapsulation protocol for this purpose is GRE because it is supported by most backbone network equipment. The alternative for GRE is L2TPv3, which is also implemented by most PE router vendors. GRE has some preference because it has the option to automatically fragment and reassemble data packets in case the MTU is larger than the MTU of the underlying IP network. It is advised to avoid the need for fragmentation, but when it is needed, GRE supports it.

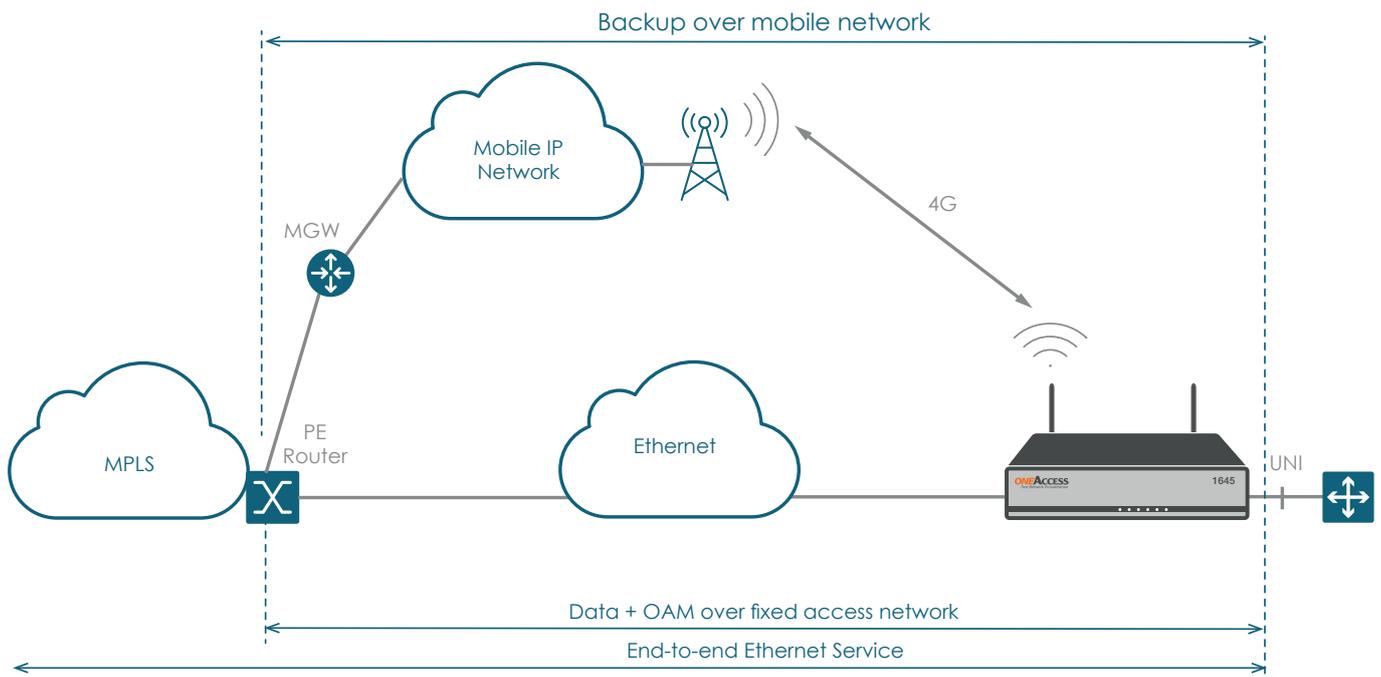
## Use Case: Backup of Ethernet Access with 4G/LTE



The access network of carrier Ethernet can be protected using the 4G/LTE network as alternative data path in case the main fiber link would be broken. In this example, the access network is between the PE router and the actual demarcation device, installed at the customer premises. Both data and OAM (Operation And Maintenance) frames are exchanged over this link. OAM frames are used by the Y.1731 protocol to measure link availability, loss, delay and jitter. It is possible to define thresholds based on these parameters to express the need to switch over to an alternative path. If e.g. packet loss exceeds 10%, the main link must be switched over to an alternative link.

The actual backup action is taken by the implemented G.8031 standard which provides a mechanism to switch the data to the alternative path, in this case the 4G connection. Before Ethernet data is sent over the 4G link it is encapsulated by the CPE in a GRE tunnel. At the same time, traffic priorities might be rescheduled because the available bandwidth on 4G is most likely not the same as on the main fiber link. The Mobile Gateway (MGW) brings the IP traffic back to the PE routers which will terminate the GRE tunnels and switch the traffic back to its normal route.

See below for the network diagram of this setup:



## Product supporting Ethernet Backup over 4G

Below are the products supporting backup of Ethernet over 4G:

Models	Technology	WAN	Backup	LAN	Throughput	MEF
1645	Fiber	GigE	GigE, SHDSL.bis, VDSL2, 4G/LTE	4-port GigE	500 Mbps	2.0 certified
1646	Fiber	GibE	GigE, 4G/LTE	4-port GigE	1 Gbps	2.0 compliant

Below is an overview of the main feature set:

Features	Details
MEF services	E-Line, E-LAN, E-Tree E-Access, E-transit (on selected products only)
Ethernet frame handling	L2 Access Lists, L2PT Tunneling, Configurable L2CP transparency, Configurable multicast traffic behaviour
VLAN support	VLAN Tagging, VLAN Switching, Port-based VLANs, QinQ, 802.1ad
QoS	Up to 8 traffic classes, Egress Shaping, Ingress Policing, Hierarchical QoS per EVC and EVC CoS (selected products only)
SLA monitoring	Link OAM, CFM OAM, Y.1731, Link-State Tracking, Dying Gasp, TWAMP
Service Activation Tsetting	RFC2544, Y.1564 with birth certificate
Protection Mechanisms	LAG/LACP (local link protection), G.8031 (end-to-end protection)
Tunneling L2 over L3	GRE
Zero-Touch provisioning	DHCP-based or TR-069, OneManage Provisioning Server
Management	CLI, SNMP, NETCONF/YANG (1651-only)

For more detailed information please refer to <http://www.ekinops.com> under Access Products.

## About Ekinops

Ekinops is a leading provider of open and fully interoperable Layer 1, 2 and 3 solutions to service providers around the world. Our programmable and highly scalable solutions enable the fast, flexible and cost-effective deployment of new services for both high-speed, high-capacity optical transport networks and virtualization-enabled managed enterprise services

Our product portfolio consists of three highly complementary product and service sets: Ekinops360, OneAccess and Compose.

- Ekinops360 provides optical transport solutions for metro, regional and long-distance networks with WDM for high-capacity point-to-point, ring and optical mesh architectures, and OTN for improved bandwidth utilization and efficient multi-service aggregation.
- OneAccess offers a wide choice of physical and virtualized deployment options for Layer 2 and Layer 3 access network functions.
- Compose supports service providers in making their networks software-defined with a variety of software management tools and services, including the scalable SD-WAN Xpress.

As service providers embrace SDN and NFV deployment models, Ekinops enables future-proofed deployment today, enabling operators to seamlessly migrate to an open, virtualized delivery model at a time of their choosing.

A global organization, with operations in 4 continents; Ekinops (EKI) - a public company traded on the Euronext Paris exchange - is headquartered in Lannion, France, and Ekinops Corp., a wholly-owned subsidiary, is incorporated in the USA.

