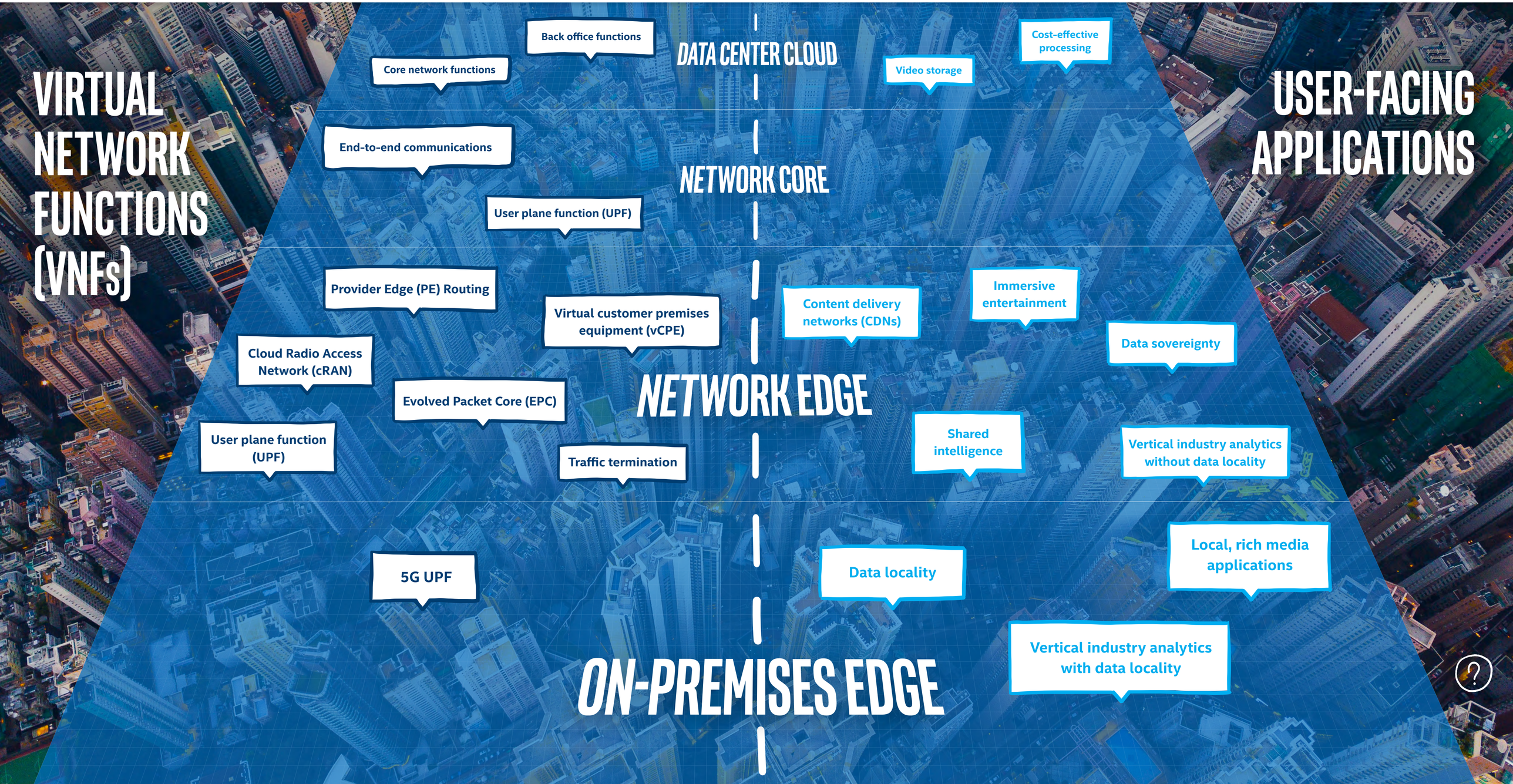
EXPLORE THE EDGE

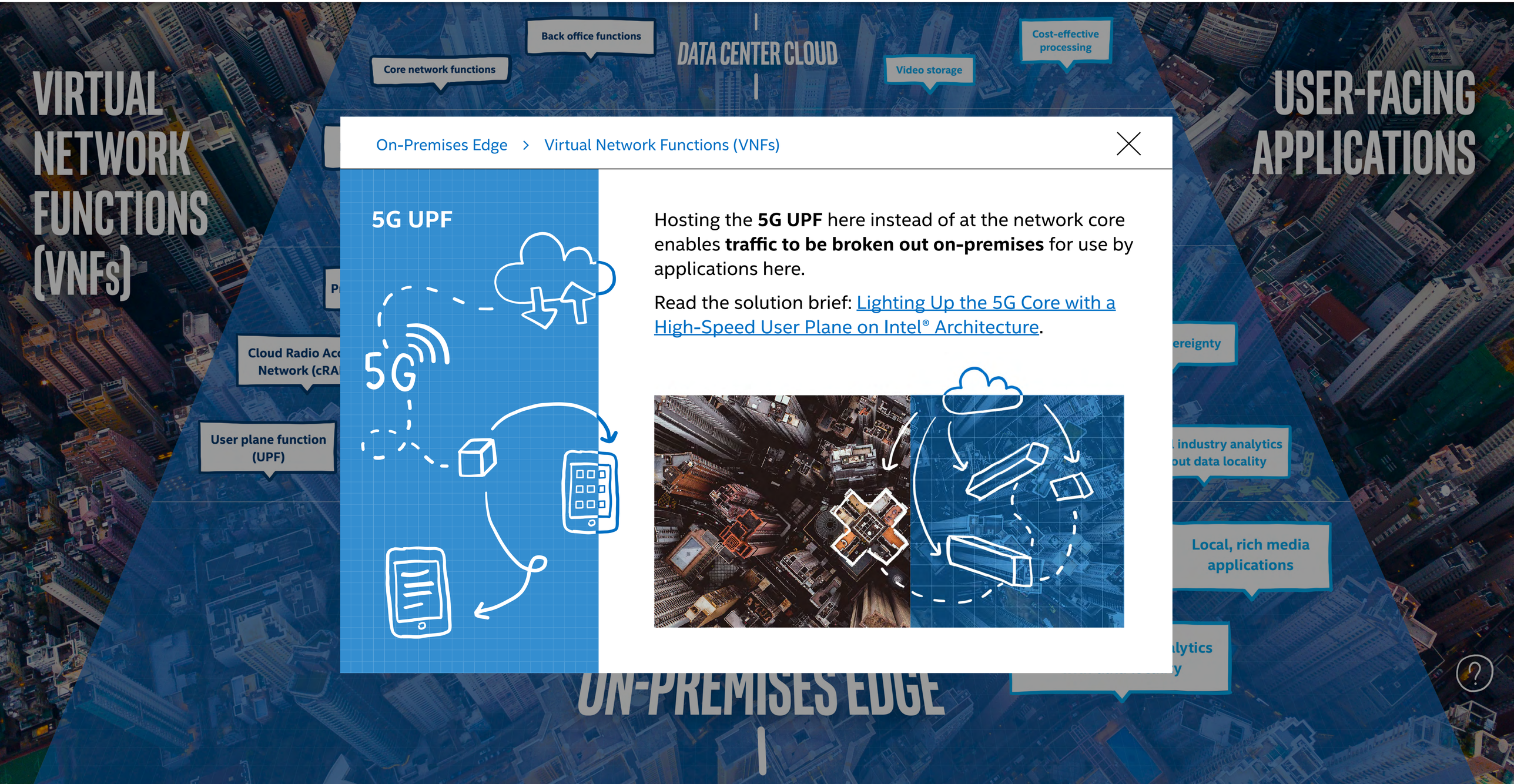
How can Communications Service Providers (CoSPs) deliver new services based on 5G, and benefit from its low-latency and high-bandwidth capabilities?

Part of the solution is to host user-facing applications and virtual network functions (VNFs) at the edge of the network.

Our interactive diagram shows where various applications and VNFs could run. Click their labels to find out more.

EXPLORE THE INTERACTIVE DIAGRAM >


VIRTUAL NETWORK FUNCTIONS (VNFs)
USER-FACING APPLICATIONS
DATA CENTER CLOUD
Back office functions
Core network functions
Video storage
Cost-effective processing
NETWORK CORE
End-to-end communications
User plane function (UPF)
NETWORK EDGE
Provider Edge (PE) Routing
Virtual customer premises equipment (vCPE)
Content delivery networks (CDNs)
Immersive entertainment
Data sovereignty
Cloud Radio Access Network (cRAN)
Evolved Packet Core (EPC)
User plane function (UPF)
Traffic termination
Shared intelligence
Vertical industry analytics without data locality
ON-PREMISES EDGE
5G UPF
Data locality
Local, rich media applications
Vertical industry analytics with data locality

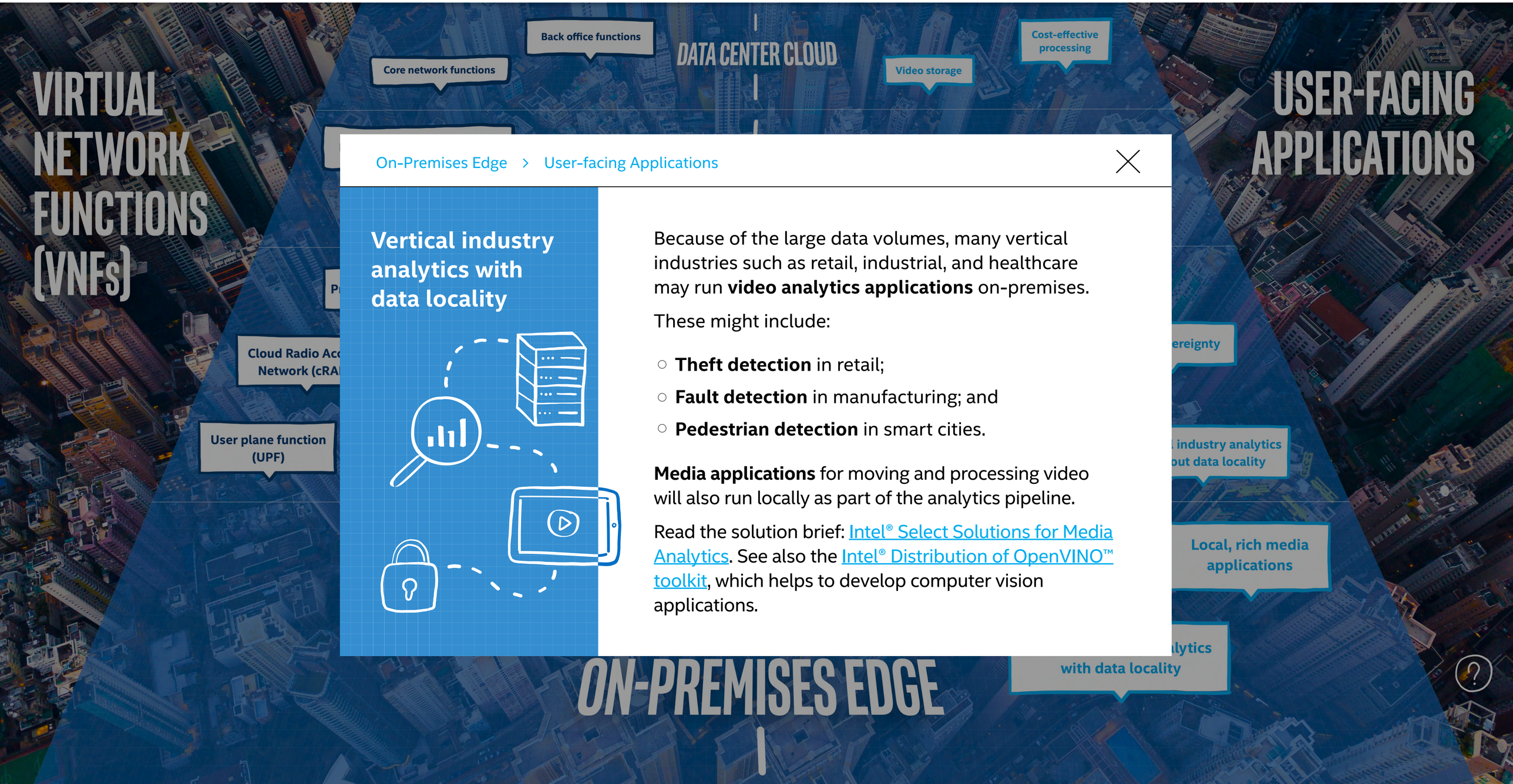


On-Premises Edge > Virtual Network Functions (VNFs)

5G UPF

Hosting the **5G UPF** here instead of at the network core enables **traffic to be broken out on-premises** for use by applications here.

Read the solution brief: [Lighting Up the 5G Core with a High-Speed User Plane on Intel® Architecture](#).



On-Premises Edge > User-facing Applications

Vertical industry analytics with data locality

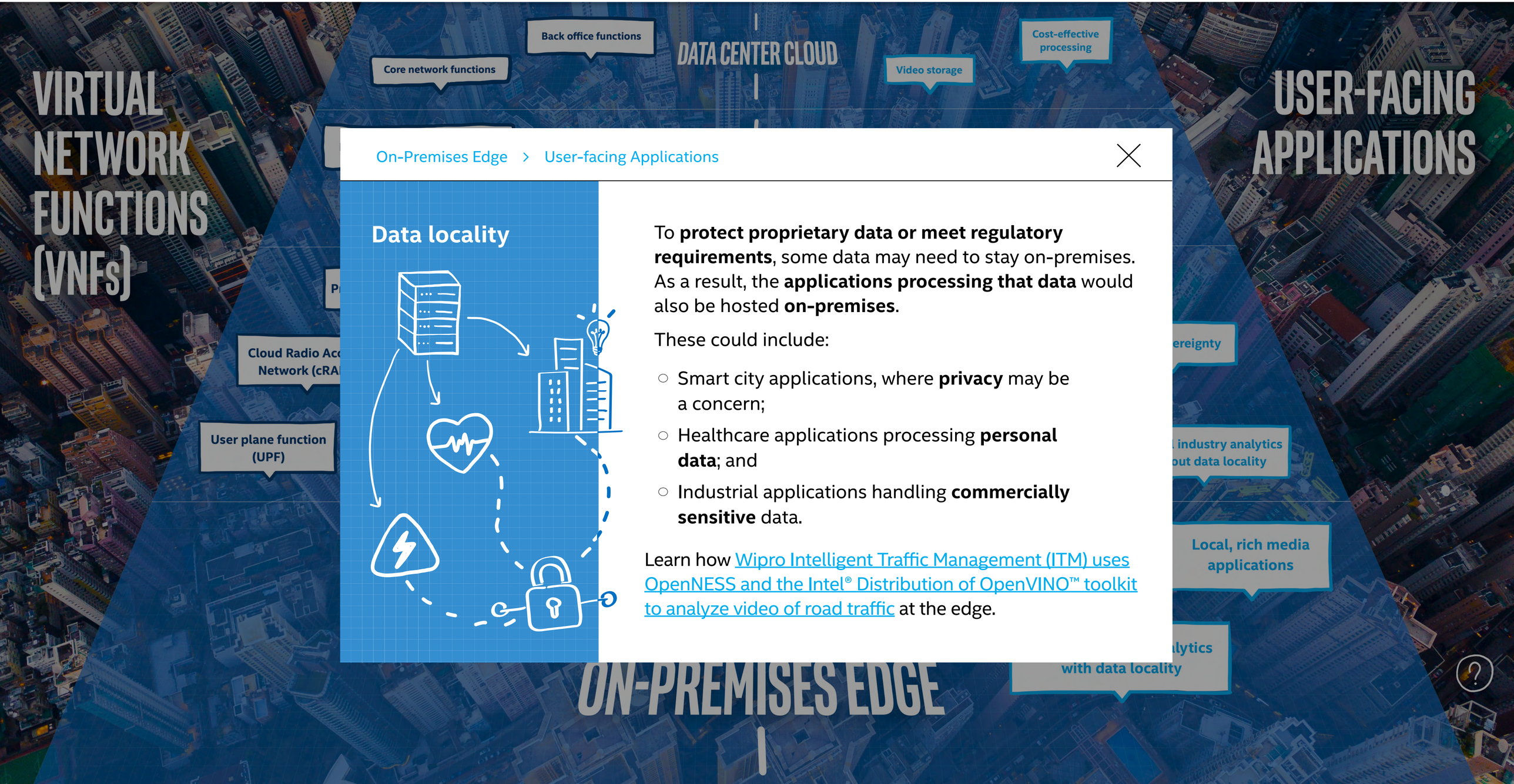
Because of the large data volumes, many vertical industries such as retail, industrial, and healthcare may run **video analytics applications** on-premises.

These might include:

- **Theft detection** in retail;
- **Fault detection** in manufacturing; and
- **Pedestrian detection** in smart cities.

Media applications for moving and processing video will also run locally as part of the analytics pipeline.

Read the solution brief: Intel® Select Solutions for Media Analytics. See also the Intel® Distribution of OpenVINO™ toolkit, which helps to develop computer vision applications.



On-Premises Edge > User-facing Applications

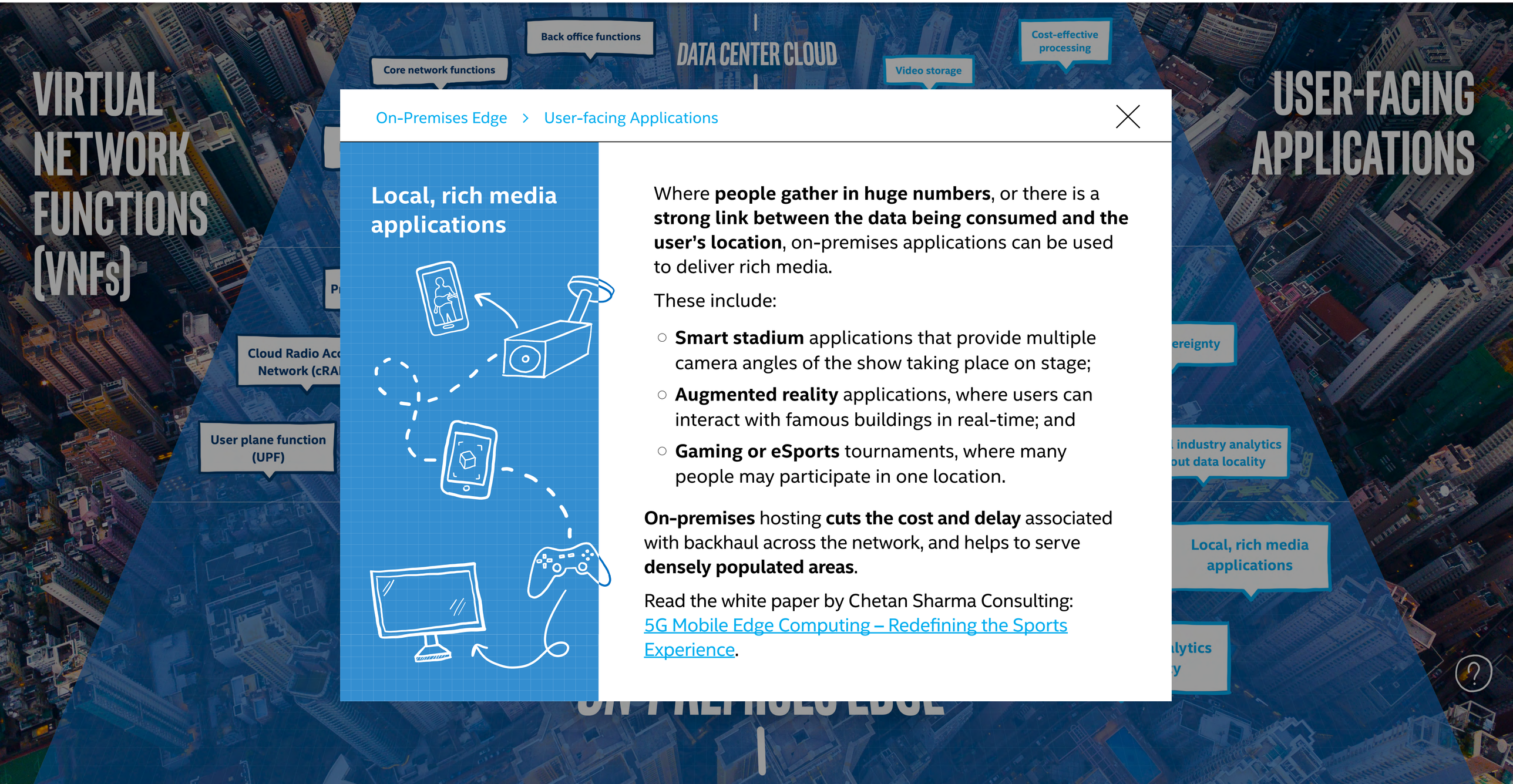
Data locality

To **protect proprietary data or meet regulatory requirements**, some data may need to stay on-premises. As a result, the **applications processing that data** would also be hosted **on-premises**.

These could include:

- Smart city applications, where **privacy** may be a concern;
- Healthcare applications processing **personal data**; and
- Industrial applications handling **commercially sensitive** data.

Learn how Wipro Intelligent Traffic Management (ITM) uses OpenNESS and the Intel® Distribution of OpenVINO™ toolkit to analyze video of road traffic at the edge.



On-Premises Edge > User-facing Applications

Local, rich media applications

Where **people gather in huge numbers**, or there is a **strong link between the data being consumed and the user's location**, on-premises applications can be used to deliver rich media.

These include:

- **Smart stadium** applications that provide multiple camera angles of the show taking place on stage;
- **Augmented reality** applications, where users can interact with famous buildings in real-time; and
- **Gaming or eSports** tournaments, where many people may participate in one location.

On-premises hosting **cuts the cost and delay** associated with backhaul across the network, and helps to serve **densely populated areas**.

Read the white paper by Chetan Sharma Consulting: 5G Mobile Edge Computing – Redefining the Sports Experience.

VIRTUAL NETWORK FUNCTIONS (VNFs)

Back office functions

Core network functions

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

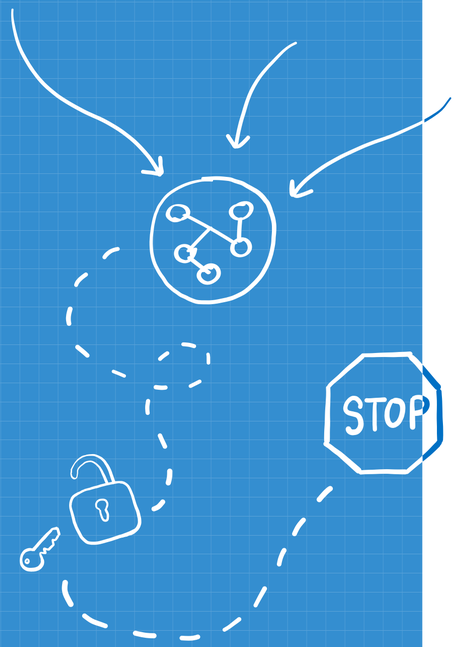
industry analytics
out data locality

Local, rich media applications

lytics
with data locality

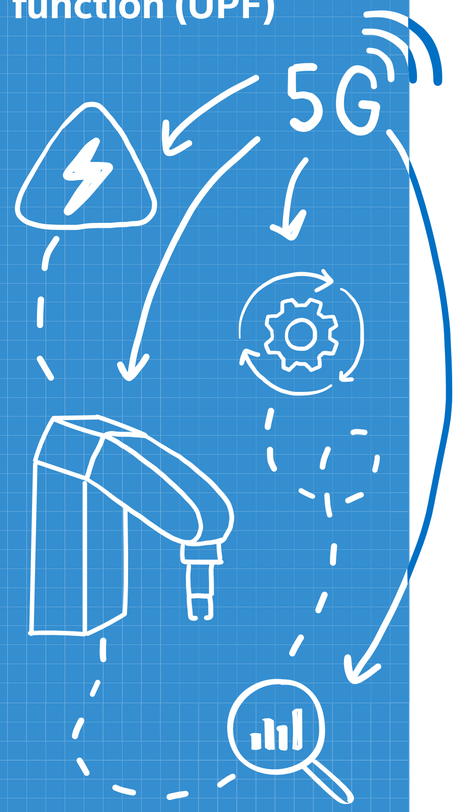
ON-PREMISES EDGE

Traffic termination



To enable **traffic** to be processed in the network edge, it must be **broken out locally**. The broadband network gateway (BNG), cable modem termination system (CMTS), and distributed 4G/5G mobile core can be hosted at the network edge.

User plane function (UPF)



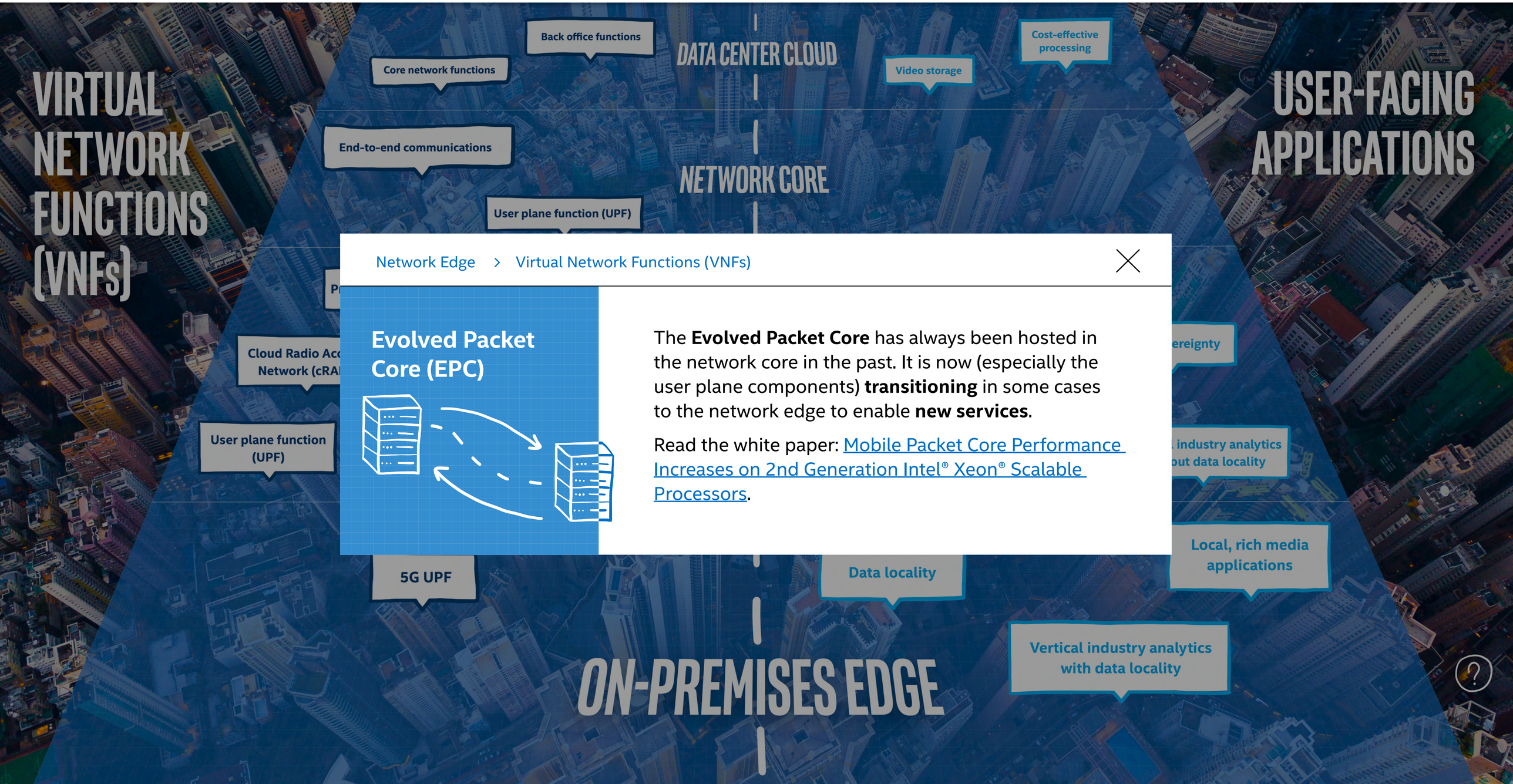
Hosting the **mobile core UPF** at the network edge supports **ultra-reliable low-latency communications (URLLC) in 5G**.

Applications include:

- **Factory automation applications**, which may require a rapid response to avoid risk of damage to work-in-progress or machinery;
- **Robotics applications**, which need to be able to navigate a changing environment in real time; and
- **Intelligent transportation systems**, which must respond quickly to passengers and other vehicles.

Note: For **extremely low latency** requirements the **UPF may need to reside on-premises**, together with control plane components such as the Access and Mobility Management Function (AMF), Session Management Function (SMF) and Unified Data Management (UDM).

Read the solution brief: [Lighting Up the 5G Core with a High-Speed User Plane on Intel® Architecture](#).

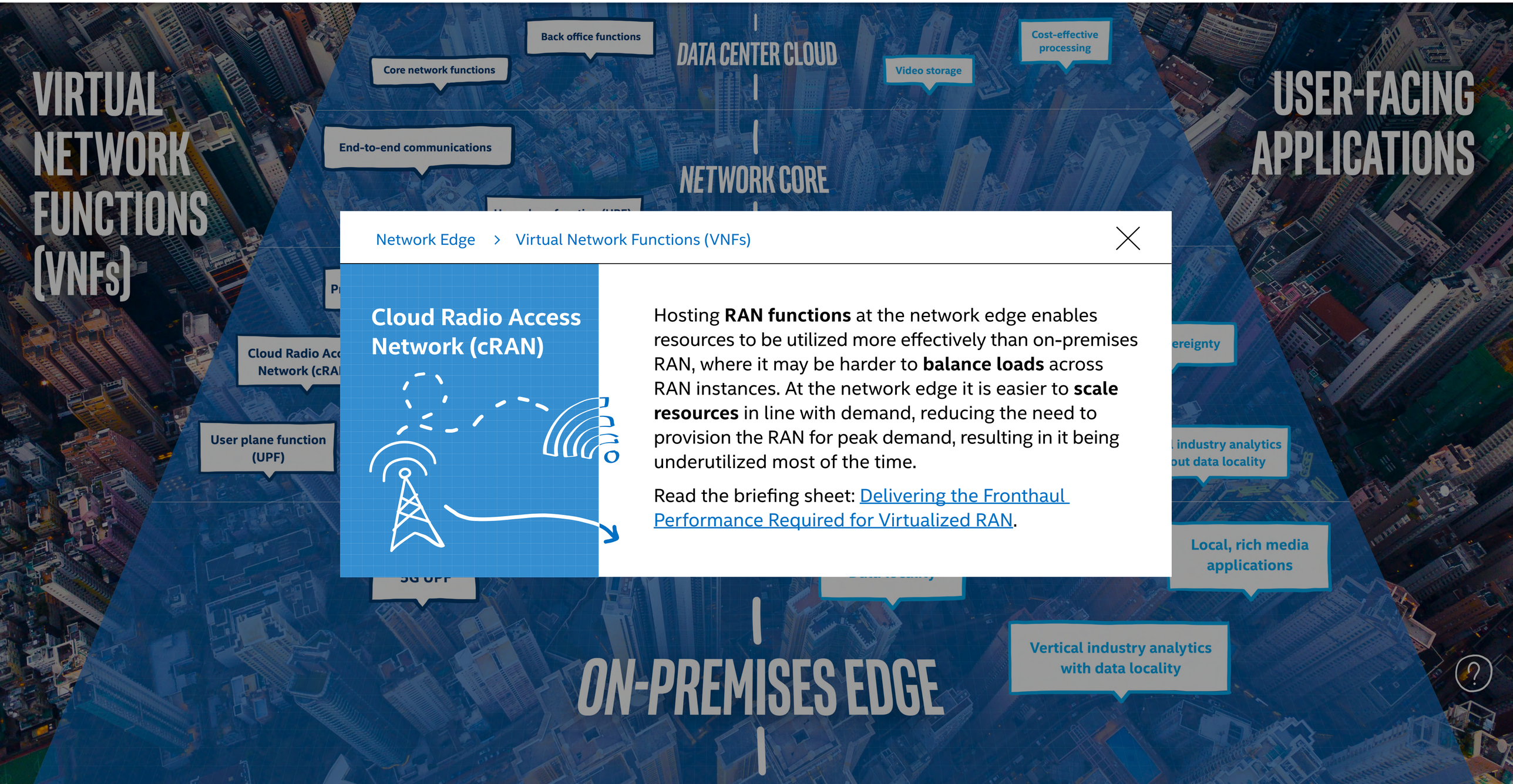


Network Edge > Virtual Network Functions (VNFs)

Evolved Packet Core (EPC)

The **Evolved Packet Core** has always been hosted in the network core in the past. It is now (especially the user plane components) **transitioning** in some cases to the network edge to enable **new services**.

Read the white paper: [Mobile Packet Core Performance Increases on 2nd Generation Intel® Xeon® Scalable Processors].

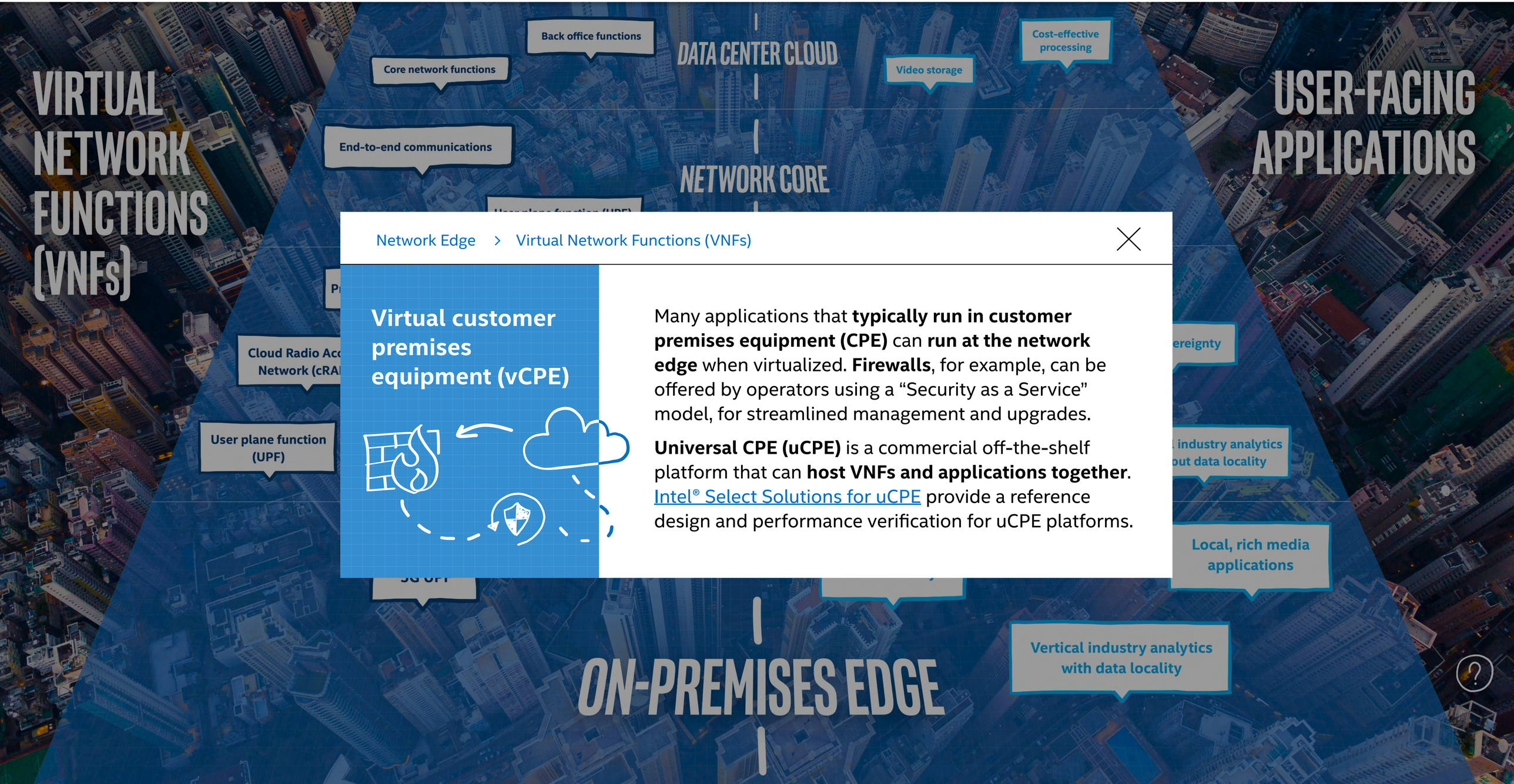


Network Edge > Virtual Network Functions (VNFs)

Cloud Radio Access Network (cRAN)

Hosting **RAN functions** at the network edge enables resources to be utilized more effectively than on-premises RAN, where it may be harder to **balance loads** across RAN instances. At the network edge it is easier to **scale resources** in line with demand, reducing the need to provision the RAN for peak demand, resulting in it being underutilized most of the time.

Read the briefing sheet: Delivering the Fronthaul Performance Required for Virtualized RAN.



Network Edge > Virtual Network Functions (VNFs)

Virtual customer premises equipment (vCPE)

Many applications that **typically run in customer premises equipment (CPE)** can **run at the network edge** when virtualized. **Firewalls**, for example, can be offered by operators using a "Security as a Service" model, for streamlined management and upgrades.

Universal CPE (uCPE) is a commercial off-the-shelf platform that can **host VNFs and applications together**. Intel® Select Solutions for uCPE provide a reference design and performance verification for uCPE platforms.

VIRTUAL NETWORK FUNCTIONS (VNFs)

Back office functions

Core network functions

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

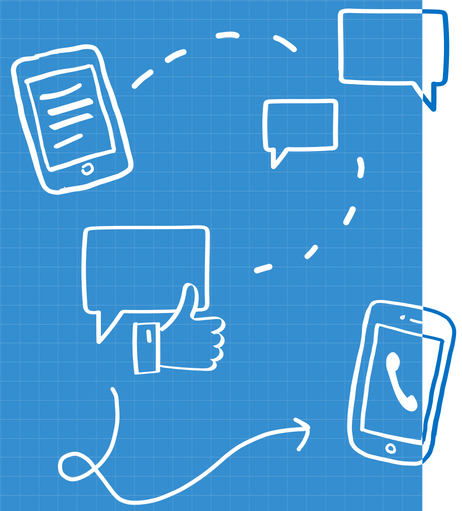
industry analytics
out data locality

Local, rich media applications

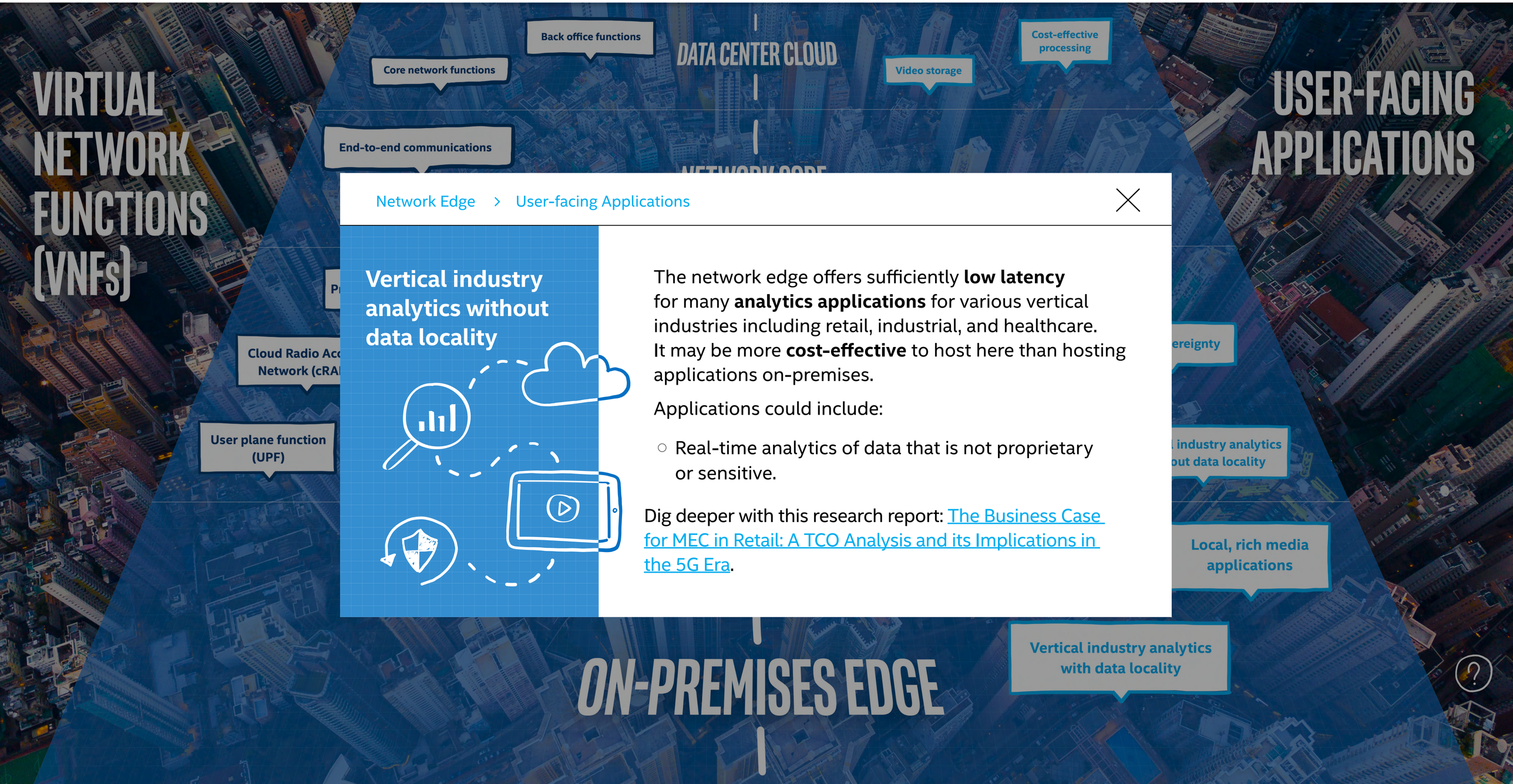
Vertical industry analytics with data locality

ON-PREMISES EDGE

Provider Edge (PE) routing



PE Routing is used to **manage traffic and subscriber sessions** from an **enterprise** connecting to the CoSP's network. It is typically hosted in the network edge today.



Network Edge > User-facing Applications

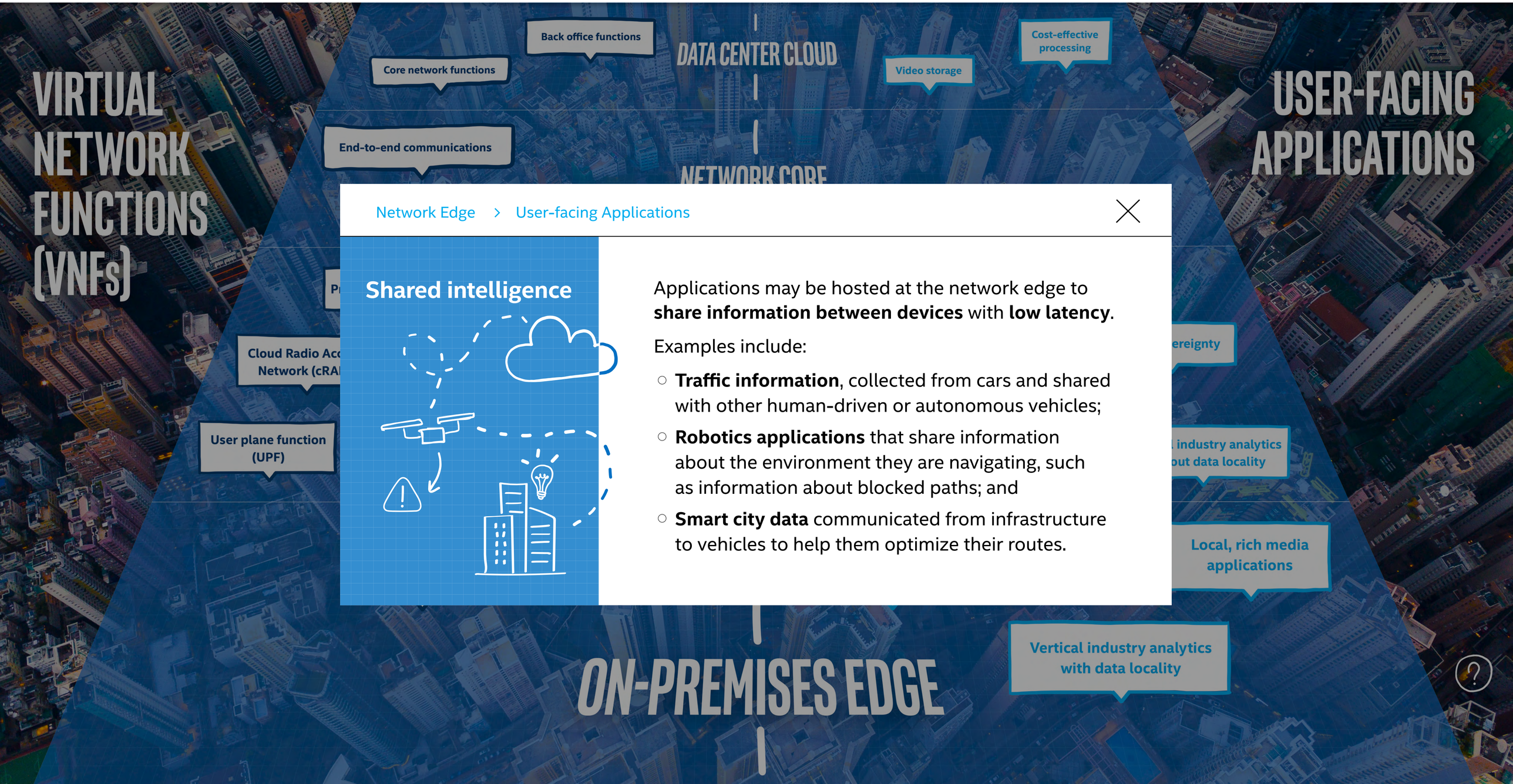
Vertical industry analytics without data locality

The network edge offers sufficiently **low latency** for many **analytics applications** for various vertical industries including retail, industrial, and healthcare. It may be more **cost-effective** to host here than hosting applications on-premises.

Applications could include:

- Real-time analytics of data that is not proprietary or sensitive.

Dig deeper with this research report: [The Business Case for MEC in Retail: A TCO Analysis and its Implications in the 5G Era].



Network Edge > User-facing Applications

Shared intelligence

Applications may be hosted at the network edge to **share information between devices** with **low latency**.

Examples include:

- **Traffic information**, collected from cars and shared with other human-driven or autonomous vehicles;
- **Robotics applications** that share information about the environment they are navigating, such as information about blocked paths; and
- **Smart city data** communicated from infrastructure to vehicles to help them optimize their routes.

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Core network functions

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

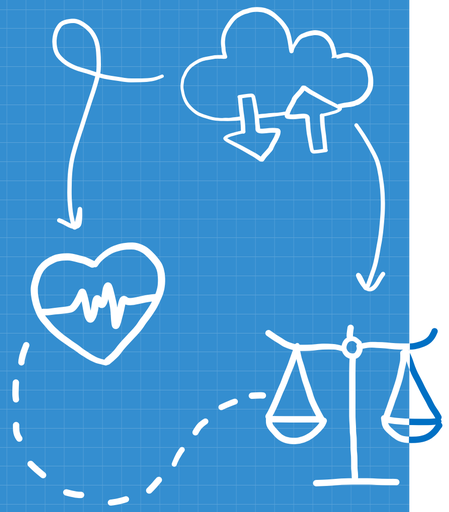
industry analytics
out data locality

Local, rich media applications

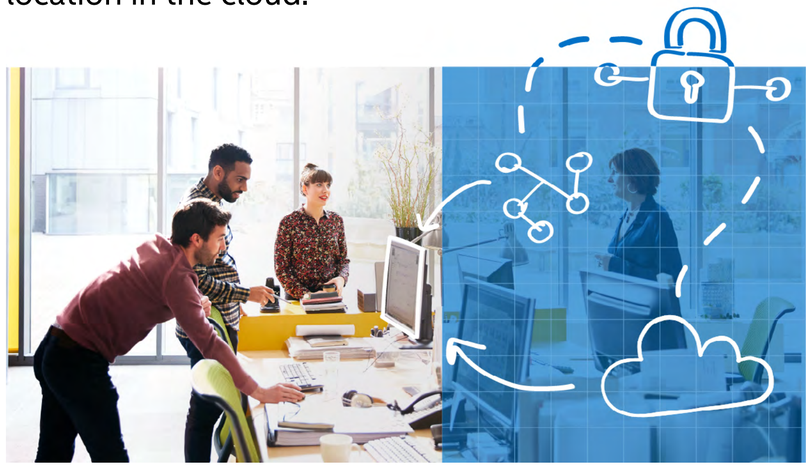
lytics
with data locality

ON-PREMISES EDGE

Data sovereignty



Edge storage is another prevalent use case for the network edge. Certain sectors (such as legal and medical) may be required to **store data in a particular region or country**, rather than sending it to an unknown location in the cloud.



VIRTUAL NETWORK FUNCTIONS (VNFs)

Back office functions

Core network functions

End-to-end communications

DATA CENTER CLOUD

Video storage

Cost-effective processing

NETWORK CORE

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

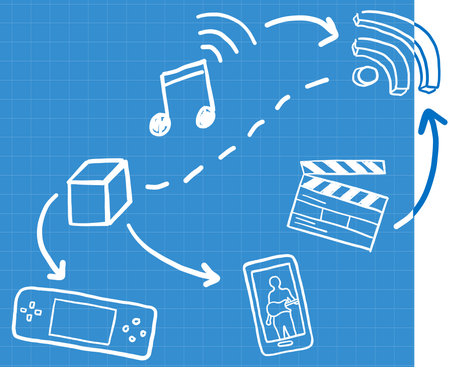
industry analytics
out data locality

Local, rich media applications

Vertical industry analytics with data locality

ON-PREMISES EDGE

Content delivery networks (CDNs)



Blockbuster movies, music and even web pages can all benefit from being hosted at the **network edge**.

Applications include:

- **Caching of popular web content** to speed up access and cut backhaul across the network; and
- **Caching movies and streaming content** to cut access times.

Intel® Select Solutions for Visual Cloud Delivery Network reference designs help to accelerate the development of next-generation CDNs, based on Intel® Xeon® processors.

VIRTUAL NETWORK FUNCTIONS (VNFs)

Back office functions

Core network functions

End-to-end communications

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

industry analytics
out data locality

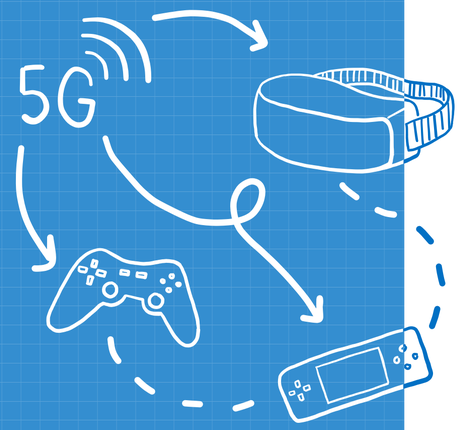
Local, rich media applications

Vertical industry analytics with data locality

ON-PREMISES EDGE

Network Edge > User-facing Applications

Immersive entertainment



We will be able to enjoy **more immersive entertainment**, thanks to 5G's higher bandwidth, lower latency, and support for many more devices. To deliver huge volumes of data at low latency, entertainment applications may be **hosted at the edge**.

These include:

- **Real-time multiplayer games**; and
- **Virtual reality applications**.

Read the white paper: Rethinking Visual Cloud Services for Evolving Media.

Network Core > Virtual Network Functions (VNFs)

User plane function (UPF)

When there is no need for data to be broken out for on-premises apps and there is no need for ultra-reliable ultra-low latency communications (URLLC) in 5G, there may be greater **economies of scale** in hosting the **UPF** in the **network core**.

Read the solution brief: Lighting Up the 5G Core with a High-Speed User Plane on Intel® Architecture.

VIRTUAL NETWORK FUNCTIONS (VNFs)

Back office functions

Core network functions

End-to-end communications

Cloud Radio Acc
Network (cRA

User plane function (UPF)

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

ereignty

industry analytics
out data locality

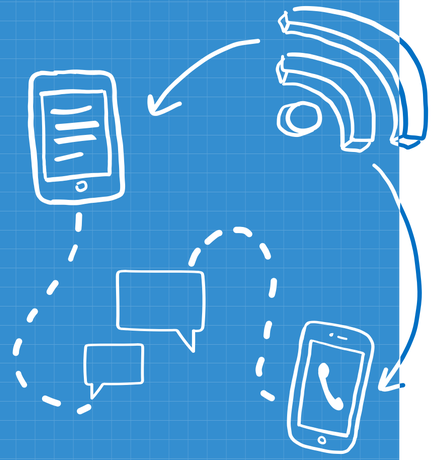
Local, rich media applications

Vertical industry analytics with data locality

ON-PREMISES EDGE

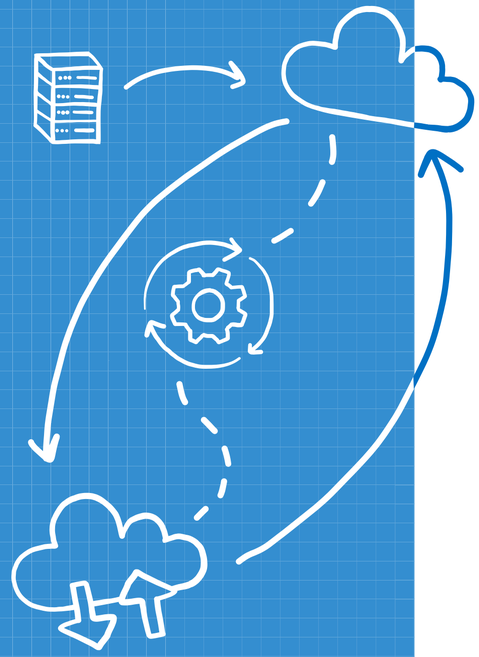
Network Core > Virtual Network Functions (VNFs)

End-to-end communications

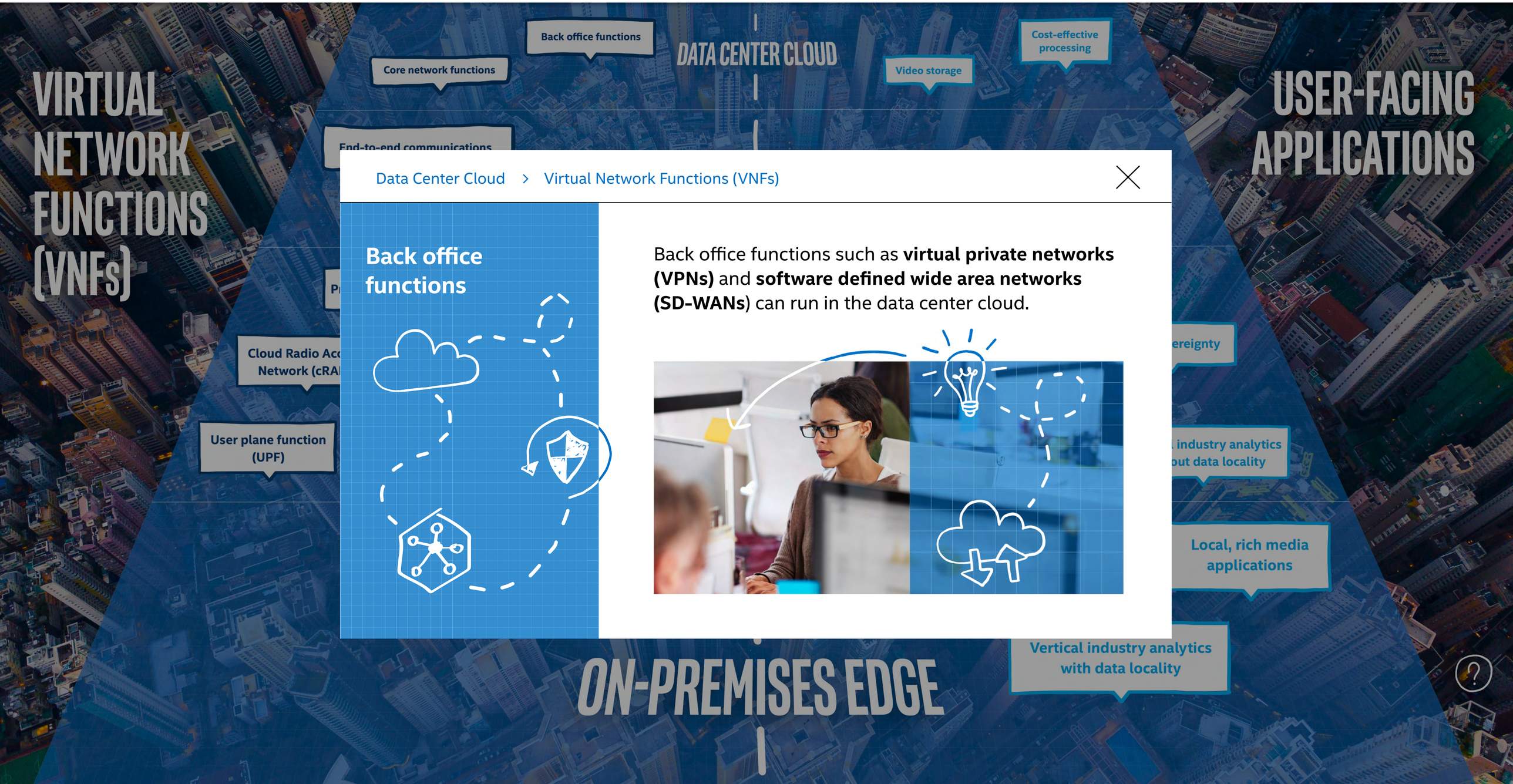


VNFs that do not migrate to the edge or cloud will continue to be hosted in the **network core**, including **voice calls** and **internet access**.

Core network functions



One emerging business model sees virtualized network functions for the **core network** migrating to **hyperscale public cloud** providers. Hosting network functions in the public cloud could help with **scalability**, and prove particularly attractive to **mobile virtual network operators (MVNOs)**, which have no infrastructure of their own.


VIRTUAL NETWORK FUNCTIONS (VNFs)
Back office functions
Core network functions
DATA CENTER CLOUD
Video storage
Cost-effective processing
USER-FACING APPLICATIONS
End-to-end communications
Cloud Radio Acc
Network (cRA
User plane function (UPF)
ereignty
industry analytics
out data locality
Local, rich media applications
Vertical industry analytics with data locality
ON-PREMISES EDGE
Data Center Cloud > Virtual Network Functions (VNFs)
Back office functions
Back office functions such as virtual private networks (VPNs) and software defined wide area networks (SD-WANs) can run in the data center cloud.

VIRTUAL NETWORK FUNCTIONS (VNFs)

Core network functions

Back office functions

DATA CENTER CLOUD

Video storage

Cost-effective processing

USER-FACING APPLICATIONS

Cloud Radio Acc
Network (cRA

User plane function (UPF)

ereignty

industry analytics
out data locality

Local, rich media applications

lytics
with data locality

UN-PREMISES EDGE

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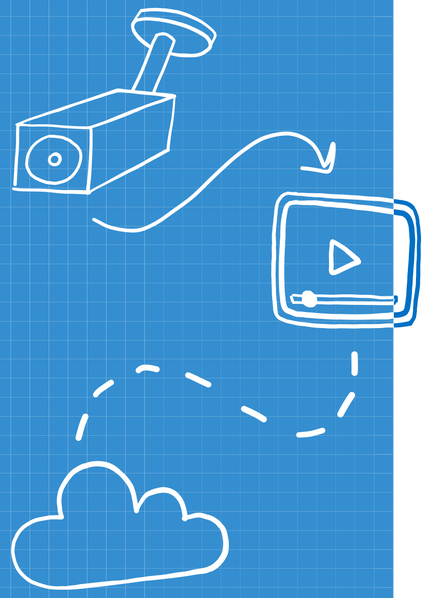
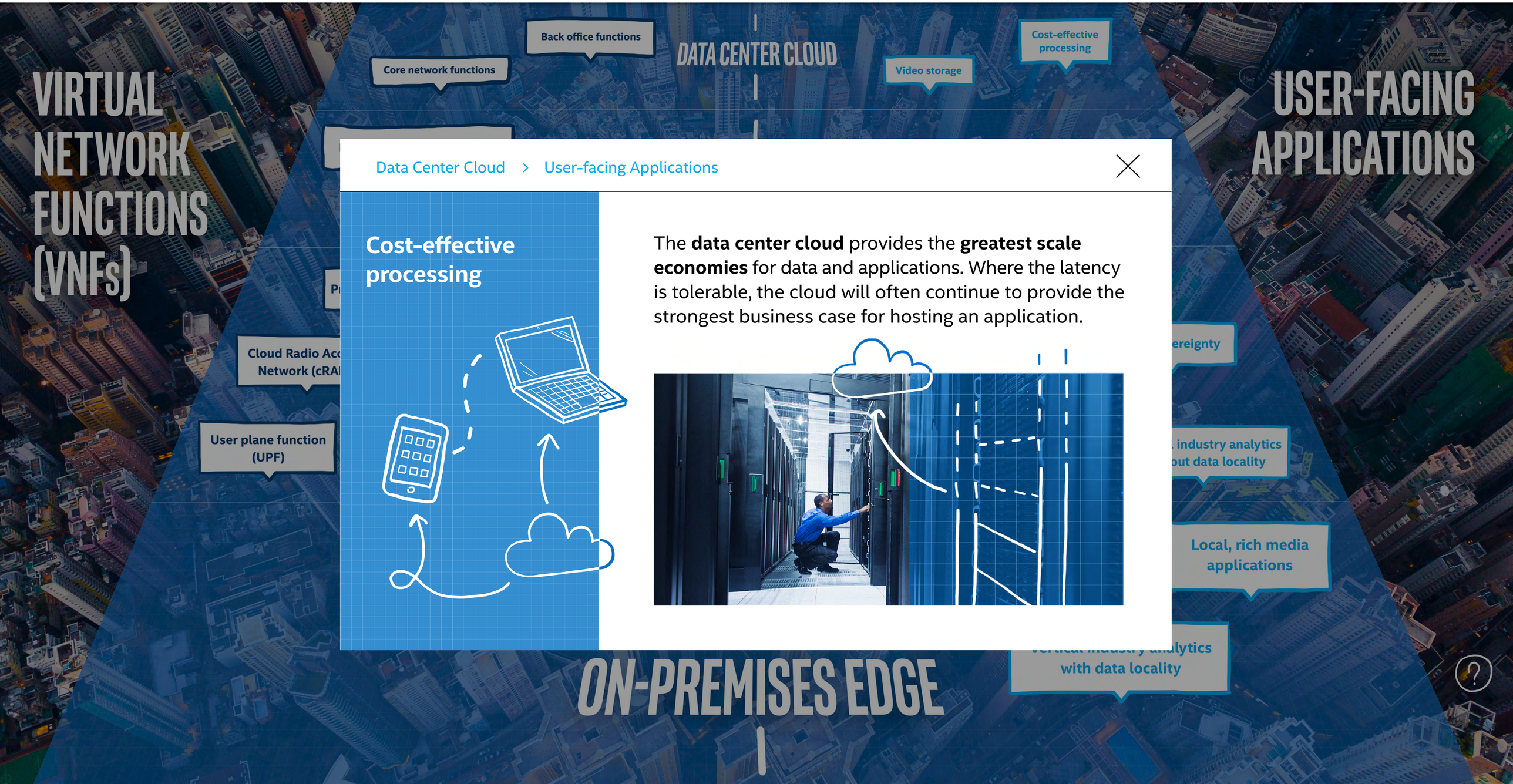


Although video can be pushed to the edge to cut access times and reduce traffic across the network, **buffering** can be used for a **good user experience** of **video streamed from the cloud**. The cloud is likely to offer a more cost-effective option for video storage than the edge.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Back office functions
Core network functions
DATA CENTER CLOUD
Video storage
Cost-effective processing
USER-FACING APPLICATIONS
Cloud Radio Acc
Network (cRA
User plane function (UPF)
ereignty
industry analytics
out data locality
Local, rich media applications
with data locality
ON-PREMISES EDGE
Data Center Cloud > User-facing Applications
Cost-effective processing
The data center cloud provides the greatest scale economies for data and applications. Where the latency is tolerable, the cloud will often continue to provide the strongest business case for hosting an application.