but before we start …
Metropolitan Area Network
Colt connected city
Operational network managed end-to-end

187k+
LDN, metro fibre and subsea and terrestrial leased capacity

25k+
Buildings directly connected

900+
Network to network interfaces

200+
Cities connected across 28 countries

800+
Key data centres, clouds and carrier hotels connected

Optical Ethernet

IP Voice Security
new sub-sea/Global100G links and North America IQNet Extension
From Traditional to Cloud Networking

From

**Traditional networking**

- Manually driven
- Delivery time in days (10-20 days typically)
- Static (1 to 3 year contracts)
- End to end products
- Vendor-controlled releases

To

**Cloud Networking**

- Software driven
- Delivery time in minutes (5-10 minutes)
- Dynamic (real-time changes & commercial models)
- Component based products
- Open platform with rapid release cycles

---

**Manual process**

*Only when physical work is required*
The foundation for Cloud Networking

- Transforming our services from end to end products to components
- Enabling customers to build their own service and increasing our ability to innovate
- Fixed commitment or flexible per hour rental commercial model
- Portal or API based consumption
Colt On Demand strategic initiatives

On Demand Platform

Novitas
Network orchestration
- Automated real time service quoting, ordering and delivery
- Service capability development
- SDN federation
- Powered by SDN control and orchestration

2015

Stratus
Network cloud
- Virtualization of network resources
- Service chaining
- Powered by NFV telco cloud, Universal CPE and NFV orchestration

2017

Sentio
Network intelligence
- Automated service management
- Service modification / restoration based on closed loop automation
- Intelligent data analysis and correlation
- Powered by AI / Machine Learning

2018
Colt On Demand benefits

- **Full control**
  Services are self-provisioned via customer portal or API

- **Fast Delivery**
  Near real-time (few minutes) service activation

- **Flexible Bandwidth**
  Fully flexible service attributes (BW, Vlans, etc)

- **Disruptive commercials**
  Pay-as-you-use billing per-hour no-commitment contracts

- **Coverage**
  On-net, Public Clouds and future off-net (SDN Federation)
Colt on Demand consumption models

1. Reserve / release ports
2. Create / delete a connection between user-reserved ports
3. Modify in real time the bandwidth of a connection

Standard HTTP based RESTful API delivered with TLS over the internet

<table>
<thead>
<tr>
<th></th>
<th>Create</th>
<th>Read</th>
<th>Update</th>
<th>Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Database</td>
<td>☐</td>
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<td>☐</td>
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<tr>
<td>Location</td>
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<tr>
<td>Port</td>
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<tr>
<td>Charges</td>
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</table>
The API is functionally equivalent to the portal. There isn’t anything that can do through the portal that can’t be done through the API.

The API will be of most interest to future focussed customers, who are trying to build end-to-end automation for internal efficiency and want to automate on-site infrastructure, cloud and network.

MEF LSO framework is being used to standardise the inter-carrier SDN Federation with the aim to extend Cloud networking beyond a single operator’s network.
Cloud Networking commercial models

A end port
Installation fee

- Ports have an associated ‘capacity’
- One off charge for creation of the port (1 port for each end)

B end port
Installation fee

- One off charge for creation of the connection
- Recurring charge based on the bandwidth ordered

Connection
Installation fee + per hour rental

Fixed commitment
- Fixed term contracts over 12/24/36 months
- Possibility to flex the bandwidth up

Flexible model
- No minimum contract term
- Connection bandwidth charged on an hourly basis
- Possibility to flex the bandwidth up or down
Colt Architecture Evolution

**Today**

- Manual operations towards closed loop automation
- Partially SDN enabled towards multi-layer SDN & NFV architecture
- Proprietary technology silos towards whitebox and cloud
- Static technology E-NNIs towards on-demand capable SDN NNIs

**Tomorrow**

- Next Gen OSS
- MDSO
- SDN
- NFV-O
- OLOs
- KVM
Colt on Demand platform

Novitas
Business Orchestration

Service Exposure API

3rd party Networks

OSS
Network Control

Multi Domain Service Orchestrator

Packet Network
SDN Controller

Optical Network
SDN Controller

SDWAN
Controller

Network Virtualisation
Controller

NFV
MANO

Colt On Demand Web Portal

Colt IQ Network

VNF

VNF

VNF

VNF

VNF

VNF

VNF
Colt On Demand strategic initiatives

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On Demand Platform

2015
2017
2018
Colt On Demand and SD WAN propositions

Two different offerings

1. Point to point “On-net” (Fibre)
   - Colt On-Demand

2. Multi-site “Off-net & on-net” mix
   - SD WAN

Future Evolution

- SDN Federation
- Optical On Demand
- DCA On Demand
  - IBM & Google Clouds
- Intercontinental Services
- IPA On Demand
- Universal CPE (NFV)
- Advanced FW, WAN Opt.
- Regional GWs
  - US/Asia
Colt on demand offerings

- Ethernet On Demand
- DCA On Demand
- DCNet On Demand

- 20,000 on-net buildings
- 570+ DCs

- Data centres
- Enterprise buildings

- Public clouds
- Microsoft Azure
- Amazon Web Services
SD WAN – Agile WAN Networking

- Use internet to lower access cost
- Agility at the edge with NFV (uCPE)
- Traffic & bandwidth management
- Central policy control via portal
- Critical vs non-critical sites

SD WAN and MPLS VPN complement each other

Critical vs non-critical sites

Traffic & bandwidth management

Agility at the edge with NFV (uCPE)

Use internet to lower access cost

Central policy control via portal

Critical vs non-critical sites

Agility at the edge with NFV (uCPE)

Traffic & bandwidth management

Use internet to lower access cost

Central policy control via portal

Critical vs non-critical sites

MPLS Link

Public Internet

SD WAN and MPLS VPN complement each other
Roadmap – Optical On Demand

Service Exposure API

Novitas
Business Orchestration

3rd party Networks

Control Layer

- Open ROADM Control
- Topology
- Path Computation
- Resource Manager
- Service Abstraction

Super-channel, sliceable and SD modulation

Programmable ROADM, flexible grid and GMPLS
Alien wave, open line system and open ROADM

Optical Infrastructure Layer

Use Cases (Optical OD)

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Colt On Demand
Web Portal

OSS
Network Control

API

Network Control

OpenROADM, flexible grid and GMPLS
Alien wave, open line system and open ROADM

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**Public Demonstrations**

- Jul 2016: AT&T – Colt
- Nov 2017: MEF17 PoC
- Mar 2018: Verizon - Colt

**Colt co-leads standardisation of SDN APIs in MEF**
MEF 2017 PoC Award (Service On Demand)

Enterprise device

Ciena

Service Catalogue / Enterprise Orchestrator

blueplanet

“Cantata” Endpoint

MEF LSO

“Sonata” Endpoint

Novitas Engine

AT&T Network

Blueplanet

Ciena

Colt

Network

MEF IQ

Cisco

Accedian

Netcracker

Colt

AWS Virtual Private Cloud

Direct Connect API for SPs

AWS APIs

AT&T Business

Amazon Web Services
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  - Network orchestration
  - 2015
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  - Automated service management
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**On Demand Platform**

- 2015
- 2017
- 2018
Colt unified NFV architecture

**Fragmented NFV architecture**
- Inefficient use of compute and networking infra
- Operational complexity due to multiple HW stacks
- Long and complex introduction of new VNFs
- Parallel and fragmented service mgmt and orch

**Unified NFV architecture**
- Automation and shared infrastructure management
- Cost efficiency
- Rapid VNF on-boarding
- E2e service lifecycle management
- Service Catalogue offering
- Reduction of operational overheads and dev cycles

COMPLEXITY SCALES EXPONENTIALLY AS EACH NEW VIRTUALISED FUNCTION IS INTRODUCED

COMPLEXITY SCALES LINEARLY AS EACH NEW VIRTUALISED FUNCTION IS INTRODUCED
Colt On Demand strategic initiatives

On Demand Platform

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2015
2017
2018
Future – AI driven networking (project Sentio)

- Fully automated service management
- Service modification / restoration (e.g. by automatic scaling in and out of VNF resources)

Realtime Closed-Loop Automation

Controllers

Analytics Engine

- Intelligent data analysis and correlation
- Based on new machine learning and artificial intelligence technics

Traffic flow classification
WAN path optimisation
Fault prediction
QoE modelling
Network security
Service restoration
Network scaling
Intelligent BW on demand
Learnings so far

- Networking as an application
- Product cloudification
- Focus on the customer experience
- Engage customers on product requirements
- Embrace agile development
- Open networks – work with partners and competition
- Manage software complexity
- Redesign organisation and processes
Thank you

Colt on Demand demo
goo.gl/ZEdwYK