Final Deliverable

Scottish Data Centre Demand Review

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Prepared for:

SCOTTISH
FUTURES
TRUST

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Scope Review: Scottish Futures Trust (SFT) has asked Gartner to review the demand for data centres in Scotland and outline the key drivers for growth
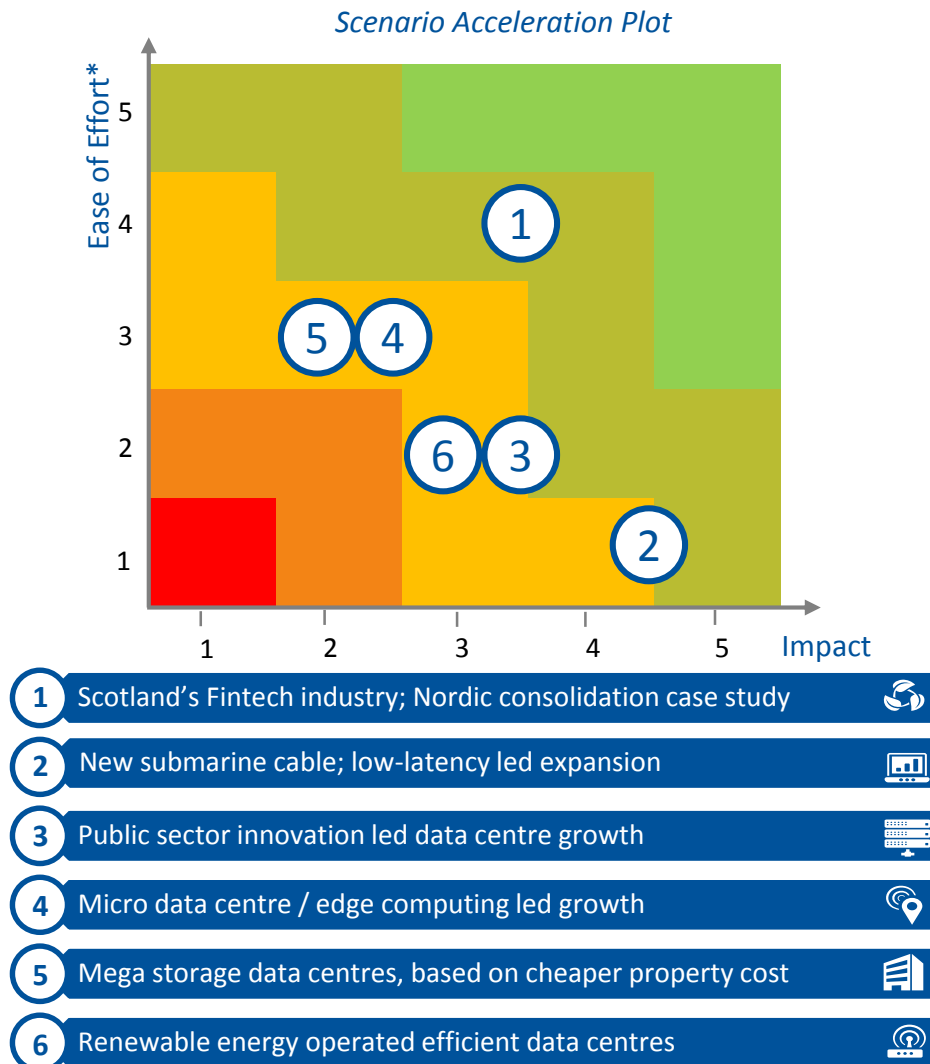
Background and Objectives	▪ There is a recognition that more could be done to promote Scotland in the global data centre market and there is an opportunity to work more closely with industry to provide an attractive, competitive environment for existing and new providers ▪ Scotland is behind other countries such as England, Ireland, the Netherlands and the Nordic / Scandinavian countries but SFT believe that if the right environment is created for investment then Scotland could attract increased interest ▪ SFT want to understand the potential data centre demand, who potential customers for the data centres would be, what the scale of opportunity is and what the nature of the need could be ▪ Gartner will investigate the market drivers for demand, as well as current internal demand, for data centres and data management both within Scotland and within the United Kingdom and determine the projected growth for both geographies
Gartner Methodology	▪ Gartner leveraged its dedicated infrastructure and data centre sourcing team that works with the largest end users and services providers to provide insights into site selection factors and requirements, and to understand the data centre providers market trends within the UK and Scotland ▪ With deep understanding of the infrastructure market globally and in the UK, and with the knowledge of Scotland's potential as a data centre provider market, Gartner has developed 6 scenarios that are focussed primarily on differentiating factors that Scotland might possess to attract the data centre providers, and also based on the potential plans within Scotland that might drive the growth ▪ Gartner has answered the questions that are outlined in the tender document in the direct Q/A section of this presentation, and included information on market trends in a market trends section in more detail ▪ All the figures and trends in this presentation are Gartner analysts and SME expert figures and may not be published information, unless otherwise specified

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- **Executive summary**
- **Data centre market trends**
- **Scenario based analysis**
- **Q/A**
- **Appendix**
- **Contact**

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Scotland can expect incremental growth by providing best in class infrastructure but radical actions are needed to differentiate as a leading geography in the market

Scenario Acceleration Plot

Ease of Effort* (y-axis, values 1–5)
Impact (x-axis, values 1–5)

Plotted points:
- 1 at (3, 4)
- 5 at (2, 3)
- 4 at (2.5, 3)
- 6 at (2.5, 2)
- 3 at (3, 2)
- 2 at (4.5, 1)

1. Scotland's Fintech industry; Nordic consolidation case study
2. New submarine cable; low-latency led expansion
3. Public sector innovation led data centre growth
4. Micro data centre / edge computing led growth
5. Mega storage data centres, based on cheaper property cost
6. Renewable energy operated efficient data centres

*5 refers to moderate effort required, 1 refers to radical effort required

Key Findings

- The shift to cloud will continue to cannibalise traditional on-premise infrastructure services. For example, data centre hosting services are estimated to decrease at a five-year CAGR of ~5%
- There is a large increase in consulting services, with a CAGR of 7% in the next 5 years vs implementation services i.e. 1%
- There is an excess supply of data centre facilities at a global level
- Data centre consolidation is on the rise, and the total number of data centres in the UK is expected to decrease by about 7% in the next 3-4 years. However, total active floor space is expected to rise
- Scotland has a high availability of land and renewable energy sources that are cheap to use with low labour costs for the operating of data centres
- Corporation tax and other public incentives are considered a major driver in attracting Tier 1 infrastructure companies

Recommendations

Scenario specific recommendations:

1. Support consolidation of the smaller Fintech companies in the Glasgow and Edinburgh regions and present as an attractive and high volume proposition for providers to enter the market
2. Recognise the opportunity to have a landing site for an intercontinental submarine cable. This will improve latency and enhance Scotland's attractiveness for data centre providers
3. Attract Tier 1 infrastructure providers through public sector investments in digital innovation initiatives like Smart City and R100
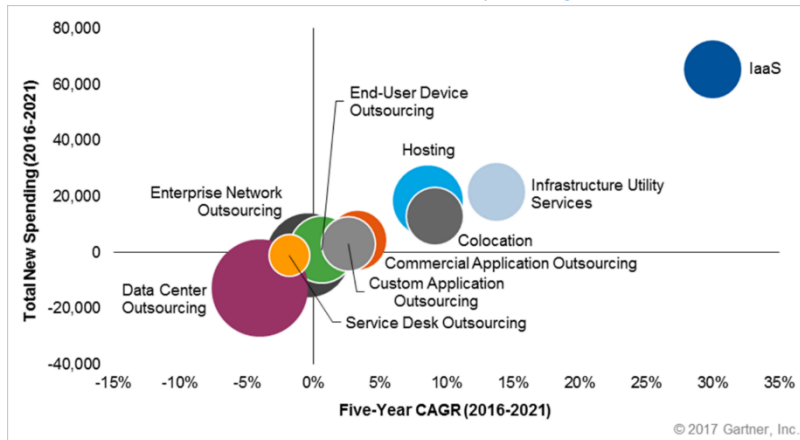
Wider recommendations:

- Invest in the development of skills to enable consulting and digital services that support the attraction of hyper-scale providers like AWS
- Invest in infrastructure to support the increasing number of micro data centres, and incentivise providers for the centralised data centres

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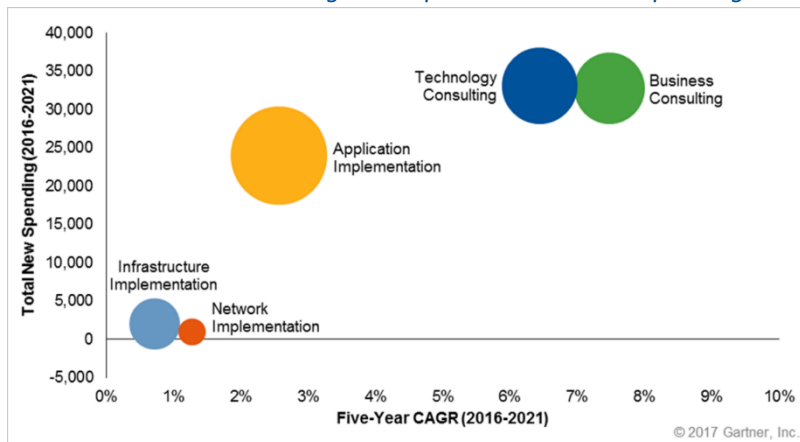- **Contact**

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Worldwide shift to cloud will continue to cannibalise traditional on-premise infrastructure services, leading to expansion of hyper-scale cloud providers

Infrastructure Trends*

Worldwide ITO New Spending

Worldwide Consulting and Implementation New Spending

*Source: Gartner Report: Market Opportunity Map: Infrastructure Outsourcing and Managed Services, Worldwide 17 May 2017

Observations

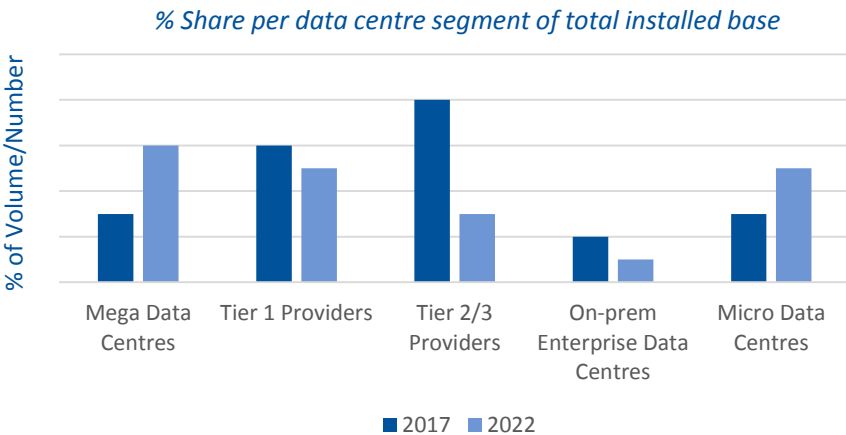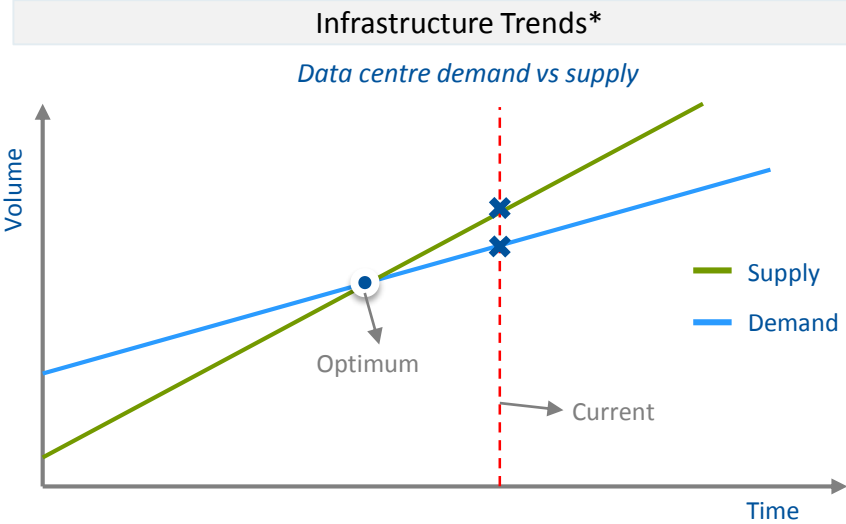- Hyper-scale Infrastructure as a Service (IaaS) offerings are estimated to grow at more than 35% through 2021, while hosting services have a Compound Annual Growth Rate (CAGR) of only 7%

- The data centre hosting services, though the biggest in terms of spending by volume, is estimated to decrease at a CAGR of 5% to 2021

- The shift to cloud will continue to cannibalise traditional on-premise infrastructure implementation service spend, resulting in a stagnating market forecast — growth is estimated at 0.7% CAGR to 2021

- Global spending for consulting is estimated to grow at a five-year CAGR of 6.9% to 2021, while the infrastructure implementation market is expected to grow at a CAGR of < 1%

Key Implications

- Decreasing spending on infrastructure services, means that Scotland should focus on investing in the development of skills to enable consulting services that will support them in bringing in hyper-scale providers like Microsoft/AWS/Google who partner with various providers of the ecosystem of services

- Scotland must capitalise on hyper-scale capabilities by prioritising investments to service offerings that can co-exist with and complement emerging ecosystems

- Scotland should also focus on modernising managed services by prioritising investments in intelligent automation services. For example Scotland has built a multi-vendor data hosting framework** which provides a framework for provisioning infrastructure through multiple cloud/colocation vendors within the public sector

**Source: http://www.gov.scot/Topics/Economy/digital/digitalservices/datahostingdatacentres

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Opportunities to attract hyperscalers exist, primarily due to infrastructure users switching to cloud that leads to consolidation of data centres; However, there is a current surplus of capacity in the UK market

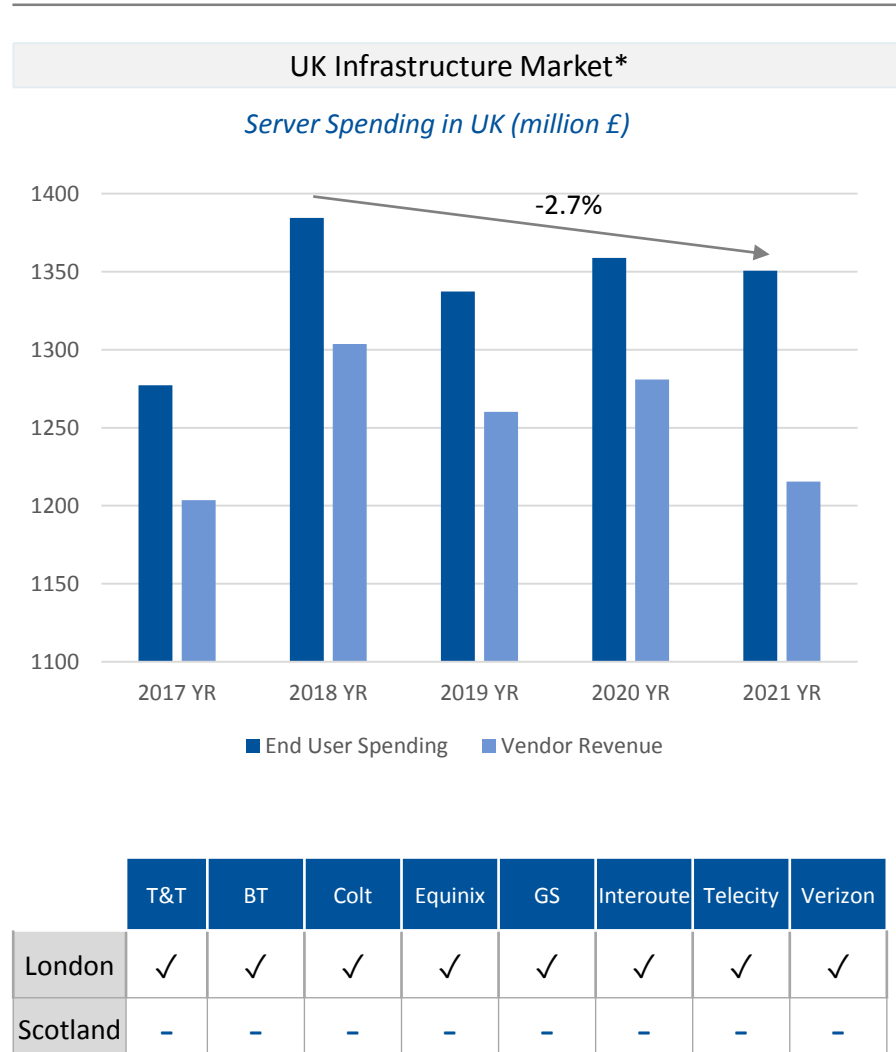## Infrastructure Trends*

Data centre demand vs supply

Volume / Time

- Supply
- Demand
- Optimum
- Current

% Share per data centre segment of total installed base

% of Volume/Number

Mega Data Centres | Tier 1 Providers | Tier 2/3 Providers | On-prem Enterprise Data Centres | Micro Data Centres

■ 2017 ■ 2022

*Source: Based on SME qualified trends. Global; indicative UK.

Observations

- There is currently an excess supply of data centre facilities at a global level. This is also indicatively true for the UK, as there is currently a surplus of data centre capacity due to the expansion of established sites, most notably London, which is within proximity of at least three 45MW commercial data centres and many medium scale data centres

- Gartner has identified an increasing trend in the consolidation of data centres. This translates into mega data centres being anticipated to double in % share of total volume/number in the next 5 years. Conversely Tier 2/3 and on-premise enterprise data centres are predicted to decrease by 50% in terms of % share of volume/number by 2022

- There is a very clear and significant increase in the proliferation of micro data centres in terms of % of share of the data centre volume/number predicted. These micro data centres include telecom, edge computing, pharma, retail and banking specific units.

Key Implications

- Consolidation of data centres is directly related to the surplus supply of data centres, mostly due to many companies switching to public cloud services

- This creates an opportunity for Scotland to provide hyper-scale data centre opportunities to such companies who are switching from on-premise infrastructure to cloud, or even to companies who currently operate their own data centre and realise the complications in doing so

- Scotland should invest in infrastructure to support the increasing number of micro data centres, and thereby also incentivise the providers for the centralised mega data centres that will provide further support in creating/expanding the indigenous infrastructure market

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Although overall demand is increasing there is a net forecast of decrease in user spending on servers in the UK due to significant price erosion expected

UK Infrastructure Market*

Server Spending in UK (million £)

-2.7%

Legend: End User Spending, Vendor Revenue

	T&T	BT	Colt	Equinix	GS	Interoute	Telecity	Verizon
London	✓	✓	✓	✓	✓	✓	✓	✓
Scotland	–	–	–	–	–	–	–	–

Observations

- End user spending for new server installation in the UK is forecast to decrease by 2.7% between 2018 and 2021. In value terms this is estimated to decrease from £1.38bn in 2018 to £1.35bn in 2021. This decrease in the spending does not necessarily mean reduced consumption. As the price decrease per server is estimated at approximately 7 to 10% year on year, a decrease of only 2.7% in user spending translates to a 6 to 8% increase in new server installation

- A similar trend is observed in the vendor revenue figures, which are predicted to reduce by about 7% between 2018 and 2021. In value this is estimated to decrease from £1bn in 2018 to £0.94bn in 2021

- The corporate regulations covering the UK also apply in Scotland. Most of Scotland's large private sector organisations (e.g. RBS, Aberdeen Standard) currently choose providers in London due to its proximity to wider markets.

Key Implications

- There are some estimates in the public domain that state that the Scottish data centre market is set to grow almost four-fold by the end of 2019**. Gartner believes this statistic to be highly unlikely, particularly in the context of trends in the whole UK server market

- There are 3 new planned/built data centres in Scotland including, the 44,000 SqFt Fortis facility in Lanarkshire. Take up has been slow to date, and the reasons for this should be analysed. It is recommended that the Scottish Government facilitate the optimisation of current data centre investments made by companies like Fortis, in parallel with discussions to attract hyperscalers.

- The Scottish Government should consider incentivising data centre providers with attractive policies to create a lucrative economic environment and retain data centres customers within Scotland whilst also potentially encouraging customers to reconsider having their hosting sites delivered from other locations such as London

* Source: Gartner Reports: Forecast: Servers, All Countries, 2014-2021, 4Q17 Update

**Source: http://www.datacenterdynamics.com/content-tracks/colo-cloud/scotland-expects-a-data-center-boom/95866.fullarticle
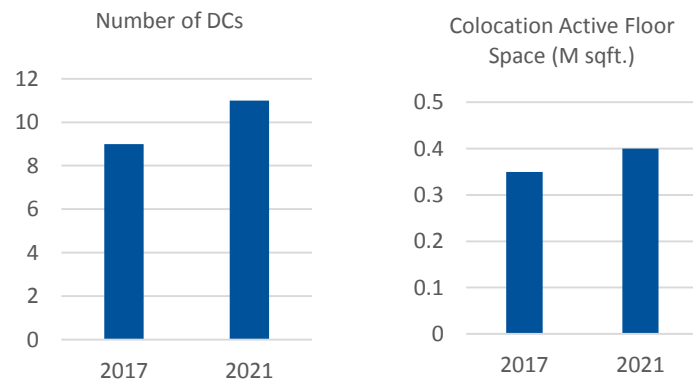
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Though there is a decrease in the total number of colocation data centres in the UK, the active floor space will increase significantly, and a similar trend is observed within Scotland

UK data centre capacity*

UK co-location data centre installed capacity

Number of DCs

	2017	2021
(axis: 0, 50, 100, 150, 200, 250, 300)

Colocation Active Floor Space (M sqft.)

(axis: 0, 1, 2, 3, 4, 5, 6)
2017 2021
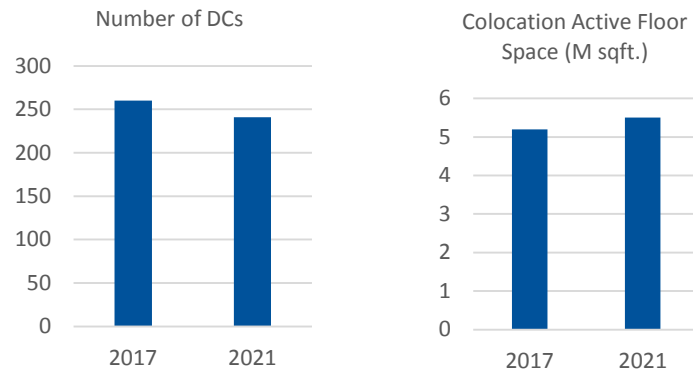
Scotland co-location data centre installed capacity

Number of DCs

(axis: 0, 2, 4, 6, 8, 10, 12)
2017 2021

Colocation Active Floor Space (M sqft.)

(axis: 0, 0.1, 0.2, 0.3, 0.4, 0.5)
2017 2021

Observations

- There are currently around 260 co-location data centres in the UK, spread across 66 locations. This is estimated to cover about 5.2 million square feet of active data centre floor space. Of these 260, approximately 9 (3.5%) are present in Scotland, which serves around 10% of total UK data traffic requirements. There is therefore a disproportionately poor coverage of data centres compared to the rest of the UK

- With data centre consolidation on the rise, the total number of data centres in the UK is expected to DECREASE by about 7% in the next 3-4 years, although the total active floor space is expected to INCREASE by up to 5.4 million square feet by 2021

- A similar trend is observed in Scotland. Whilst this will not effect the number of data centres linearly, there is potential to increase the number of data centres in Scotland with new innovation drives such as Smart City initiatives, R100 etc.

Key Implications

- The global trend of data centre consolidation is also true in the UK market, confirming the rise of bigger but fewer data centres

- For Scotland this trend can bring new business as more and more smaller data centres consolidate which could attract the bigger data centre providers to enter the market

- The Scottish Government should support this opportunity through focussed public sector investments, and simultaneously provide commercial incentives to infrastructure providers to market Scotland as an attractive option. Digital innovation initiatives such as Smart Cities and the R100 Programme will generate more data and in turn drive demand

*Source: http://www.datacentermap.com/united-kingdom/sources and SME expert figures

With key disadvantages against their neighboring markets, Scotland must identify alternative routes to gain a competitive advantage over established players

Colocation Centres in Major European Cities

	T&T	BT	Colt	Equinix	GS	Interoute	Telecity	Verizon
London	✓	✓	✓	✓	✓	✓	✓	✓
Dublin		✓				✓	✓	✓
Paris	✓	✓	✓	✓	✓	✓	✓	✓
Lyon		✓				✓		
Amsterdam	✓	✓	✓	✓	✓	✓	✓	✓
Brussels		✓	✓			✓		✓
Frankfurt	✓	✓	✓	✓	✓	✓	✓	✓
Munich		✓		✓		✓		
Milan		✓	✓	✓		✓	✓	✓
Barcelona		✓	✓			✓		
Madrid		✓	✓		✓	✓		✓
Zurich			✓	✓		✓		
Lisbon			✓					
Stockholm						✓	✓	✓
Istanbul								✓
Scotland								

Observations*

- Scotland has a lack of connectivity entry-points in comparison to the rest of the UK with only two main access points primarily through Ireland making it unsuitable for intercontinental connectivity. The rest of the UK has significantly more of these points with direct links to larger market players in the USA and Europe

- On a connectivity level, Scotland is remote from major cities in Europe by comparison to alternatives such as Sweden, Finland, Belgium, and Iceland. Norway and France also have a competitive advantage due to their access to cheaper nuclear electricity

- Scotland's Corporation Tax/Business Rate regimes are much more stringent and unfavourable than countries like Ireland, and this negatively impacts on its ability to attract large international companies into the local market

- Scotland does have a high availability of land and renewable energy sources

Key Implications

- If Scotland is to compete in the global market it must identify other methods of driving growth for demand such as supporting the creation of data centres powered by cleaner and more sustainable energy as well as meeting other growing customer-centric demands such as high security and resiliency

- Direct connectivity to intercontinental submarine cables is essential. Scotland faces strong competition from both Ireland and London as they do have access to this and therefore wider markets, such as the Tier 1 enterprises

- Scotland must provide clarity to the market in order to better understand the attractive offerings it can provide to customers and make policy more beneficial for data centre providers

- As the satellite communication services are commoditising and the prices are dropping in general, Scotland should consider utilising them in areas where low latency is not a constraint
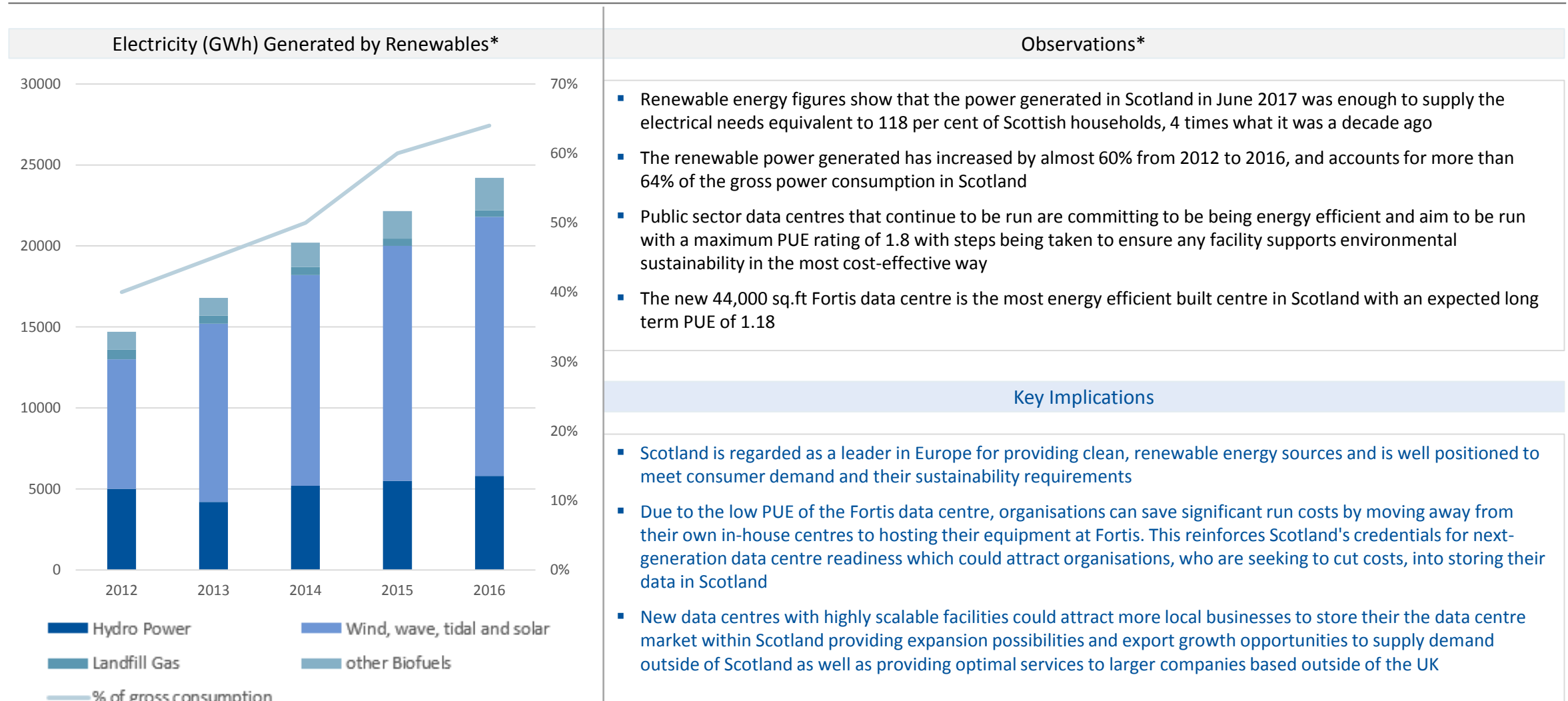
*Source: Scottish govt. publications http://www.gov.scot/Topics/Economy/digital/digitalservices/datahostingdatacentres

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Many organisations in Scotland are reducing their data centre costs by collocating or moving to cloud to reduce their operational costs, hence increasing demands for bigger but fewer data centres

Data Centre: Cost Breakdown Structures

- Hardware 27%
- Software 25%
- Staff / Facility/Power 47%

Avg. Best in class PUE values*

2012	2017	2022	Facebook
<1.8	<1.3	<1.1	1.07

*Source: Based on SME qualified trends. Global; indicative UK.

Observations

- The Improvement Services (IS) renewed a number of technology stacks and hardware was hosted in a co-location facility. The solution is now hosted in a private cloud for less than 1/2 the price that IS were previously paying
- Highland Council estimates they will make savings of £1m through a reduction in power and £175,000 through standardising the technology they use
- Scottish Prison Service will avoid costs of upgrading the existing environment and power consumption estimated at £20m by co-locating with Scottish Government backed up to South Lanarkshire Council
- St Andrews University currently runs their data centre at a Power Usage Effectiveness (PUE) of 1.34 and have a target to run it at less than 1.2 through further programmes of virtualisation and shared and managed services. They will save £1.4m over 10 years and a reduction of 6.8m Kg CO_2 emissions

Key Implications

- With cost-effective strategies being deployed within Scotland's public sector data centre market, it has the potential to become an attractive market for stakeholders seeking to reduce the costs of storing their data elsewhere in the UK
- As facility / power cost contributes to 47% of total data centre operational expense new data centres being built in Scotland powered by clean energy would be well positioned to provide data centre solutions to customers with sustainable energy. This will help major businesses reduce their carbon footprint and could also motivate some customers to relocate their operations from London to Scotland
- As the PUE ratios continue to decrease for more efficient data centres, Scotland should promote best in class infrastructure to become more relevant and increase growth opportunities by attracting data centre companies by marketing operational cost savings policy

Scotland is well positioned to provide cheaper renewable power to data centre providers, which could be a major factor at enabling efficient infrastructure services

Electricity (GWh) Generated by Renewables*

Chart showing stacked bars from 2012 to 2016 with left axis 0–30000 GWh and right axis 0%–70%, and a line for % of gross consumption.

Legend:
- Hydro Power
- Wind, wave, tidal and solar
- Landfill Gas
- other Biofuels
- % of gross consumption

Observations*

- Renewable energy figures show that the power generated in Scotland in June 2017 was enough to supply the electrical needs equivalent to 118 per cent of Scottish households, 4 times what it was a decade ago

- The renewable power generated has increased by almost 60% from 2012 to 2016, and accounts for more than 64% of the gross power consumption in Scotland

- Public sector data centres that continue to be run are committing to be being energy efficient and aim to be run with a maximum PUE rating of 1.8 with steps being taken to ensure any facility supports environmental sustainability in the most cost-effective way

- The new 44,000 sq.ft Fortis data centre is the most energy efficient built centre in Scotland with an expected long term PUE of 1.18

Key Implications

- Scotland is regarded as a leader in Europe for providing clean, renewable energy sources and is well positioned to meet consumer demand and their sustainability requirements

- Due to the low PUE of the Fortis data centre, organisations can save significant run costs by moving away from their own in-house centres to hosting their equipment at Fortis. This reinforces Scotland's credentials for next-generation data centre readiness which could attract organisations, who are seeking to cut costs, into storing their data in Scotland

- New data centres with highly scalable facilities could attract more local businesses to store their the data centre market within Scotland providing expansion possibilities and export growth opportunities to supply demand outside of Scotland as well as providing optimal services to larger companies based outside of the UK

*High Level Summary of Statistics Trend Last update: Thursday, December 22, 2016 Renewable Energy; and Gartner SME figures
http://www.gov.scot/Topics/Statistics/Browse/Business/TrenRenEnergy

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Scotland can potentially benefit from the long term effects of Brexit, such as the long term expected increase infrastructure services demand in the UK

Observations*

- In the short term (1-2 years), Brexit is expected to provide a headwind, as its negative impact on business confidence will lead to stalling, postponement and cancellation of project work in the UK

- In the long term (3-5 years), however, Brexit is expected to drive an increase in implementation services in the U.K. as companies are required to conform to relevant regulatory requirements

- The negative impact from Brexit has been affecting the U.K. server market and services; with an overall 5 year forecast CAGR reduced from 2.3% to 1.9%. This trend is likely to continue till 2019, after which the situation is predicted to stabilise

- Despite Brexit and GDPR initiatives taking place, large enterprises such as Google have stated that it will not affect their data interactions with the UK, as is the case with Microsoft that has UK data centres

Key Implications

- Data centres within the UK may have less strenuous regulation than previously under Brexit which represents an opportunity to gain an advantage over its neighbouring competition in the long term

- For Scotland, Brexit will have limited impact on the demand for data centres as most Tier 1 and 2 companies based in the US still identify England and Ireland as soptimal entry points to the European markets; this is due to high demand pertaining to a higher number of businesses around the M4 and M25 corridors, and Ireland is more attractive as it provides more attractive policy incentives for data centre providers

- In the advent of GDPR, Ireland would potentially be prioritised by both current and new data centre providers following its continued status within the EU as this would be a more attractive stepping stone for providing services to other organisations within the EU

*Source: Gartner SME expert figures

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Baseline analysis – Scotland must at least provide minimum entry point requirements for best in class data centre infrastructure to become a competitive and relevant data centre market for providers

Performance Factors	2022 Futureproof Values*	Description
Power Usage Effectiveness (PUE)	<1.1	- PUE ratios, one of the most popular data centre facility efficiency metrics, continue to demonstrate a decreasing trend - The global average of best in class figures has decreased from 1.8 in 2012 to 1.3 in 2017, and is estimated to reduce further to 1.1 by 2022 - Facebook has one of the lowest PUE ratios for a data centre of 1.07
Redundancy	2(N+1), active/active	- Tier 4 level redundancy i.e. 2(n+1) is the new best in class, where there is twice the number of infrastructure components for each active and passive (secondary backup) unit - Redundancy in terms of "active/active," describes redundant capacity that is always online, with the goal of avoiding any disruption at all
Availability/Downtime	> 99.9965% / < 26.3 mins	- The adoption of cloud has pushed the providers to the limits of providing better than four 9s availability and less than 30mins downtime in an year - Hosting company Peak Web suffered a 10-hour network outage, ultimately leading to its bankruptcy
Resiliency	Maximized through leaf/spine design (see appendix) with fixed-form factor switches	An upcoming trend observed in data centre networking for improved resiliency is leaf/spine architecture (see page 58) as it includes better efficiency, horizontal scalability, consistent/deterministic performance, simplicity and availability, compared to traditional 3-Tier designs
Security	Tier 4	A very important aspect of cloud is to provide secure infrastructure services to the consumers, and Tier 4 level of physical and access security is on the path of becoming an integral part of data centres, especially for the hyperscalers

*Source: Gartner SME expert figures

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Scotland's potential differentiating factors – only after adhering to the minimum entry point requirements, Scotland should focus on how its differentiating factors can contribute to the data centre market growth

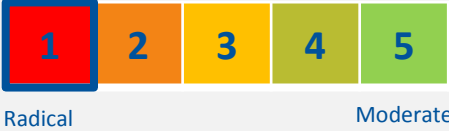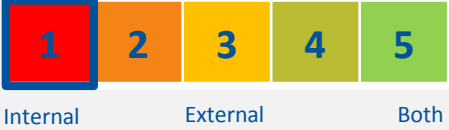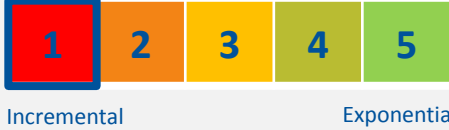| Potential Differentiating Factors	Overview
Fintech led digital innovation	▪ With a growing Fintech market, Scotland is well placed to target and consolidate the huge number of smaller companies and provide them an ecosystem which has low cost, local data centre services that offer long-term sustainability powered by renewable energy ▪ Collaboration among the providers has already been observed, for example a Dundee-based company, Brightsolid, has agreed a partnership with Lanarkshire-based DataVita to offer cloud services to businesses across Scotland ▪ The *CivTech® pilot is one of the ways of harnessing this initiative. It brings together private sector innovation, public sector organisations and citizens to develop more efficient and effective products and services. Backed by the Scottish Government, it provides an unprecedented route for entrepreneurs, start-ups, SMEs and other businesses to develop the benefits of digital transformation in the public sector. http://www.gov.scot/Topics/Economy/digital/digitalservices/civtech
Renewable Energy	▪ Scotland is a leader in providing clean, renewable energy sources. Scotland is well positioned to meet data centre providers' demands of providing cheaper renewable power that will support them in operational cost savings and also improve their carbon credit rating ▪ Iceland is already marketing itself as an attractive location for data centre operators because of their plentiful renewable energy
Property cost	▪ Traditionally clients have wanted to be close to their data, therefore most of the data centres tended to be located in urban centres. However, with cost pressures there is an increasing trend to build in more remote areas where land is cheaper for reduced facilities costs ▪ For land intensive data centres such as mega storage units, that don't require very low latency, lower property costs can be attractive to data centre contractors/providers
Climate	▪ An important factor for running a data centre efficiently is cooling with the minimal amount of additional power required to drive the cooling system. Free air cooling is the way to achieve this, and Scotland has a climate which is close to optimal for this ▪ Similarly, Iceland has an optimum climate for data centres, which they are advertising as a great opportunity to build energy efficient facilities

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Scenarios – based on the market trends and Scotland's differentiating factors, below are the scenarios on top of best practice infrastructure requirements

1 Scotland's Fintech industry; Nordic consolidation case study

2 New submarine cable connectivity; low-latency led expansion

3 Public sector innovation led data centre growth

4 Micro data centre / edge computing led growth

5 Mega storage data centres, based on cheaper property costs

6 Renewable energy operated efficient data centres

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Scenario n – Template (1/2)

Scenario Overview
▪ An overview of the scenario, including how the factors based on current external trends effect the demand of data centres and data management in the Scottish market

Scotland's Differentiating Factor	Perceived Customer Value
▪ What are Scotland's key USPs within the infrastructure market, and how much do these support and are leveraged by this scenario as a success criteria	▪ In terms of opportunities for growth/savings, how lucrative and attractive is this scenario for the data centre providers to enter/expand in the Scotland market

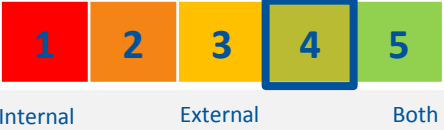| Effect of Supply conditions	Effects of Potential Demand
▪ How much is the abundance/lack of these supply conditions within Scotland and to what extent does that favour or enable the scenario?	▪ To what extent does the abundance of this considered demand profile, favour or enable the scenario?

Importance/Impact = Limited (1) Low (2) Average (3) High (4) Advanced (5)

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Effort Needed

	1	2	3	4	5	
	Radical				Moderate	

- Actions and recommendations that can be taken to help mitigate any implications e.g. Scotland's use of Unique Selling Points (USPs), current positional strengths, what marketing messages can be used etc
- The scale on the left shows how effort intensive these actions would be;
  - Moderate efforts: they are more in line with current and ongoing developments in Scotland
  - In the middle: the action requires some improved/innovative efforts to turn this scenario in a viable option
  - Radical efforts: these would ask for a total strategy shift or can be very politically and commercially intensive

Outcome/Impact

	1	2	3	4	5	
	Internal		External		Both	

- What does this mean for Scotland in terms of internal vs external impacts
  - Internal: this scenario has more potential to increase internal data centre demand and lead to increase in data centre services consumption within Scotland
  - External: this scenario is more focused on creating Scotland as a data centre provider market for other nearby geographies, and would bring providers not just for consumption but also for provision

	1	2	3	4	5	
	Incremental				Exponential	

- What does this mean for Scotland in terms of incremental vs exponential growth of number of data centres, workload volumes and providers
  - Incremental: a low growth but steady progress which is mostly an outcome of increase in consumption and global technology trends
  - Exponential: huge growth opportunity that can make Scotland stand out as a lucrative market for data centre providers

Scenario 1 – Scotland's Fintech industry; Nordic consolidation case study (1/2)

Scenario Overview
▪ Norway was a small data centre market and chose to consolidate smaller companies into using their newly built data centres and appointed IBM to operate these from separate locations where the labour was cheaper ▪ This strategic initiative led to many Tier 2 enterprises using their services, and it was also considerably successful in attracting Tier 1 customers like EVRY ▪ On the whole this created a data centre market in this region, though some domestic Tier 2 companies such as banks became nervous that 3rd party operators were handing their data

Scotland's Differentiating Factor	Perceived Customer Value
▪ With the growth of the Fintech market, Scotland is well placed to target and consolidate these huge number of smaller companies and provide them with cheap, local data centre offerings that offer long-term sustainability powered by renewable energy	▪ The Fintech industry is one of the fastest growing industries globally, and as there is huge requirement of data processing, it becomes a valuable option for providers to deliver consolidated infrastructure service

Effect of Supply conditions	Effects of Potential Demand
▪ Scotland's Fintech sector is brimming with commercial opportunity with over 86,000 people in the sector and over 100,000 in the digital technology sector, positioning Scotland as a catalyst for Fintech growth in the nearby markets as well	▪ Fintech industry generates huge amounts of data that needs processing and storing, and with numerous smaller companies in Scotland, the demand for infrastructure services to support them is increasing ▪ This abundance of Fintech data can attract the bigger providers in the market to provide consolidated services to all the smaller places

Importance /Impact = ○ Limited (1) ◔ Low (2) ◑ Average (3) ◕ High (4) ● Advanced (5)

Gartner.

Scenario 1 – Scotland's Fintech industry; Nordic consolidation case study (2/2)

Effort Needed

1	2	3	**4**	5

Radical — Moderate

- The Fintech industry in Scotland is quite mature and has started to make a mark in global financial innovation; this should be kept on track with stable and steady growth with the right amount of political support
- The majority of effort required is to support consolidation of the smaller Fintech companies in the Glasgow and Edinburgh regions and turn them into an attractive and high volume proposition for providers to enter the market
- Pilot programs like CivTech® are one of the ways of harnessing this initiative, that supports the bringing together of private sector innovation, public sector organisations and citizens

Outcome/Impact

1	2	3	**4**	5

Internal — External — Both

- Pertaining to the efforts made, on a short term this can lead to tremendous internal expansion, with various technology providers entering the market to provide services to a set/combination of Fintech companies
- In the longer run, this also has a potential to attract Fintech and their supporting companies from other geographies to setup in Scotland

1	2	**3**	4	5

Incremental — Exponential

- In the long term, this can have a much better than incremental growth in attracting data centre providers and increasing workload volumes to be handled
- Depending on how the consolidation is marketed and the Fintech companies incentivised, it has a potential for global impact

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Scenario 2 – New submarine cable connectivity; low-latency led expansion (1/2)

Scenario Overview

- Commercial data centre providers prefer to locate their facilities near future cable landing stations to provide access points for network, cloud, content, social media, and enterprise customers. Hyperscale data centre providers always seek to control their bandwidth by funding submarine cable projects
- There is always an exponential increase in data flowing through new cables, hence data centre providers with facilities located where they land benefit hugely
- A success factor for Ireland as a data centre market is that many of the submarine cables that link mainland Europe and the UK to the US, for internet and communications connectivity, pass in and around Ireland

Scotland's Differentiating Factor	Perceived Customer Value
● At the time of writing there is an opportunity to have a major submarine cable landing site in Scotland. This cable would provide intercontinental connectivity between Boston (USA) and Denmark	● Data centres with access to more landing sites are far more attractive than those who don't as they have better connectivity with the world ● Also, owning landing sites helps lower the upfront cost to access of that kind, hence it is highly valuable

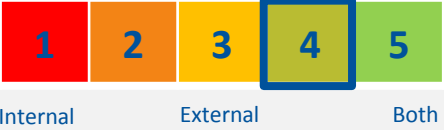| Effect of Supply conditions	Effects of Potential Demand
● As there is a lack of an intercontinental submarine cable landing in Scotland, the latency and connectivity is much poorer than the nearby geographies ● This supports the expansion opportunity that any new submarine cable landing site will bring, as it will highly reduce the latency of interconnectivity ● Other factors for efficient data centres, such as low facilities cost and sustainable power are already present in Scotland	● There is huge demand for owning a submarine cable landing site, as data centre providers are always looking for an upper-hand in delivering connectivity ● A landing site hugely increases the data flow within the geography, thereby attracting infrastructure providers to make the most of it; although there would be a lot of traffic split into new landing sites in nearby geographies

Importance /Impact = ○ Limited (1)   ◔ Low (2)   ◑ Average (3)   ◕ High (4)   ● Advanced (5)

Gartner.

Scenario 2 – New submarine cable connectivity; low-latency led expansion (2/2)

Effort Needed

| 1 | 2 | 3 | 4 | 5 |

Radical — **Moderate**

- There are radical measures required to be undertaken in order to translate any opportunities into a real plan and then implement
- This would require multiple political and commercial decisions to be made in order to approve the landing site of the cable, and all of this should be done within timescales, which may not be a long time from when the opportunity is first observed
- To implement these opportunities, Scotland will have to make a public sector intervention underwrite part fund or wholly fund in order to get connectivity to terminate. Though there might be a possibility to get some funding from the hyperscalers/Tier 1 providers, it is highly unlikely as Scotland is not considered as a developed market for these players to invest

Outcome/Impact

| 1 | 2 | 3 | 4 | 5 |

Internal — **External** — **Both**

- This will bring significant benefits, both internally and externally, as it will not only bring all the Scotland traffic directly to be processed within the country, but also a lot of intercontinental data processing between US and Europe – hence attracting major commercial data centres

| 1 | 2 | 3 | 4 | 5 |

Incremental — **Exponential**

- There will be a very high to exponential increase in traffic and data volumes processed leading to more providers setting up as data centres in Scotland
- Though the new landing sites planned in other nearby geographies can have some impact on these volumes, overall it will lead to huge growth

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Scenario 3 – Public sector innovation led data centre growth (1/2)

Scenario Overview
▪ Public sector innovation led funding in technology generates positive spill-over effects that induce the private sector to further invest and expand that market ▪ Digital expansion in the government through utilisation of private players in the market attracts them into providing similar services to other nearby demand centres such as other private enterprises and in turn creates a sustainable eco-system

Scotland's Differentiating Factor		Perceived Customer Value	
	▪ With digital innovation as a priority, Scottish Government is now looking more closely at the opportunities readily available in the marketplace that can support cloud computing services for agility and improved commercial models		▪ This is can be of high value for Tier 2 cloud providers, for most of the Tier 1 and hyperscale providers, catering only to the Scottish Government for their infrastructure needs is not very lucrative
Effect of Supply conditions		**Effects of Potential Demand**	
	▪ Scottish govt. review suggests that over £270m is spent on running 120 data centres in the public sector, and there is a potential to save about £50m by utilising public cloud ▪ This public sector infrastructure innovation through public cloud can support the growth of data centre requirement in Scotland		▪ Scotland public sector investments in new and innovative infrastructure solutions will potentially also bring investments from private sector, thereby increasing the demand for infrastructure services further ▪ As there is a lot of unused pre-existing data centre facilities, demand for more/new data centres might come in slower than expected

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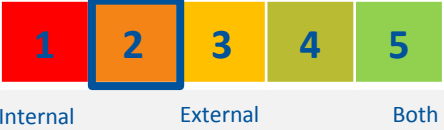
Scenario 3 – Public sector innovation led data centre growth (2/2)

Effort Needed

| 1 | 2 | 3 | 4 | 5 |

Radical   Moderate

- Scotland has created a political environment of innovation in the public sector, but now it needs to support this in order to create the right economic environment; primarily by getting behind the large data centres like Fortis, Pyramids, Queensway or Pentlands in order to attract providers
- The second thing, which the Irish Government have done really well, is to put the conditions and incentives in place, to attract inward investment from large organisations – mainly the content providers such as Amazon, Google, Apple, Microsoft, and others

Outcome/Impact

| 1 | 2 | 3 | 4 | 5 |

Internal   External   Both

- This has the potential to have both internal and external benefits
- Internal, as the government utilises public cloud, it will bring Tier 1/2 players that resell or provide public cloud services
- But only through radical efforts, will it realise most of its external benefits, that is to attract hyperscalers as global providers

| 1 | 2 | 3 | 4 | 5 |

Incremental   Exponential

- The innovation in public sector will potentially bring only incremental growth in terms of new data centre facilities requirement and increased workload, as there is no significant new infrastructure requirement but instead it is more of transformation

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Scenario 4 – Micro data centre / edge computing led growth (1/2)

Scenario Overview

- Gartner expects digital traffic to expand by 23 percent annually with 8.6 zettabytes of IP traffic by 2018 globally, which demands high bandwidth for reduced latency. Installing bigger switches to increase bandwidth in centralized enterprise data centres only goes so far in reducing latency
- The solution to this problem is installing micro data centres for low latency workloads in between centralised large data centres and user applications

Scotland's Differentiating Factor	**Perceived Customer Value**
- There is over £7bn of investment, through the Scottish City Alliance, planned across 7 cities in Scotland with various Smart City initiatives to accelerate and transform the delivery of city services	- This is of an average value to large data centre providers as the increase of micro data centres will drive the need for centralised data centres, but not exponentially
Effect of Supply conditions	**Effects of Potential Demand**
- Low latency is essential for banking and financial services and with Scotland's booming Fintech industry there will be an increase of micro data centres - The R100 initiative, which requires high speed internet usage, will also drive the increase of micro data centres	- The increasing number of micro data centres, with all the digital initiatives happening in Scotland will increase the demand for centralized data centre facilities to support them - But there already exists capacity within data centre facilities such as Fortis, that is capable of supporting the infrastructure and network requirements of the surging number of new micro data centres

Importance /Impact =

Limited (1)	Low (2)	Average (3)	High (4)	Advanced (5)

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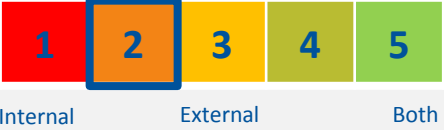
Scenario 4 – Micro data centre / edge computing led growth (2/2)

Effort Needed

Radical 1 2 **3** 4 5 **Moderate**

- With substantial investment already planned with Smart City initiatives, Scotland must also focus on attracting and nurturing new and current Fintech players through pilot programmes such as CivTech®, that will allow significant public / private collaborative innovation leading to a consolidated infrastructure growth
- With the R100 program in the process of implementation the Scottish Government must collaborate with telecom players and infrastructure / network service providers to deliver high speed interconnectivity by building more micro data centres and also incentivise large data centre players to serve as centralised hubs

Outcome/Impact

Internal 1 **2** 3 4 5 **External** **Both**

- This has the potential to have major internal and less likely external impact
- Internal, as micro data centre growth is driven by increased local consumption of data which will largely affect data centre growth within Scotland
- Nearby geographies can have minimal benefit from this growth although this is unlikely

Incremental 1 2 **3** 4 5 **Exponential**

- This can potentially lead to moderate growth as a steady increase in consumption in data is observed
- Only after the moderate growth is realised, more radical measures must be identified in order to increase benefits

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Scenario Overview
▪ With the advent of digital innovation, IoT, and Big Data, the need for storing data is exponentially increased in the last decade and will continue the trend as the number of connected devices globally is estimated to reach 30bn by 2025 ▪ This volume of data storage requirement demands cheap and efficient mega storage data centres, that don't necessarily need low latency for frequent transmission of information but instead needs huge, stable and cheap land for building this infrastructure for secondary storage sites

Scotland's Differentiating Factor	Perceived Customer Value
▪ Scotland has a cheaper land cost than its neighbouring countries, has an abundance of renewable energy and is also considered to be politically stable and safe. Because there is lack of submarine cable connectivity, low latency data centres such as mega storage centres are better suited	▪ Cheaper property costs and renewable energy, are two of the most important factors that providers consider when building a mega storage centre ▪ This will not be of high value to those who need low latency, which is becoming a norm

Effect of Supply conditions	Effects of Potential Demand
▪ Supply of cheaper land and labour is in abundance within Scotland, in comparison to the nearby geographies ▪ For land intensive data centres such as mega storage units, that don't require very low latency, low property costs can be attractive to data centre contractors/providers	▪ Traditionally clients have wanted to be close to their data, therefore most data centres used to be located in urban centres, but, as the storage requirements have exponentially increased, with cost pressures there is an increasing demand to build in areas where land, labour and power cost is cheaper for reduced facilities costs

Importance /Impact = Limited (1) Low (2) Average (3) High (4) Advanced (5)

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Scenario 5 – Mega storage data centres, based on cheaper property costs (2/2)

Effort Needed	
1 **2** **3** **4** **5** Radical　　　　　　　Moderate	▪ In order to market Scotland as potential geography for mega storage data centre, Scotland will have to make significant investments to create case study examples to showcase the cost effectiveness of building them in Scotland ▪ Along with marketing, this would also require an initial push from the public sector to create this niche demand by consolidation, and convert this into a large scale market ▪ These data centres will have the potential to act as stepping stones to bringing full-scale data centres in Scotland, if latency and provider incentives were to be improved in future

Outcome/Impact			
1 **2** **3** **4** **5** Internal　　External　　Both	▪ Mega storage data centres will mostly impact the internal consumers of the data, due to lack of subsea cable connectivity with other geographies ▪ For external, it will only suit where there is a need for secondary storage/backup and low latency is not required	**1** **2** **3** **4** **5** Incremental　　Exponential	▪ It will have an incremental and steady growth, as per the increase in storage consumption in and around Scotland ▪ As the footprint of data centres does not increase linearly with storage volumes, the data centre growth is estimated to be much lower

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Scenario 6 – Renewable energy operated efficient data centres (1/2)

Scenario Overview
▪ With power requirements increasing almost two fold every four years, data centre providers are always under pressure to improve their energy efficiencies, not just by improving their facility efficiency, but also by utilising renewable energy as a source of operating power for the data centre ▪ As power from renewable energy is much cheaper and cleaner than fossil fuel power, it will reduce the operating expenses and also improve the data centre provider's carbon credit rating making them more environmentally stable in the long-term

Scotland's Differentiating Factor		Perceived Customer Value	
	▪ As a leading provider of renewable energy in Europe, Scotland is well positioned to attract market players seeking to reduce their carbon footprint and adopt cleaner power consumption initiatives whilst additionally offering cost effective solutions for running data centres		▪ Renewable energy is an important factor of consideration for the data centre providers while building one, but it is not perceived as of very high value, as there are other more important ones such as consumption volumes, latency/connectivity etc.
Effect of Supply conditions		**Effects of Potential Demand**	
	▪ Scotland produced 118% of the power requirements in June 2017 through renewables , hence it has potential surplus renewable energy to support any new demands that may arise in near future ▪ Scotland shares the same power grid network with the rest of the UK so costs are about the same as those across the UK, though there might be slight difference pertaining to the wheeling charges		▪ There has been a new trend in the data centre market, especially within the hyperscalers like AWS, Google etc., to reduce their carbon footprint ▪ Renewable power can not be a primary factor, as there is a lack of consumption and connectivity in Scotland, in comparison to nearby countries which makes it less lucrative for data centres

Importance /Impact =   Limited (1)   Low (2)   Average (3)   High (4)   Advanced (5)

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Effort Needed

| 1 | 2 | 3 | 4 | 5 |

Radical   Moderate

- As Scotland is already one of the largest producers of renewable energy in Europe, only moderate effort is required in order to expand the generation for more commercial use, and also to market/advertise Scotland as a haven for environmentally sustainable data centres, something that Iceland has been doing very well
- More radical actions are needed in order to create commercial incentives for data centre providers to enter the market, as only operational efficiency can add only limited value. As of yet, Scotland has no plans for the same, but Ireland on the other hand, has successfully incentivised large-scale investments

Outcome/Impact

| 1 | 2 | 3 | 4 | 5 |

Internal   External   Both

- The potential to build operationally cost efficient, and environmentally sustainable and cleaner data centres can push expansion
  - Internally, by making sure all Scottish demands are catered for within Scotland cost effectively
  - Externally, by attracting global data centre providers to operate more efficiently from Scotland. This requires a lot of effort

| 1 | 2 | 3 | 4 | 5 |

Incremental   Exponential

- Marketing renewable energy as the only benefit to data centre providers can provide only incremental growth, mostly driven by internal expansion
- Radical efforts are necessary for any further growth, but nearby competition could adversely affect this

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The quantified analysis of these scenarios clearly suggests, landing site of a submarine cable in Scotland, and the Fintech industry in Scotland, can play a strong role in developing a data centre market potential

Scenario	Basic (differentiating factor + customer value + supply + demand) 4	Effort	Impact (internal vs external + incremental vs exponential) 2	Gross (Basic + Effort + Impact)
Scotland's Fintech industry; Nordic consolidation case study	3.75	4	3.5	**11.25**
New submarine cable; low-latency led expansion	4.5	1	4.5	**10**
Public sector innovation led data centre growth	3.5	2	3.5	**9**
Micro data centre / edge computing led growth	3.5	3	2.5	**9**
Mega storage data centres, basis the cheaper property costs	3.75	3	2	**8.75**
Renewable energy operated efficient data centres	2.75	2	3	**7.75**

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There are a few potential future risks that could have a negative impact on Scotland's plans to expand its presence in the global infrastructure market

Hard Brexit	▪ Brexit's impact on the UK economy could have a significant impact on some industry verticals leading to providers with a focus on these industries in need of contingency plans for customers who are possibly changing their investment decisions and/or shutting down operations ▪ Scotland's financial services, construction, travel, manufacturing and retail industries could be among those impacted by a combination of the fall in the pound and the expected slowdown in the economy. This would adversely affect the need for new or even current infrastructure services – Scotland must proactively put in place contingency plans at a number of levels to mitigate the risk, secure its future economy and exploit the benefits of this shift
Digital-Cloud Disruption	▪ Technologies like Data Centre Interconnect Fabric and Server-less Infrastructure, though still in the early stages in the Gartner hype cycle can bring about accelerated transformation in infrastructure services' delivery. As organisations embrace automation and Artificial Intelligence enabled infrastructure, the current small and medium size, and possible even large data centre providers could become obsolete ▪ Scotland has to be agile at re-inventing and innovating their infrastructure services market. If they don't do this it could lead to Scotland falling behind the competitors as the customers switch to more digital infrastructure solutions – Scotland should make significant investment to enable customer adoption and vendor delivery of future proof technologies in order to stay relevant in the market
Irish Competition	▪ Amazon's Irish unit, Amazon Data Services Ireland Limited was recently granted permission to build a 223,000 Sq Ft building under it's code-name "Project G"; Amazon's footprint in the Irish capital alone now stands at close to ten buildings ▪ Major wins like AWS in Ireland could spark further interest from other mega data centre providers and hyperscalers. This could lure more potential tier 1 enterprise customers into choosing Ireland and not Scotland as a data centre location – Scotland must heavily advertise and market itself better through its potential differentiating factors to attract the providers like AWS
Industry Migration	▪ Industries like Fintech and pharmaceuticals demand the latest and fastest infrastructure services and therefore prefer providers who can support their ever increasing needs of data crunching, high speed data transactions, service reliability and data security ▪ Despite a booming Fintech market in Scotland, if Scotland was not ready to provide low latency (which is a major requirement for organisations in the financial sector), these growing Fintech companies could opt to move their hosting demands to alternative locations like London – Upcoming industries in Scotland like Fintech, must be supported and incentivised to expand within Scotland through technological and corporate transformations
Next Generation Infrastructure	▪ With the advent of Hyper-Converged Infrastructure (HCIS) to support intelligent workload processing, it is expected that the majority of HCIS revenue will be attributed to evolutionary disruptors like AWS and Azure, resulting in a significant decrease in demand for small and medium data centre providers ▪ The Scottish infrastructure market is still relatively immature. Scotland needs to keep pace with the evolution of this market. If it doesn't this will lead to a lack of skills needed to support next generation infrastructure services. This could minimise the number of customers considering Scotland as a data centre location – Scotland must invest in and promote development of the evolving high-tech and digital skills within the infrastructure services

Disclaimer: These five risks proposed by Gartner are based on consulting SME discussion, and do not exclusively reflect and cover the full extent of potential risks in the market

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- **Executive summary**
- **Data centre market trends**
- **Scenario based analysis**
- **Q/A**
- **Appendix**
- **Contact**

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Demand Drivers
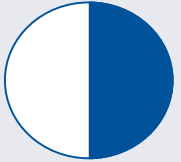
SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.9	What are some data case study examples where organizations are embracing change and transforming their data management and storage?	▪ **Case 1: Atos** were appointed by the Scottish Government to enter the data centre market and enhance the delivery of digital services to its citizens within the public sector ▪ Approximately £7.4bn has been invested both publicly and privately into digital initiatives in Scotland across a variety of industries such as healthcare, transport, education and connectivity; Atos have contributed to the transformation of data management and storage capabilities within the public sector, notably within the health industry having designed new systems for the NHS in Scotland ▪ Gartner predicts that the investments made alongside the transformation of these services will attract more Tier 1 and 2 providers / customers into the data centre market in Scotland, as every £1 of public sector investment in research and innovation is estimated to attract an average of £1.40 of private sector investment (basis, survey conducted in 15 European countries)* ▪ This would translate into an increase in demand for services provided by companies such as Atos and in turn also attract other infrastructure service providers to enter the market		

*Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/438763/bis-15-340-relationship-between-public-and-private-investment-in-R-D.pdf

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Demand Drivers

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.9	What are some data case study examples where organizations are embracing change and transforming their data management and storage?	▪ **Case 2:** The **Fortis data** data centre became the most energy efficient built centre in Scotland with an expected PUE of 1.18 costing an estimated £200m ▪ Due to the low PUE of the Fortis data centre alone, the average public sector organisation could save around £200k a year by moving away from their own in-house centres to hosting their equipment at Fortis ▪ Gartner predicts that Scotland's growing ability for next-generation data centres will promote other public sector players into realising the cost-effectiveness by accessing a multi-vendor data hosting framework, an initiative launched by the Scottish Government to utilise newly built data centres like Fortis ▪ Gartner analysts also predict that with the increase in edge data centres and improved latency, data centres like the Fortis data centre will appeal to larger companies who are seeking to reduce their transaction time and thus will drive investment to build additional capacity in Scotland		

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Demand Drivers

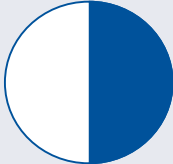| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.9	What are some data case study examples where organizations are embracing change and transforming their data management and storage?	▪ **Case 3: Sky**'s data centre in Edinburgh was recognised for its energy demand reduction drive and was included as a participant in the EU's Code of Conduct (CoC) for optimal energy efficiency in Data Centres ▪ Sky demonstrated adherence to a stringent set of practises on design, build and operation with a PUE of 1.33 which is significantly lower in comparison to other data centres in the vicinity ▪ Gartner predicts that new market players seeking to improve their energy efficiencies and costs, as a well as reducing their carbon footprint, will be more attracted to the data centre market in Scotland which is making progressive changes to the amount of power consumption used in data centres and also has an abundance of power generation through renewables		

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Demand Drivers

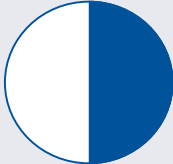| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.9	What are some data case study examples where organizations are embracing change and transforming their data management and storage?	▪ **Case 4: Google** implemented an artificial intelligence system designed by UK based company **DeepMind** to help cut down their energy usage for their data centres and successfully helped reduce energy consumption by up to 40% resulting in an estimated 15% PUE reduction in one of their data centres ▪ DeepMind's self-learning algorithms predicted how hot data centres would get within the hour and through sensor technology, activated cooling systems to operate at the required capacity only when needed ▪ In addition to helping reduce Google's emissions; this technology will also help other companies, who run on Google's cloud, to improve their own efficiencies ▪ By attracting Tier 1 operators such as Google into a data centre market, more companies are likely to store their data at their centres to benefit from continuous efforts to build innovative solutions to data storage such as their DeepMind initiative		

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Demand Drivers

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.9	What are some data case study examples where organizations are embracing change and transforming their data management and storage?	▪ **Case 5: VMware** partnered with an advanced endpoint security company **Carbon Black** to provide a new joint data centre security solution offering better protection against both current and emerging cyber security risks. Their solution improves response time to security incidents by leveraging Carbon Black's automation tools with VMware's endpoint security product to detect threats, quarantine machines and perform analysis ▪ Gartner predicts that by 2020, 60% of digital businesses will suffer major service failures due to the inability of IT security teams to manage risk; this tailored automated solution will alleviate the risks associated with human monitoring ▪ Gartner also predicts that by 2018, 25% of corporate data traffic will flow directly from mobile devices to the cloud, bypassing security controls. This solution is an optimal platform to detect such incidents for cloud-based and hybrid environments ▪ With security recognised as one of the most important factors when choosing a data centre, customers are more likely to choose markets that adopt innovative and collaborative solutions such as this case study		

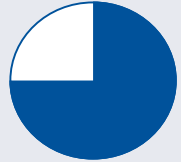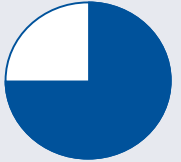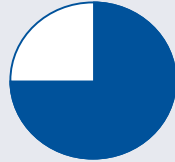# Demand Drivers

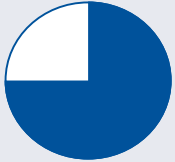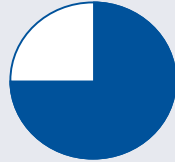| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	**Supply**
1.10	What are the requirements by reference of power to enable a total Scottish potential power need?	▪ The total power demand of the UK data centre sector is between 2.7 to 3.2TWh per year. Energy is usually the largest single element of operating costs for data centres, varying from 40 - 60%. If it is estimated that Scotland's data traffic/consumption is around 10% of the whole of UK, this translates into about 0.3 TWh per year. Using the average commercially available per KWh cost, i.e. 9-12p, the overall power consumption cost by the data centre market is estimated at around £27-36m (0.3 TWh * 9 to 12p/KWh) yearly in 2017 (source: SME/analyst figures) ▪ Data centre power demand is not growing exponentially due to Moore's law of power usage per unit of processing; It is still a significant increase of about 10-14% year on year, largely due to the exponential growth of demand for digital data ▪ As per this growth rate, the power consumption by data centre market in Scotland would reach around 0.55TWh per year, hence the power cost per year can be estimated to increase to about £50-£60m by 2022		

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Demand Drivers

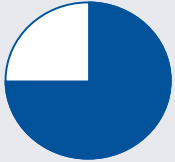| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.11	How will 5G and other emerging technologies increase the amount of 'edge' data centre capacity to provide these services?	▪ Approximately £7.4bn has been invested both privately and publicly into Smart City initiatives in Scotland across a variety of industries such as healthcare, transport, education and IoT ▪ These initiatives will require low latency so that city infrastructures can process decisions in real-time and ensure that the data is received and delivered as quickly as possible to meet with the needs of the consumer ▪ Gartner understands that the increase of 5G and other emerging technologies will directly impact the increase in the number of "edge" data centres to enhance the delivery of these new services and meet with low latency requirements ▪ Gartner predicts that Smart City and IoT initiatives in countries like the UK and other European geographies is estimated to increase the data traffic flow from the current 10-15% to around 20-25% YoY by 2022 ▪ As IoT usage increases, so will the demand for enhanced cloud cybersecurity; data centre operators should consider innovative security solutions to mitigate the key risks associated with cloud to attract customers currently using less advanced measures		

Demand Drivers

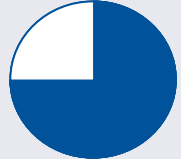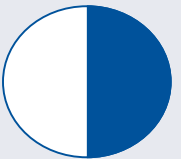| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.12	What are the core demands of the Scottish government's R100 program?	▪ The R100 programme states that 100% internet access will be provided for all premises in Scotland with a minimum 30mbps download speed by 2021 ▪ Scotland is well positioned to service its major cities with high speed bandwidth; however, given its hilly landscape and high amount of rural consumers; it will need to establish new data and aggregation points to ensure R100 requirements are met ▪ Gartner predicts more micro data centres would need to be built as well as an increase in both 5G and edge computing capacity that will drive the need for a higher number of large data centres ▪ Gartner believes that this increase of larger data centres can potentially attract new providers and customers into the data centre market in Scotland ▪ With high speed data as a general norm, there will be a spike in media consumption over the internet leading to an increased demand of micro and edge data centres		

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Demand Drivers

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.13	The report should consider the regulatory context of data governance and control in the light of both BREXIT and possible future constitutional reform of the United Kingdom and its relationship with Scotland.	▪ Brexit is expected to bring short-term negative impacts on business confidence that could lead to businesses stalling, postponing or cancelling project work in the UK, as well as migrating their headquarters to an EU territory ▪ Despite Brexit and GDPR initiatives taking place; large enterprises such as Google have stated that it will not affect their data interactions with the UK. There are potentially greater long term benefits forecasted such as a strong financial market and a politically stable environment ▪ In the advent of GDPR, Ireland would potentially be prioritised by both current and new data centre providers due to its continued status within the EU as this would be a more attractive stepping stone for providing services to other organisations within the EU. i.e. these providers would be required to adhere to just one supervisor's set of rules ▪ If Scotland maintained its EU status, it could potentially become a more attractive market for data centre providers and customers based in non-EU territories such as London, post Brexit		

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Public Sector

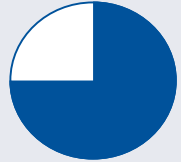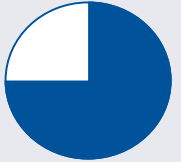| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.14	What are the future storage needs?	▪ Storage needs in the UK are estimated to increase by approximately 12% year on year, and with a surge of IoT devices and big data this year on year increase can spike to more than 15% growth ▪ With generated data estimated to be around 18 to 20 Zettabytes by 2025 in the UK, based on current trends, Scotland will account for approximately 10% that is ~ 2 Zettabytes by 2025 with no clear distinction of storage volumes across industries ▪ With the increase of storage requirements comes an increased risk of data breach, but current trends stipulate that in the fast approaching future only an estimated 23% of all data created will be stored ▪ Other risks include; redundancy, resiliency, sovereignty and security		

Public Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.15	What are the risks of inappropriate data managements facilities? (power failures, disaster recover failure, hacking etc.)	▪ Risks associated with power failures or data breaches can lead to business interruption / reputational risk, unwanted attention from the government regulators / regulatory risk, time consuming / large expenses on data recovery for numerous customers and legal lawsuits depending on the breach / monetary risk ▪ With the abundance of both renewable energy and fossil power, if Scotland manages to provide Tier 4 level facility requirements, risks related to power failures are minimised ▪ Gartner believes that in order to mitigate risk, Scotland must provide minimum entry point requirements which are Tier 4 level redundancy (2n+2) and security whilst providing better PUE efficiency		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.16	The report should consider the demand issues in the above sections in respect of enterprise data facilities and consider how the top businesses in Scotland could be/have been exposed to data breaches in recent periods. In so doing, the study should consider the burgeoning potential in the Scottish data sector, for example Rockstar / Skyscanner etc. and the growing Big Data sector. The report should consider how Scotland can harness the digital unicorns and develop expertise and demand from across the globe in these industries.	▪ Rockstar recently reported that several unauthorised attempts were made to access multiple Social Gaming accounts compromising sensitive data of its users ▪ Gartner understands that to meet with the needs of fast growing enterprises such as Rockstar; resiliency and reliability are essential factors that will directly impact the experience of the users of their services. Downtime or prevented access can damage confidence and result in a temporary loss of users ▪ With new GDPR regulations coming into place; enterprises are under greater pressure to ensure that sensitive data is better protected and breaches of this nature are faster reported; failure to do so will result in either a €20m fine or 4% of gross annual turnover (whichever is larger) ▪ With low latency as an essential requirement for the streaming of online video; an increased capacity of edge computing is essential to maintain the highest quality of delivery of services; Gartner understands that the increase of micro data centres required to enhance edge computing directly heightens security risks; therefore data centre operators must ensure tight security measures are in place to mitigate the new waves of risk		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
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1.16	The report should consider the demand issues in the above sections in respect of enterprise data facilities and consider how the top businesses in Scotland could be/have been exposed to data breaches in recent periods. In so doing, the study should consider the burgeoning potential in the Scottish data sector, for example Rockstar / Skyscanner etc. and the growing Big Data sector. The report should consider how Scotland can harness the digital unicorns and develop expertise and demand from across the globe in these industries.	▪ SkyScanner partnered with Dell to build new converged data centres in the UK with each centre equipped with Dell's blade solutions that optimised IT management and operations through providing a highly scalable, secure and flexible product to match the performance required to sustain its rapid growth ▪ To harness digital unicorns, data centre operators are faced with the challenge to maintain optimal quality of service to meet with the growing demands of such companies including the heightened sensitivity of possible data breaches despite a lack of evidence of this nature in Scotland ▪ With highly scalable data centres already built in Scotland such as the Fortis data centre, with a potential size of 500,000 sqft from its current 200,000 sqft, Scotland demonstrates the necessary requirements to attract fast-growing companies ▪ Gartner believes through the consolidation of the booming Fintech market in Scotland, an opportunity exists to service a StartUp with "unicorn" status potential, and in providing optimal data centre services that meet with its growing demands can further drive the demand for new entrants across the globe to store their data in what would be proven market		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.17	What different segments of demand derive from which industries?	▪ **Oil & gas**: With £2m recently made available by Scotland's Oil & Gas Technology Centre on a call for ideas on digital transformation and decommissioning; operators are looking to integrate cameras and sensors; send data streams that help perform complex-event processing and batch processing, which contributes to improving production; personnel safety; predictive maintenance and asset tracking. Stand-alone applications that serve local requirements may also be hosted; all these tasks will require large data centres with close proximity to enable fast decisions to be made ▪ With Scotland owning the largest oil reserves in the European Union with oil and gas exports reaching £11.4bn in 2015; Smart technologies come at an increased demand for larger data centres with the ability to store huge sets of data with advanced machine learning and AI in place to enhance business processes ▪ Gartner predicts that the demand for using large data centres in Scotland will rise to meet with the demands in the oil and gas industry for large data storage; also, an increase in digital data traffic will drive the demands for local micro data centres and edge computing capacity to ensure lower latency		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.17	What different segments of demand derive from which industries?	▪ **Finance**: Interxion, a data centre operator, is spending £30m to add more capacity to its site in London to add more edge capacity to meet with increasing demand for lower latency from banks and high-frequency traders ▪ The financial sector is subject to strict regulation and high levels of security and risk management across all areas; this has made the migration of data from on premise data centres into outsourced and cloud environments more challenging ▪ This presents a driving opportunity for the Fintech sector as a means of challenging the efficient control and analysis of the huge volumes of data collected; Scotland's Fintech sector is brimming with commercial opportunity, with over 86,000 people working in the financial sector and over 100,000 in the digital technology sector positioning Scotland to act as a catalyst for Fintech growth and drive demand for financial data storage in Scotland. With the sensitivity of the data being collected, new security vendor types will also enter the market. ▪ With increasing demand for low latency; Gartner believes that if the new subsea cable route from the USA to Scotland is landed then the market will will attract new Fintech / Banking players		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.17	What different segments of demand derive from which industries?	**Retail**: Verizon is is working with Tesco to move the retailer to a single global network infrastructure to link Tesco's suppliers, partners, customers and colleagues in 12 countries facilitating fast and efficient roll out of new technologies and services Retail companies are developing new digital strategy initiatives to enhance business productivity; video streams from surveillance cameras are aggregated in the server to measure store traffic flow and perform sentiment analysis to create heat maps that will optimise their operations management In order to store the large quantities of data; Scotland will need to ensure it has data centres with sufficient capacity to manage and aggregate all data for mining purposes. In addition, localised micro data centres will need to be built in close proximity to cities that have large retailers as well as larger data centres to ensure that data mining and storage requirements are met Gartner believes that an enhanced infrastructure of micro data centres and lower latency through 5G and edge computing capacity will drive demand for more retailers to adopt these new digital initiatives and encourage more customers to enter a local data centre market within Scotland		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.17	What different segments of demand derive from which industries?	▪ **Transport**: With Smart City initiatives developing across 3 cities in England and 7 in Scotland; government initiatives as well as private investments from venture capital and investment funds are driving technological innovation in the transport sector; including intelligent street lighting, Bus Tracker and intelligent city infrastructures in Scotland ▪ In order to ensure efficient delivery of services to enable Smart city initiatives, data centres will need to be capable of handling large quantities of data; edge computing, fixed wireless access (FWA) and 5G technologies will be required to ensure lower latency and smooth real time running of services; resiliency and reliability will also be fundamental to ensure 24/7 operations ▪ Gartner research finds that the majority of these investments are focused within the busier cities of Scotland; these investments will drive an increase in the number of micro data centres and edge computing capacity to ensure lower latency and enhance the delivery of these services		

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Enterprise Sector

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.17	What different segments of demand derive from which industries?	▪ **Manufacturing:** Unilever are leveraging the Internet of Things such as Amazon's Alexa platform to get closer to their customers with voice-powered searches to play a central part in their digital transformation ▪ Services have become diversified over time; as part of manufacturing services, data centre functions are being used increasingly to consolidate operations and integrate diverse manufacturing and service functions. Data centres are finding a larger role in automating routine manufacturing functions and analyzing data in order to improve operations and support services ▪ Gartner believes Scotland will need more micro data centres with an increased demand for edge computing capacity and 5G technologies to ensure low latency for automated routine manufacturing processes as well as being able to store and aggregate the data in order to improve operations ▪ With the sector growing, data centres must also have scalability to meet with the growing demand; with the Fortis centre having a maximum capacity of 500,000 sqft, Gartner believes that Scotland has attractive offerings for this sector		

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International Perspectives

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
1.18	Is there a correlation with submarine fibre cabling lands and data centre space consumption in the region?	▪ Scotland has a lack of sub sea cable entry-points in comparison to the rest of the UK with only two main access points through Ireland and Scandinavia; the rest of the UK and Ireland have multiple times the amount of access points with reach to larger market players within Europe, North America and Africa ▪ The amount of entry points is directly proportional to the data consumption in the UK; There is always an exponential increase in data flowing through new and existing cables, hence data centre providers with facilities located where they land benefit hugely ▪ Commercial data centre providers prefer to locate their facilities near both current and future cable landing stations to provide access points for network, cloud, content, social media, and enterprise customers		

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International Perspectives

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
Discussion Point	SFT and key industry stakeholders have sought to initially consider the value winners and value killers in the Scottish data centre sector which will be provided to the successful bidder. The successful bidder will develop this thinking and seek to establish what would encourage companies such as Google, Amazon, Apple and Netflix to put content in Scotland when other areas of the world, and indeed the UK, appear (at face value at least) to have a more compelling proposition. The report should comment on the key criteria used by the hyperscale providers to understand Scotland's ability to compete in this space.	▪ Gartner analysts confirm that the biggest driving force for large data centre organisations such as Google, Apple and AWS etc. is providing them with commercial incentives to operate within the geography; Ireland had considerable success in driving Tier 1 content providers through such an initiatives ▪ With a booming Fintech industry in Scotland, an opportunity exists to support consolidation of smaller Fintech companies into a more attractive high volume proposition to motivate larger providers to enter the market ▪ As one of the largest producers of renewable energy in Europe, Scotland can market its environmentally sustainable data centres to attract large Tier 1 companies who are seeking to reduce their carbon footprint		

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International Perspectives

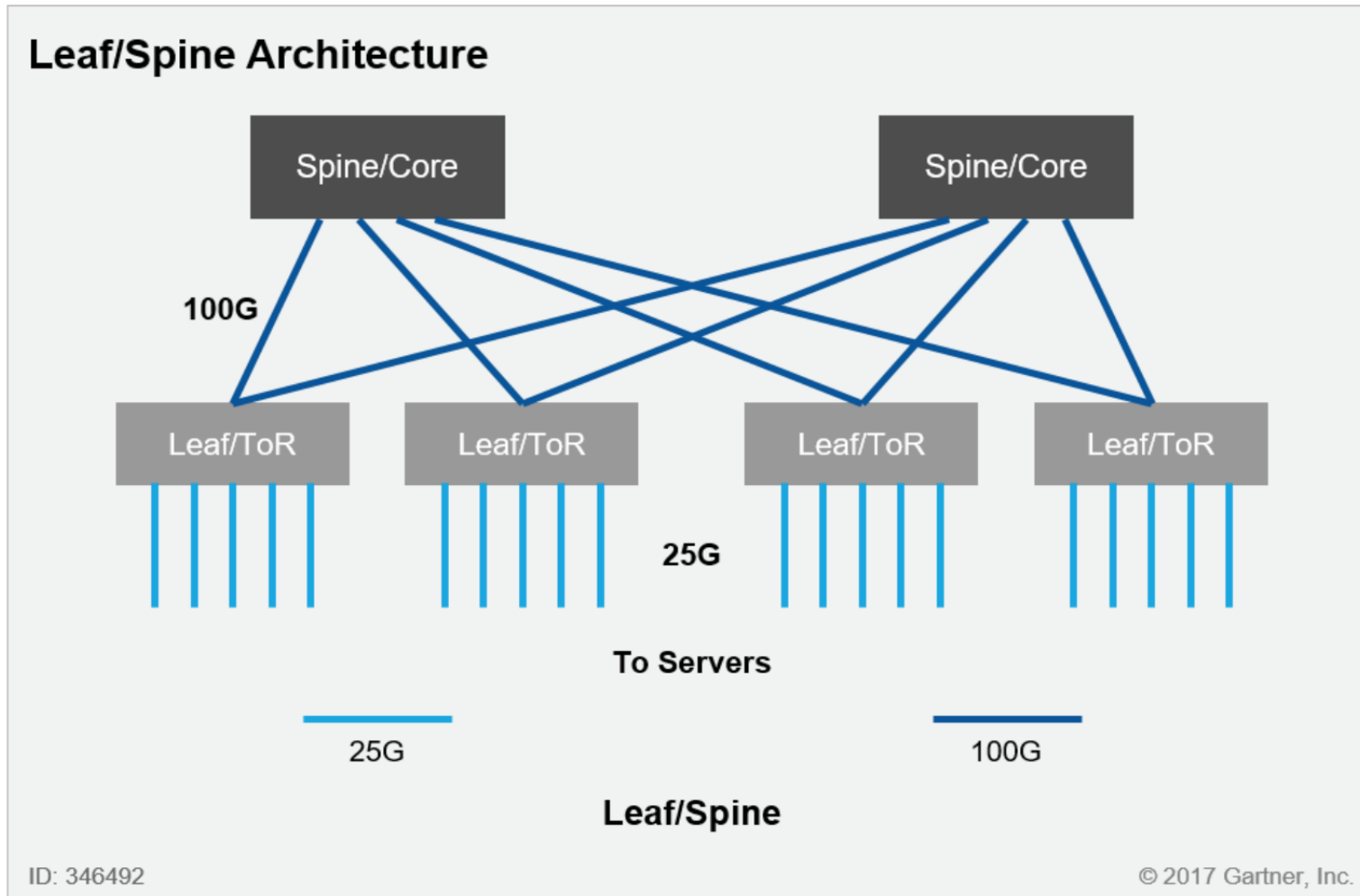| SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
Discussion Point	Why are countries such as England and Ireland more compelling propositions?	▪ Data centres with more access to landing sites are more attractive than those who do not; it also lowers the cost of access to the data in terms of overall wheeling power ▪ Ireland's continued status in the EU is an attractive option for customers seeking to minimise complications when adopting GDPR regulations; such organisations would only have to deal with one single supervisory ▪ With direct connectivity to submarine cables being essential, Scotland face strong competition from both Ireland and London as they have greater access to wider markets and therefore are more likely to attract Tier 1 enterprises		

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International Perspectives

SFT Reference	SFT Requirement	Observations / Implications	Impact To	
			Demand	Supply
Discussion Point	What are the opportunities that dark fibre in Scotland bring about for the infrastructure services?	▪ Dark fibre is a term given to the unused or unlit cables used in fibre optic communication. The unused network holds the potential for businesses and organisations to reap the benefits of a pure fibre connection, benefits include gigabit speeds and future-proof connectivity ▪ Several of Scotland's key cities have tapped into the potential of dark fibre that was left unused after the dot-com burst. Cities like Aberdeen, Edinburgh and Glasgow have become Gigabit Cities where business can thrive ▪ 50 mile dark fibre between Glasgow and Edinburgh was procured and put to reuse, which supports the connection between the Pulsant data centre in Edinburgh and Fortis data centre in north Lanarkshire, carrying tens of gigabits capacity ▪ With the ongoing digital revolution in Scotland, the dark fibre can definitely play a key role in efficiently improving the network's adaptability; but it can not be a driving force for this expansion ▪ There is lack of practical examples/evidence where the abundance of dark fibre has introduced or created demand for infrastructure services, but definitely it can support the increasing data consumption and data traffic flow between the cities		

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- **Data centre market trends**
- **Scenario based analysis**
- **Q/A**
- **Appendix**
- **Contact**

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Glossary

Term	Definition
Compounded Annual Growth Rate (CAGR)	A measure of growth over multiple time periods
CIVTech	Civtech brings together private sector innovation, public sector organisations and citizens to develop more efficient and effective products and services. Backed by the Scottish Government, it provides an unprecedented route for entrepreneurs, start-ups, SMEs and other businesses to develop the benefits of digital transformation in the public sector.
Edge computing	Extending the reach of the original data centre through use of micro data centres
Fixed wireless access (FWA)	An alternative means of providing internet connectivity that uses wireless technology
General Data Protection Regulation (GDPR)	A regulation by the European Parliament, the Council of the EU and European Commission to strengthen data protection within EU
Hyperscaler	Refers to the leading companies in the data centre industry
Internet of things (IoT)	The Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment
Latency	Measure of the responsiveness of a network, often expressed as the round-trip time (in milliseconds); that is, the time between initiating a network request and receiving a response
Micro data centre	Small sized hubs used to increase edge capacity of a main data centre
Private cloud	Private cloud is a form of cloud computing that is used by only one organisation, or that ensures that an organisation is completely isolated from others
Public cloud	A form of cloud computing that is available to the general public over the internet
Power Usage Efficiency (PUE)	The ratio of the total amount of energy used by a data centre facility to the energy delivered to computing equipment
R100	The Reaching 100% Programme ("R100") is striving to extend the availability of NGA broadband infrastructure to meet the Scottish Government's commitment to deliver superfast broadband access to 100% of premises in Scotland by 2021
Redundancy	A process through which additional or alternate instances of network devices, equipment and communication mediums are installed within network infrastructure. It is a method for ensuring network availability in case of a network device or path failure and unavailability
Resiliency	The ability to provide and maintain an acceptable level of service in the face of faults and challenges to normal operation. Threats and challenges for services can range from simple misconfiguration over large scale natural disasters to targeted attacks
Sovereignty	The concept that information which has been converted and stored in binary digital form is subject to the laws of the country in which it is located
Unicorn	A start-up company valued at more than a billion dollars, typically in the software or technology sector

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Leaf/Spine Architecture

Spine/Core   Spine/Core

100G

Leaf/ToR   Leaf/ToR   Leaf/ToR   Leaf/ToR

25G

To Servers

25G   100G

Leaf/Spine

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Source: Gartner (December 2017)

- Leaf/spine architectures map to prevailing application patterns that we see in the enterprise, in which traffic is increasingly server-to-server.
- The benefits of a leaf/spine architecture include better efficiency, scalability, consistent/deterministic performance, simplicity and availability, compared to traditional designs

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Gartner must-reads

- 2018 Planning Guide for Infrastructure and Operations Published: 29 September 2017

- Next-Generation Hyperconverged Integrated Infrastructure Must Include Machine Learning Published: 11 January 2018

- Hype Cycle for Infrastructure Strategies, 2017: 27 July 2017

- Market Opportunity Map: Infrastructure Outsourcing and Managed Services, Worldwide 17 May 2017

- Predicts 2018: Infrastructure Services in a State of Disruption: 07 December 2017

- IT Market Clock for Hybrid Infrastructure Services, 2017: 22 September 2017

- Gartner Report: What Data Center and Enterprise Communications Service Providers Need to Do Now About Brexit Published: 27 July 2016

- Hype Cycle for Hybrid Infrastructure Services, 2017: 25 July 2017

- Top 10 Strategic Technology Trends for 2018: 03 October 2017

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