Smart Communications – the choices

A summary review prepared by:

Peter Franklin, Director Enstra Consulting

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About this document:
Enstra Consulting has been commissioned by Zouk Capital to review the issues facing the government as it decides on the communications architecture to be deployed to support the roll-out of smart metering.

Enstra Consulting is a niche strategy consultancy focused entirely on the energy and utilities arena. Enstra is led by Peter Franklin, the author of this document. Peter has over 30 years' experience in the industry in both senior management roles, and senior consulting positions. Peter has followed Smart metering activities both in the UK and internationally since its inception, and is a regularly published author in this specific domain as well as on industry developments and issue in general.

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Executive Summary – Maximising competition and minimising risk

The race to provide communications services to underpin Smart Meter roll-out is nearly over. The government will be deciding in June/July on who will be granted one or more of the 3 regional contracts for becoming a Communication Services Provider (CSP).

In making their determination the government needs to look at the Smart metering system as a whole to determine which option delivers maximum value for GB Plc. It is definitely not the case that lowest CSP tender price alone is the best value. This is because each of the options brings with it a set of consequences which can have material impacts on the economic outcomes of Smart Meter roll-out. These include the total cost of ownership, risk, and coverage.

The considerations which need to be examined alongside the simple tender price are as follows:

1. The costs and benefits of multiple vs single CSP supply
2. The ability of different technologies to deliver the information needed for consumers to access the energy savings that Smart Metering can facilitate
3. The delivery risks associated with alternative spectrum choices

This review looks at each of the above questions in turn and concludes that:

1. **Multiple CSPs are by far the most economically attractive option due to the benefits derived from greater innovation, supply chain competition, and change management transparency over the 15 year contract period. Savings from a dual CSP option vis a vis a single CSP could be as much as £686 million over the 15 year period of the contract. Savings from a triple CSP solution could be as much as £1,016 million**

2. **Only technologies that can deliver full smart metering functionality at the time of install should be chosen. Without this consumer experience will suffer and the energy savings which would come from their changed behavior will be lost. This is the driving force behind the Smart Meter programme and must not be compromised**

3. **There are significant risks associated with using unlicensed, and currently unavailable, spectrum in the 870-876 MHz band. These should be avoided as there are many licensed and available spectrum options available.**

Bidding for the CSP contracts – the final furlong

June and July 2013 are critical months for the GB Smart metering programme as the government decides on the architecture for data services and communications infrastructure to support Smart Meter roll-out across the country.

For the purposes of procuring the requisite communications infrastructure and service provision Great Britain has been split into 3 geographical areas:

1. Northern England and Scotland
2. Midlands and Wales
3. South of England

Interested companies were asked to put forward proposals to take up one or more of these Communications Service Provider (CSP) opportunities on a monopoly service provision basis for each region. There are 4 bidders left in the race to supply CSP infrastructure and operations for one or more of these regions.

The remaining bidders are Airwave, Arqiva (leading the SmartReach consortium), Telefonica, and Vodafone.

With the exception of Airwave, they are bidding for all three regions with Airwave only looking to provide services to Scotland and the North.

Choosing CSPs to maximise value for GB Plc.

The GB Smart metering programme represents the convergence of two worlds: the world of energy and the world of telecommunications. Indeed whether the world of energy succeeds in delivering its Smart metering programme will depend on whether the government puts in place an appropriate telecommunications solution to support roll-out.

The chosen solution or solutions need to offer the best overall outcome for GB Plc. when seen in the round. The considerations which need to be taken into account are consumer impact, cost, coverage and risk.

Consumer Impact

As will be seen some options risk jeopardising the consumer behavioural change needed to deliver the energy savings which are the driving rationale behind the Smart Metering programme.

When looking at the broader impacts of technology choice on the Smart Metering business system, sight must not be lost on the overall aim of the programme which is to enable consumers to take control of their energy by making their use of energy clearly visible to them. This then allows them to change their behaviours and to both save energy and potentially to shift its use if required. The ESMIG (European Smart Metering Group) studies of international experience on the impact of the adoption of Smart Meters with IHDs (in-home displays) found that average energy savings of 9% were achieved. That is more than three times the saving assumed in the DECC Smart Metering Business case. If national roll-out achieves a similar outcome – and there is no reason why it should not – the benefits to GB Plc. in terms of reduced energy imports, improved balance of trade, increased supply security, and reduced carbon emissions will be unarguable. For British households the energy savings will provide extremely welcome relief from rising energy prices. However, for these savings to be realised, the Smart Meter roll-out has to deliver the consumer experience that triggers the change in behaviour. So each technological solution needs to be appraised on its ability to deliver this.

A less than optimal consumer experience will also potentially drive unfavourable publicity, and a lack of consumer willingness to co-operate fully with the roll-out. This would in turn lead to increased costs as suppliers find themselves with higher levels of aborted visits as consumers fail to be at home when required.

Cost

In addition consideration needs to be given to what would be the potential costs and benefits of moving to a single supplier of communication services versus multiple supply. On the one hand there are some cost savings in having a single interface with the DCC (Data Communications Company) rather than having to build multiple interfaces. However, these one-time costs pale into insignificance when compared to the on-going costs of operating and maintaining the WAN (Wide area network) over the 15 year term of the contract, and the savings that could accrue from increased innovation and supply chain competition in a multiple supplier environment.

There is also the insurance value of multiple supply – since should there be a supplier failure having operational alternatives will be a much cheaper solution than having to start the communications service provider (CSP) selection process from scratch.

Risk

Finally consideration needs to be given to the suitability of the spectrum to be used to the needs of Smart metering. Should the spectrum be owned by CSPs or should it be publically available shared spectrum? The latter option may bring with it issues of interference with other services using the same spectrum (with potential damaging impacts on both smart metering and the other services). It may also bring with it issues of congestion and bandwidth availability which may negatively impact Smart metering service provision.

As can be seen from the foregoing it is not simply a case of choosing the lowest cost CSP solution – the decision needs to look at the Smart Metering system as a whole to make an informed judgement regarding the optimum solution for GB Plc.

So the key considerations that the government needs to assess when determining the architecture of communications services to underpin the GB Smart Metering programme are:

- Whether there should be single, dual or triple CSP supply provision
- Which Technology or technologies should be deployed
- Which telecommunications spectrum should be used

Should there be single, dual or triple CSP supply provision?

At the start of the tendering process the government wisely decided to break the country into three separate regions with the possibility of providers securing one or more areas. Whilst within an area a monopoly situation will persist over the 15 year life of a communications service provider (CSP), nationally one could have a single monopoly, or have two, or three different providers. What are the benefits and risks associated with each of the options?

It is essential for Great Britain to have more than one CSP to assure both economic and delivery sustainability.

This is because multiple CSPs deliver:

- Lower overall cost over the lifetime of the contract
- Lower levels of risk
- Ensure Scotland is not left lagging behind in Smart metering roll-out

Lower overall cost over the lifetime of the contract

If a single supplier is granted all three regions there will be an absence of comparator(s) to keep the monopoly supplier honest. For years the benefits of having comparators have been proven in other businesses where natural regional monopolies exist such as the water industry, and the gas and electricity distribution sectors. The provision of CSP services in the energy sector is no different. Having comparators will allow regulators to ask the question of why the service is more expensive in one region than another and what can be done about it. Without comparators this simply cannot happen.

Having multiple CSPs will drive competition in the supply chain to CSPs. In a world of transparent comparison CSPs will vie with each other to achieve the lowest cost solution through putting pressure on their supply chain. In a GB-wide monopoly, this would not be the case since cost pass-through would be much easier.

In a single CSP world the supplier can demand whatever price it desires for changes outside the contract specification over the coming 15 years. It is impossible to include every possible eventuality in a supply contract written today. There will inevitably be demands for changes and these need to be cost controlled. Without comparators and supply chain competition, this will simply not be possible and costs will rise.

A poignant example of the danger of creating a single supplier is the de-facto selection of BT as the sole provider of the BDUK (Broadband Delivery UK) scheme which is installing high-speed broadband in rural areas. The National Audit Office has heavily criticized the Department of Culture, Media and

Sport for allowing the creation of a structure that lacks transparency and competition and thus leads to inflated pricing.

Finally, having multiple CSPs will lead to higher investment in innovation in GB Plc. – which in itself paves the way for economic growth both domestically and internationally.

We have modelled the trade-off between initial implementation cost of multiple versus single CSP supply and the benefits that would come from increased comparison, supply chain competition, and innovation.

The results clearly indicate, that over the duration of the contract, and based on conservative assumptions regarding the savings that might come from innovation and competition, that a multiple CSP architecture is certain to be the most cost effective option.

Whilst there is some work duplication in moving from a single CSP to multiple providers, here are significant offsets which more than counterbalance these in terms of:

- Comparator availability. Being able to contrast the costs achieved by one provider with those of another will lead to prices being driven down over time. This particularly true in the area of change requests where a monopoly position would risk seeing these costs escalate.
- Increased innovation due to having two or three R&D teams rather than one. This will drive costs down over the 15 year timeframe of the contract
- Supply chain competition. As multiple providers vie with each other to perform best, there will be increasing pressure on the supply chain to find lower cost solutions over the duration of the contract

The analysis shown in the Appendix looks at the cost savings of having multiple rather than single CSP supply for a range of assumptions regarding the offsets described above.

The analysis looks at a range of cost savings over 15 years driven by innovation and supply chain competition. This range goes from 0% to 20%. This is only applied to on-going costs and not to start-up costs since these are determined in the existing bids. The analysis also looks at the potential savings on change requests and uses a range of 0% to 40%.

What is clear is that the Dual CSP option is cheaper than the Single CSP option in all outcomes where the savings from comparison, innovation and supply chain competition are greater than 1% over the 15 year period. If the maximum savings examined were delivered i.e. 20% innovation and supply competition and 40% on change requests, the savings would be £686 million over the term of the contract.

The triple CSP option would be cheaper if savings exceed 1.5% over the term of the contract. In this case the savings at maximum would be £1,016 million over the term of the contract.

It seems inconceivable that savings will be less than 5% over the term of the contract, and may well be more in the 10-15% range making the multiple CSP option the best economic alternative.

Lower levels of risk

CSPs could breach their contracts or suffer a technical failure. Since there are significant technical risks in deploying a meter networking solution across a nation-wide geography, DECC would be well served to have viable alternatives in play. In a multiple CSP world, Government would have the availability of a supplier of last resort (i.e. one of the other CSPs) who would have the operating technologies and processes in place to take over much more quickly and at much lower cost than an organisation outside the Smart Metering CSP arena.

This would additionally avoid the time and cost of retendering if a supplier fails.

Ensure Scotland is not left lagging behind in Smart metering roll-out

In a world controlled by one CSP the focus may well be on lowest implementation cost areas. These are likely to be urban rather than rural areas which could well mean that the pace of roll-out in remote areas, such as the North of Scotland, is held back. This would clearly be to the detriment to those living in those areas given the overall benefits of the Smart Metering programme.

Which Technology or technologies need to be deployed?

There are three principle technologies in the frame:

- GPRS with some Mesh radio infill from Telefonica.
- Long Range radio: The existing Long Range Radio (LRR) Network operated by Airwave and the proposed extension of the LRR network by Arqiva
- Mesh radio from Vodafone

1. GPRS from Telefonica

   GPRS is a well-established technology that has been operational across the UK for many years. Its main issue is geographical coverage, given that 100% of Great Britain needs to be covered for Smart Metering to be a truly universal feature of the energy landscape. To achieve this, Telefonica is looking to use mesh radio for infill where GPRS coverage is poor.

2. Long range radio from Arqiva and Airwave

   Long range radio is a proven technology in the UK.

   Airwave have been deploying this type of technology to provide communications services for "blue light" services (fire, police, ambulance) for many years.

   Arqiva have been running a trial of long range radio in England and Scotland which are reported as having been successful in communicating with both easy to reach and hard to reach buildings.

3. Mesh radio from Vodafone is a proven technology in the US where it has been the technology of choice for Smart Meter deployments. However, the US is characterised by externally sited meters and monopoly metering service provision whereas Great Britain has a mix of internal and external meters, and a supplier- based roll-out in a fully liberalised and competitive market structure.

   To function effectively, Mesh radio needs to achieve critical mass nodes in a locality for a mesh to form as signals hop from house to house until they can reach the transmitter base station for onward transmission back to the CSP. In the US this was achieved through street by street deployments as metering deployment is implemented by a single party. In GB roll-out this is not the case since each energy supplier will make its own decision as to which

streets they will do at any particular time in the roll-out programme.

Local Mesh networks in Great Britain may also suffer from planning delays since they require the installation of communications equipment on street furniture e.g. street lights wherever a local mesh is desired. Typical global deployments of mesh use over-ground power infrastructure to site communications equipment, but Great Britain typically has underground infrastructure in most areas, so this model cannot be used.

This means that effective local meshes may not develop for some time in particular geographies.

Therefore either a back-up radio system needs to installed alongside mesh (with the associated cost penalty) or consumers will have to wait between Smart Meter installation and the time when their smart meter and IHD become fully operational. For example: supplier tariffs need to be loaded to the smart meter to enable the IHD to display energy costs; this requires a fully operational mesh to achieve. In effect, the smart metering system will behave as a legacy "dumb" meter until the mesh forms completely such that communication to all homes is possible.

Provision for this has been made in the procurement process by allowing a three month grace period, called "Install & Leave" between installation of meters, communications infrastructure, and delivery of IHDs.

To understand the implications of "Install & Leave" on GB Plc. it is important to look at the drivers of value from the Smart Metering programme.

The diagram below illustrates the three drivers of value:

- Roll-out costs
- Energy costs
- Operating costs

Clearly what is wanted is a solution that minimises all of these.

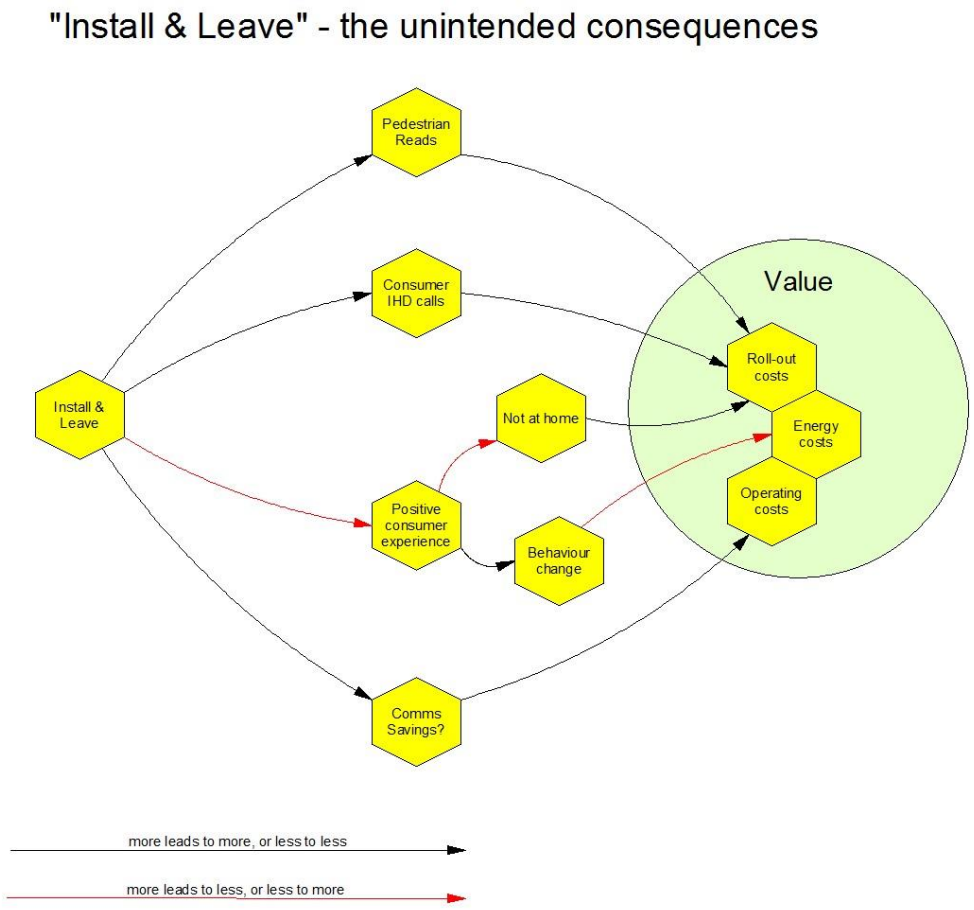
On the left hand side of the diagram (see next page) there is the "Install & Leave" hexagon. The arrows leading from it describe its impact on elements of the Smart Metering system which in turn impact on the value drivers.

A black arrow indicates that more of the entity at the start of the arrow leads to more of the entity at the end of the arrow, or less leads to less.

A red arrow indicates that more of the entity at the start of the arrow leads to less of the entity at the end of the arrow, or vice versa.

So for example, more ”Install & Leave” leads to more “Pedestrian Reads” as traditional meter reading needs to continue until effective communications are established. This was a major source of cost over run in the US deployment of mesh.

Looking at a red arrow, more “Install & Leave” leads to less “Positive Consumer experience” as householders are left with a lack of functioning equipment on the day of Smart Meter install.



So looking at the system as shown in the diagram we can see a host of unintended consequences emerging:

- More “Install & Leave” leads to more “Pedestrian Reads” which in turn leads to more “Roll-out costs”. A value destroyer.
- More “Install & Leave” will lead to more calls to supplier call centres regarding IHDs which are not functioning as advertised. This in turn also increases roll-out costs and works against the Smart Metering business case.

- Most importantly more “Install & Leave” leads to less “Positive consumer experience” since the IHD and Smart Meter will not perform as promised on the day of install. Less “positive consumer experience” then leads to less consumer “behaviour change” which in turn leads to more “Energy costs”. This actually threatens the achievement of the primary objective of the Smart Metering programme itself.
  In addition less “Positive consumer experience” leads to more “Not at home” i.e. consumers not being at home to enable successful installation. This will happen as word of mouth spreads dissatisfaction with the experience of staying at home to receive smart meters and an IHD but not to have them fully functioning.
- Set against all of the above there might be some cost savings associated with the technology but whether these exist or not will only be known once the various tenders are submitted.

Even if mesh radio could avoid “Install & Leave” by convincing the government to mandate a full street by street solution there remains the question of its ability to communicate with meters sited inside buildings, through thick walls, in basements etc. The transmit power levels and bandwidth being considered by OFCOM for GB smart metering are far more restrictive than what is available in North America. Therefore, the success that mesh has enjoyed in North America will **not** be easily replicated in the GB roll-out.

This is evidenced by the significant industry disquiet regarding the problems that may arise with mesh radio solutions in the GB roll-out context as exemplified by some quotes from industry players during the recent hearings on Smart Meter roll-out by the Energy and Climate Change committee in the House of Commons.

Stuart Rolland, Managing Director – Smart Metering, British Gas: “Our concern on the 97.5% [coverage] is how quickly it can be got up and running. If you look at other networks, mesh-based networks, radio-based networks, they will get to that level of coverage but how long does it take to achieve that because mesh needs a sort of critical mass in a given region to achieve that. By the time the DCC goes live, we will have an engineer population of 2,000 or 3,000 engineers who we do not want sitting on their hands because they can’t commission a smart meter in that particular region. “

Darren Braham, First Utility: “if they do use some wireless technology that does not have the same coverage at the point of launch that would be a big problem for us because we do not have the luxury of saying, Right, we will pick and choose you guys because we have coverage in that particular area. From a competition point of view and independent supplier perspective, that is an issue.”

Tony House, Smart Programme Director, SSE: “One of the very important key enablers is to ensure that we have that wide area network coverage in line with our roll-out projections, otherwise we will have to be selective as to where we go and that leads to a poor customer experience. Alternatively, it may be that we arrive at premises and we have to walk away because we do not have comms. Again, that is not driving a good customer experience.”

From our discussions with the industry it is clear that a positive consumer experience is eminently achievable as evidenced by Centrica's roll-out activities to date. It is important that this is replicated during the main roll-out programme.

In order to mitigate the potential risks associated with Communication Service Provision the government should only choose technologies and solutions that have been fully proven in Great Britain, and which avoid "Install & Leave"

Which telecommunications spectrum should be used?

Some of the potential CSPs are offering solutions based on licenced spectrum and others are proposing to use a currently un-licenced and unavailable band (870-876 MHz and its duplex 915-921 MHz). Part of this band (870-872 and its duplex of 915-917) is currently owned by the MOD (Ministry of Defence) and is being cleared of users in preparation for its more general release should this be approved. The rest of the band is currently used by other licensed services.

OFCOM has consulted on the benefits and risks of release of the bands 870-876 MHz and 915-921 MHz. This consultation is due to report by the end of June 2013, with the spectrum being potentially made available after spring 2014. In addition to the spectrum award, a statutory legislative change is required to confirm the duty cycle and power. The impact of this may well render the spectrum not fit for purpose.

Should Great Britain pick a solution utilising the 870-876 unlicensed band[1]?

Given the importance of the success of Smart meter roll-out it would seem prudent for the government to pick a solution based on existing licensed or other available spectrum in order to minimise risk.

This is because using existing licensed spectrum minimises:

- Availability risk
- Performance risk
- Coverage risk
- Cost risk
- Legislative change risk

<u>Availability risk</u>

The spectrum under consideration (870-876 MHz) will not be released until 2014 at the earliest – and therefore cannot be effectively tested and proven across Great Britain until nearing the beginning of National roll-out (the "Enduring" phase of Smart meter roll-out).

The decision by OFCOM to release the spectrum will have to await the CEPT (European conference of postal and telecommunications administrators) process to allow member states to release this

[1] The 915 – 921MHz band is essentially off limits to smart metering, , due to location of four high powered RFID channels within this band, in addition to the ER-GSM downlink in the 918 – 921MHz band.

spectrum. This will not be complete until the end of 2013 at the earliest. Interestingly, an independent report commissioned by the CEPT highlights potential interference issues between service providers aiming to use this spectrum (see performance risk section below).

- http://www.cept.org/Documents/se-24/10702/Temp02_WI41-Draft-ECC-Report-v0201-changes-in-sections-3322-and-35

- Given the in-process status of release investigations there can be no guarantee that this band will be released. In addition to the spectrum award a statutory legislative change is required to confirm the duty cycle and power. The impact of which may leave the spectrum not fit for purpose.

Performance risk

OFCOM's consultation document recognises that there are multiple service providers wishing to use the 870-876 MHz band (or adjacent bands) for communications.

These include:

- Meteorological service wind monitoring
- Rail safety and signalling (GSM-R)
- Future High-speed rail safety and signalling (GSM-ER, as used in European high speed rail services)
- RFID tags (Radio frequency identification tags)
- Smart Meter HAN (Home area network – in-home communications)
- Home automation and Alarms

Using this band for a ubiquitous Smart metering WAN (wide area network – meter to industry communications) may be fraught with difficulty for four reasons:

1. Interference between services. The recent CEPT report cites a 47% chance of interference between Smart metering WAN communications and other services. Whilst probably not an issue for smart metering it could well be for safety critical systems like those used on the railways.

2. Data transfer delays. Due to band sharing by multiple services the duty cycle is restricted. The duty cycle basically dictates the available bandwidth. The consequence of this is that the amount of data that can be handled per second is extremely small. So for example sending a 1-2 MB file would take approximately 60 days. This is the size of file that an energy supplier would want to transmit to upgrade the firmware of a meter or other energy supply device.

This will greatly downgrade an energy supplier's ability to manage their meter portfolio effectively, potentially causing detrimental billing and customer service issues.

3. Accessing hard-to-reach locations. This band of spectrum, if released, will be for low power applications only, and may well suffer from performance issues where communications boxes are located in hard-to-reach locations such as basements. This is very different from the situation in North America where the spectrum used allows transmit power levels and available bandwidth that are an order of magnitude greater than what is being considered for the GB roll-out.

4. In the particular case of Mesh radio - delays to mesh formation. Due to the low power of radio communications within this spectrum band there needs to be a critical mass of nearby sited nodes (meters and associated communication boxes) for a mesh to form and operate. Given the nature of supplier led roll-out in Great Britain this is unlikely to occur until well into the rollout programme since different energy suppliers will choose different streets for their Smart metering programmes at different times. This effect will be exacerbated in rural areas.

Cost risk

Again, due to the roll-out approach, mesh in-fill will have to be used until critical mass of installations is used and an operating mesh network forms. This in-fill is most likely to be cellular based. However, if significant in-fill is required this carries with it a cost penalty. In addition, as the CSP has no say over where the smart meters will be installed through the rollout programme, the volume of cellular connections is likely to be very high in the initial rollout. If the number of expensive in-fill connections is artificially restricted, the result will be widespread coverage gaps.

Legislative risk

It should be noted that it is a stipulation of the procurement process that tenderers needed to confirm that they have access to currently available spectrum which is fit for purpose. Clearly the 870-876 MHz band is not currently available, and may not be fit for purpose.

This then brings with it the risk that should one of the bidders lose out to a bidder using this spectrum that a legal challenge might well be mounted. This has the potential to delay Smart Metering roll-out even further since it could delay the implementation of the communications infrastructure by a year or more.

Creating maximum value

In order to mitigate the potential risks associated with Communication Service Provision the government should do the following:

- **Follow its original plan, as structured in the tender process, and award different regions to different CSPs, or as a minimum have two suppliers**
- **Only choose technologies and solutions that have been fully proven in Great Britain, and which avoid "Install & Leave"**
- **Avoid the use of the unlicensed, and as yet unavailable, 870-876MHz spectrum**

Appendix – Sensitivity analysis Single vs Multiple CSP

Base Assumptions

CSP deployment costs over 30m homes (whole UK)

	Cost per home	Single CSP	% innovation saving	Dual CSP	% Innovation saving	Tri-CSP	
Total Setup Costs nationwide							
Pre-Integration	£3.00	£90,000,000	0.0%	£90,000,000	0.0%	£90,000,000	estimate
Systems Integation	£5.00	£150,000,000	0.0%	£150,000,000	0.0%	£150,000,000	estimate
Rollout/Coverage	£10.00	£300,000,000	7.0%	£279,000,000	10.5%	£268,500,000	estimate
SMWAN Field Unit Assets	£25.60	£768,000,000	7.0%	£714,240,000	10.5%	£687,360,000	DECC Impact Assessment
Total Fixed Setup costs per CSP							
User Integration	£1.00	£30,000,000	0.0%	£60,000,000	0.0%	£90,000,000	estimate
Change Requests	£0.80	£24,000,000	20.0%	£38,400,000	30.0%	£50,400,000	estimate
Total Operating costs							
WAN (over 15 years)	£5.30	£2,385,000,000	7.0%	£2,218,050,000	10.5%	£2,134,575,000	DECC Impact Assessment
Communications hub	£5.00	£150,000,000	7.0%	£139,500,000	10.5%	£134,250,000	estimate
Total Cost to UK exc penalties		**£3,897,000,000**		**£3,689,190,000**		**£3,605,085,000**	
Savings				**£207,810,000**		**£291,915,000**	

Single versus Dual CSP – Sensitivity.

Pink = Single CSP lower cost. Yellow = Dual CSP lower cost.

Figures show savings in £ million over the lifetime of the contract.

£58.89	0.0%	2.5%	5.0%	7.5%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%	32.5%	35.0%	37.5%	40.0%	Change request saving
0.0%	-54	-53	-52	-50	-49	-48	-47	-46	-44	-43	-42	-41	-40	-38	-37	-36	-35	
0.5%	-36	-35	-34	-32	-31	-30	-29	-28	-26	-25	-24	-23	-22	-20	-19	-18	-17	
1.0%	-18	-17	-16	-14	-13	-12	-11	-10	-8	-7	-6	-5	-4	-2	-1	0	1	
1.5%	0	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19	
2.0%	18	19	20	22	23	24	25	26	28	29	30	31	32	34	35	36	37	
2.5%	36	37	38	40	41	42	43	44	46	47	48	49	50	52	53	54	55	
3.0%	54	55	56	58	59	60	61	62	64	65	66	67	68	70	71	72	73	
3.5%	72	73	75	76	77	78	79	81	82	83	84	85	87	88	89	90	91	
4.0%	90	91	93	94	95	96	97	99	100	101	102	103	105	106	107	108	109	
4.5%	108	109	111	112	113	114	115	117	118	119	120	121	123	124	125	126	127	
5.0%	126	127	129	130	131	132	133	135	136	137	138	139	141	142	143	144	145	
5.5%	144	145	147	148	149	150	151	153	154	155	156	157	159	160	161	162	163	
6.0%	162	163	165	166	167	168	169	171	172	173	174	175	177	178	179	180	181	
6.5%	180	181	183	184	185	186	187	189	190	191	192	193	195	196	197	198	199	
7.0%	198	199	201	202	203	204	205	207	208	209	210	211	213	214	215	216	217	
7.5%	216	217	219	220	221	222	223	225	226	227	228	229	231	232	233	234	235	
8.0%	234	235	237	238	239	240	241	243	244	245	246	247	249	250	251	252	253	
8.5%	252	253	255	256	257	258	259	261	262	263	264	265	267	268	269	270	271	
9.0%	270	271	273	274	275	276	277	279	280	281	282	283	285	286	287	288	289	
9.5%	288	289	291	292	293	294	295	297	298	299	300	301	303	304	305	306	307	
10.0%	306	308	309	310	311	312	314	315	316	317	318	320	321	322	323	324	326	
10.5%	324	326	327	328	329	330	332	333	334	335	336	338	339	340	341	342	344	
11.0%	342	344	345	346	347	348	350	351	352	353	354	356	357	358	359	360	362	
11.5%	360	362	363	364	365	366	368	369	370	371	372	374	375	376	377	378	380	
12.0%	378	380	381	382	383	384	386	387	388	389	390	392	393	394	395	396	398	
12.5%	396	398	399	400	401	402	404	405	406	407	408	410	411	412	413	414	416	
13.0%	414	416	417	418	419	420	422	423	424	425	426	428	429	430	431	432	434	
13.5%	432	434	435	436	437	438	440	441	442	443	444	446	447	448	449	450	452	
14.0%	450	452	453	454	455	456	458	459	460	461	462	464	465	466	467	468	470	
14.5%	468	470	471	472	473	474	476	477	478	479	480	482	483	484	485	486	488	
15.0%	486	488	489	490	491	492	494	495	496	497	498	500	501	502	503	504	506	
15.5%	504	506	507	508	509	510	512	513	514	515	516	518	519	520	521	522	524	
16.0%	522	524	525	526	527	528	530	531	532	533	534	536	537	538	539	540	542	
16.5%	540	542	543	544	545	546	548	549	550	551	552	554	555	556	557	558	560	
17.0%	559	560	561	562	563	565	566	567	568	569	571	572	573	574	575	577	578	
17.5%	577	578	579	580	581	583	584	585	586	587	589	590	591	592	593	595	596	
18.0%	595	596	597	598	599	601	602	603	604	605	607	608	609	610	611	613	614	
18.5%	613	614	615	616	617	619	620	621	622	623	625	626	627	628	629	631	632	
19.0%	631	632	633	634	635	637	638	639	640	641	643	644	645	646	647	649	650	
19.5%	649	650	651	652	653	655	656	657	658	659	661	662	663	664	665	667	668	
20.0%	667	668	669	670	671	673	674	675	676	677	679	680	681	682	683	685	686	

Innovation and competition saving

Single versus triple CSP – Sensitivity.

Pink = Single CSP lower cost. Yellow = Triple CSP lower cost.

Figures show savings in £million over the lifetime of the contract.

£291.92	0.0%	2.5%	5.0%	7.5%	10.0%	12.5%	15.0%	17.5%	20.0%	22.5%	25.0%	27.5%	30.0%	32.5%	35.0%	37.5%	40.0%	Change request saving
0.0%	-108	-105	-103	-100	-97	-95	-92	-89	-86	-84	-81	-78	-76	-73	-70	-68	-65	
0.5%	-81	-78	-76	-73	-70	-67	-65	-62	-59	-57	-54	-51	-49	-46	-43	-40	-38	
1.0%	-54	-51	-49	-46	-43	-40	-38	-35	-32	-30	-27	-24	-22	-19	-16	-13	-11	
1.5%	-27	-24	-22	-19	-16	-13	-11	-8	-5	-3	0	3	5	8	11	14	16	
2.0%	0	3	5	8	11	14	16	19	22	24	27	30	32	35	38	41	43	
2.5%	27	30	33	35	38	41	43	46	49	51	54	57	60	62	65	68	70	
3.0%	54	57	60	62	65	68	70	73	76	78	81	84	87	89	92	95	97	
3.5%	81	84	87	89	92	95	97	100	103	105	108	111	114	116	119	122	124	
4.0%	108	111	114	116	119	122	124	127	130	132	135	138	141	143	146	149	151	
4.5%	135	138	141	143	146	149	151	154	157	160	162	165	168	170	173	176	178	
5.0%	162	165	168	170	173	176	178	181	184	187	189	192	195	197	200	203	205	
5.5%	189	192	195	197	200	203	205	208	211	214	216	219	222	224	227	230	232	
6.0%	216	219	222	224	227	230	232	235	238	241	243	246	249	251	254	257	259	
6.5%	243	246	249	251	254	257	259	262	265	268	270	273	276	278	281	284	286	
7.0%	270	273	276	278	281	284	287	289	292	295	297	300	303	305	308	311	314	
7.5%	297	300	303	305	308	311	314	316	319	322	324	327	330	332	335	338	341	
8.0%	324	327	330	332	335	338	341	343	346	349	351	354	357	359	362	365	368	
8.5%	351	354	357	359	362	365	368	370	373	376	378	381	384	386	389	392	395	
9.0%	378	381	384	387	389	392	395	397	400	403	405	408	411	414	416	419	422	
9.5%	405	408	411	414	416	419	422	424	427	430	432	435	438	441	443	446	449	
10.0%	432	435	438	441	443	446	449	451	454	457	459	462	465	468	470	473	476	
10.5%	459	462	465	468	470	473	476	478	481	484	486	489	492	495	497	500	503	
11.0%	486	489	492	495	497	500	503	505	508	511	513	516	519	522	524	527	530	
11.5%	514	516	519	522	524	527	530	532	535	538	541	543	546	549	551	554	557	
12.0%	541	543	546	549	551	554	557	559	562	565	568	570	573	576	578	581	584	
12.5%	568	570	573	576	578	581	584	586	589	592	595	597	600	603	605	608	611	
13.0%	595	597	600	603	605	608	611	613	616	619	622	624	627	630	632	635	638	
13.5%	622	624	627	630	632	635	638	641	643	646	649	651	654	657	659	662	665	
14.0%	649	651	654	657	659	662	665	668	670	673	676	678	681	684	686	689	692	
14.5%	676	678	681	684	686	689	692	695	697	700	703	705	708	711	713	716	719	
15.0%	703	705	708	711	713	716	719	722	724	727	730	732	735	738	740	743	746	
15.5%	730	732	735	738	740	743	746	749	751	754	757	759	762	765	767	770	773	
16.0%	757	759	762	765	768	770	773	776	778	781	784	786	789	792	795	797	800	
16.5%	784	786	789	792	795	797	800	803	805	808	811	813	816	819	822	824	827	
17.0%	811	813	816	819	822	824	827	830	832	835	838	840	843	846	849	851	854	
17.5%	838	840	843	846	849	851	854	857	859	862	865	867	870	873	876	878	881	
18.0%	865	868	870	873	876	878	881	884	886	889	892	895	897	900	903	905	908	
18.5%	892	895	897	900	903	905	908	911	913	916	919	922	924	927	930	932	935	
19.0%	919	922	924	927	930	932	935	938	940	943	946	949	951	954	957	959	962	
19.5%	946	949	951	954	957	959	962	965	967	970	973	976	978	981	984	986	989	
20.0%	973	976	978	981	984	986	989	992	995	997	1000	1003	1005	1008	1011	1013	1016	

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