6 Public investments

The American Recovery and Reinvestment Act appropriated USD7.2 billion to development of broadband networks throughout the United States. In this part, we survey similar stimulus-type investments in other countries, as well as investments by countries that have been supporting the construction of networks on the supply side, or fostering demand for broadband on the demand side, over a longer time period and as part of a strategic focus on broadband, rather than as a specific response to the economic crisis.

Some countries, most prominently South Korea, Japan, and Sweden, have had long-standing investments in rolling out infrastructure both to urban centers and to wider populations. In Europe, government investments are constrained by European Union rules limiting state aid, which were put in place originally to prevent national governments from using their funds to aid local industries in contravention of the single market. This has meant relatively constrained programs with an emphasis either on unserved populations or on company- and technology-neutral public tenders. More generally, getting numbers on actual public investments is difficult. The OECD reports total investments in public infrastructure, but does not separate what is publicly funded from what is privately funded. South Korea often announces total investment that includes both government and government-mandated private investment, an arrangement that has no real parallel in the United States. With Japan, much of the public support has come in the form of loan guarantees and low-cost loans, the costs and value of which are not readily available. These difficulties are not unique to other countries. One would be hard-pressed to describe all the government investments of the United States in Internet infrastructure, from Defense Advance Research Projects Agency (DARPA) funding of early Internet development through every bond issued by a local municipality to support rollout by its rural electric utility. Describing levels of long-term investment is therefore a less certain exercise than describing immediate stimulus-style responses. The descriptions we offer here should therefore be taken more as illustrations of the kinds of investments made than as a comprehensive and exhaustive catalog.

Here we offer a description of major supply-side national investments in infrastructure, followed by a major example of municipal investment and how it was dealt with in Europe. The section on supply-side investments ends with the European guidelines on state investment in broadband, issued September 17, 2009. It is followed by a description of demand-side spending programs.

6.1 Major public investments

By far the most ambitious public investment program, an outlier by all accounts, is the current Australian government's announced investment in building a 100Mbps fiber-to-the-home network to 90% of its citizens, complemented by wireless and satellite technologies for the remaining population that lives too remotely to be served by fiber. Public reports of this plan suggested an investment level of AUD43 billion, or somewhat over USD34 billion. In comparative terms, adjusted for population size, this would mean the equivalent of somewhat less than a half trillion dollar investment by the United States. In terms of proportion of GDP, it would be the equivalent of a one-time investment of 4.24% of annual GDP. Again, this would be the approximate equivalent of a USD600 billion investment. Upon inspection, the news reporting on this plan substantially overstates the public funds commitment.[323] The announcement followed a smaller, unsuccessful public tender for the construction of a publicly-supported national network. The Australian government then announced that it would invest in, and form, a public-private partnership whose goal would be to roll out the national fiber network. The total

323 http://www.minister.dbcde.gov.au/media/media_releases/2009/022.

cost of the project over eight years is projected to be up to 43 billion AUS. The initial actual investment of the government would be a reallocation of funds appropriated under a 2007 plan, AUD4.7 billion, or about USD3.175 billion in purchasing power parity terms. Furthermore, the government plans to issue infrastructure bonds for 6.3 billion Australian dollars, for a total investment in the public-private partnership of AUD11 billion, or $7.43 billion PPP. When one adjusts for the size of the Australian population, the Australian government's commitment would be the equivalent of a U.S. government investment of USD107 billion to build fiber to the home networks to 90% of the U.S. population. If one counts solely the committed funds from 2007, this would be the equivalent of about USD46 billion.

The other major country cited for massive direct public investments is South Korea. The most expansive descriptions of what the South Korean government invested[324] place that number at USD24 billion for the KII-Government phase in the late 1990s, 1.76 billion in low cost loans to the private providers, 16.3 billion from 2000 to 2006, 25.5 billion, public and private investment, from 2004 to 2007, and another 18 billion public and private from 2008 to 2010. This is about USD85 billion in total, which is higher, but on the same order as a USD70 billion number also occasionally proffered as the South Korean investment, public and private, in broadband deployment. As already mentioned, these numbers bundle public and private investment in ways that makes it difficult to tease them apart. In U.S. terms, adjusted for population size, the total investment since the mid-1990s would translate into about USD443 billion, again, roughly commensurate with the purported Australian commitment. But again, as in Australia, these numbers are more representative of investments in the total costs of deployment, rather than actual government outlays. The current South Korean plan, for example, calls for an additional USD27 billion to be spent between now and 2012. Only USD1 billion of this amount will be spent directly by the government.[325] As such, while these numbers sound outlandishly large as specifically government expenditures, they are well below the total (overwhelmingly private) investment in public telecommunications facilities in the United States since 1997, which has been over USD750 billion.[326] The question for our purposes here is, in all these cases, what is the proportion of public funds spent.

By contrast to the less certain numbers elsewhere, it is quite clear that public authorities in Sweden spent about USD817 million between 2001-2007.[327] In per capita terms, that is just over USD90, which translates into about USD27.6 billion dollars. In terms of percent of annual GDP, it is about one quarter of one percent of Sweden's GDP, spent over six years. In U.S. terms, this would translate into a commitment of just under USD35 billion dollars over six years. This number is lower than, but roughly consistent with, some of the proposals for stimulus spending on broadband infrastructure in the United States.[328]

6.2 Stimulus investments

Like the U.S. Congress, other countries have announced or committed funds, often as part of broader investment encouragement, to support the next generation transition. The following table summarizes these investments.

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324 The most comprehensive description of past investments that we have found is Atkinson et al, ITIF, Explaining International Broadband Leadership (2008).

325 OECD, Working Party on Information Economy, The Impact of the Crisis on ICTs and Their Role in the Recovery, Aug 17, 2009. p. 34. (OECD Impact of Crisis on ICTs)

326 OECD Communications Outlook 2009 Table 4.17.

327 Ministry of Enterprise, Energy, and Communications Sweden, June 4 2009 presentation; ITIF Broadband Report, 2008, p. 25.

328 Derek Turner, Down Payment on Our Digital Future, Free Press 2008. http://www.freepress.net/files/DownPayment_DigitalFuture.pdf

Table 6.1. Public investment in broadband from around the world

	Planned investment	Government share	Govt share in US terms, pop. adjusted, in millions USD[329]
Australia	AUD43B	4.7B AUD (reallocated funds) 6.3B AUD (anticipated bonds)	45,853 61,463
Austria	EUR125M	EUR25M	1,050
Canada	CAD225M	CAD225M	1,677
Finland	EUR66M	EUR66M	3,920
France	EUR750M	Unknown	Unknown
EU	EUR1B	EUR1B	912
Germany	EUR150M	EUR150M (uncertain)	657
Italy	EUR1.25B	EUR1.25 (not yet committed)	7,770
Japan	JPY185B	JPY185B	3,820
South Korea	USD27B	~USD1B	6,330
Luxembourg	EUR195M	EUR195M	126,000
New Zealand	NZD1.7B	NZD850M (not yet committed)	58,300
Portugal	EUR50M + EUR61M	EUR111M	4,700
United Kingdom	GBP200M + GBP150-175M per year	GBP200M + GBP150-175M per year	1,530 + 1,150-1,340 per year
United States	USD7.2B	USD7.2B	7,200

Looking at the investments reported as stimulus responses to the financial crisis in August of 2009 alone, the United States has made one of the larger public commitments to next generation broadband. Luxembourg is an outlier in terms of per-capita investment, but its minuscule size and extreme wealth make it a largely irrelevant comparator. Australia and New Zealand have both made major public announcements about plans to make major government investments, but we are not certain at this point what the level of funds actually committed in New Zealand will be, or what the ultimate result of the bonds issuance in Australia will be. Both of these plans, should they be put into effect as announced, will outstrip on a per capita basis even Sweden's investments in the first half of this decade and place the two countries as among the most publicly-funded networks in the world. Italy has not yet appropriated sums equivalent to those that the U.S. has committed (on a per-capita basis), but has announced plans to do so. The South Korean government's share of investments planned for the coming three years is similar to the U.S. recovery investment, but needs to be taken on the background of the already very large investment that government has made in both the first generation and next generation transitions. The other major investors are Finland, Japan, Portugal, and the United Kingdom, all of which have invested about half or a bit more than half on a per capita basis than the American Recovery and Reinvestment Act appropriated. Of this group only the U.K., with its new tax on copper loops intended

329 This number converts local currency investment to PPP dollars, divided by the population size to reach per-inhabitant investment, multiplied by 307 million to simulate what a similar per-population investment in the United States would be. The initial numbers are taken from OECD Impact of Crisis on ICTs, Aug 2009, p. 34.

to provide a large annual infusion to next generation roll out, on the order of what would be the equivalent of a USD1.15 to 1.35 billion per year, has chosen a path that will ultimately lead it to higher direct public investments, should it continue this policy for five more years.

Observing both longer term and stimulus investments, it appears that the United States has spent more in the stimulus mode than most other nations, but less than the most publicly-funded nations, in particular Sweden, as well as South Korea and Japan. We note only that these three nations are, by a wide margin, the leaders in fiber deployment. To the extent that one sees the long-term trajectory of the fixed element of next generation networks to be in fiber closer to — and ultimately at — the home, we can perhaps say that substantial government investments seem to be associated with approaching that goal more rapidly.

6.3 Municipal investments

There has been substantial attention given to municipal and regional efforts as a pathway for private intervention. In the United States, various stories from Burlington, Vermont to Bristol, Virginia at the municipal level, have suggested that municipal and regional investments may provide an appropriate and productive pathway for public investment. The finances of local and regional projects are difficult to capture comprehensively in a way that would allow genuine, aggregate comparisons of levels of investments. False starts are unlikely to be reported systematically. As a result, making a strong analysis of the relative effectiveness of municipal initiatives is beyond the scope of our analysis. We treat the examples more as inspiration for a future, more detailed study, and for efforts to create learning networks and systems for synthesizing and communicating best-practices.

The role of municipalities has been the most extensive and systematic in Sweden.[330] Of Sweden's roughly 290 municipalities, over 200 have been engaged in some form of public support for, or tendering of, broadband deployment. They have been the conduit of over USD 250 million, or the rough equivalent of what a USD12 billion investment would mean in U.S. per capita terms. They added their own funds to these national funds, at a level that accounts for about 11% of total investment in broadband deployment from 2001-2007. The basic model of the Swedish municipal investment is that the municipality builds passive capacity, or dark fiber, and leases it out to private providers who then compete on services and electronics, and do so through operator-neutral public tenders put in place for constructing the capacity. The model is applied both in major cities, like Stockholm, and in smaller towns, including surrounding countryside.

The most recent annual report by the Swedish regulatory authority suggests that municipalities will continue to play a central role in the country's next generation broadband strategy. Specifically, the Swedish Post and Telecom agency (PTS) noted that municipalities would begin to integrate communications infrastructure planning into their urban planning programs. A particular target would be to identify pockets of unavailability on a very local level, and to ensure that these are covered by connectivity. To support efforts in that direction, while limiting the reporting burdens on carriers, the national authority would collect information about network services and availability on a comprehensive, geographic basis, and make that information available to municipalities to include in their local and urban planning processes and in their network deployment tenders. Moreover, the Swedish report suggested that as part of their task, one major role municipalities can play going forward is to minimize the difficulties of obtaining permits to site equipment and access ducts. In all, the Swedish experience has worked substantially through local authorities, in collaboration with the national

330 Sources: Ministry of Enterprise, Energy, and Communications Sweden, June 4 2009 presentation; ITIF Broadband Report, 2008, p. 25; EU Guidelines for State Aid, Sept 2009.

government, and has included funneling of national funds, application of local funds, and the integration of local planning powers with funding and expenditure to attain near-universal coverage.

Perhaps the most ambitious — and for a while, contentious — municipal project outside of Sweden has been Amsterdam's CityNet.[331] The project is deemed ambitious because its ultimate aim was to provide a fiber-to-the-home network throughout the city, and controversial because its deployment sparked a political and legal battle with, in particular, the Dutch cable broadband industry. At an operation level, the project has only been partially successful. While 43,000 homes have been passed, only a small proportion of the houses passed signing up for service. Nonetheless, it has been sufficiently successful to draw the investments from the KPN Reggefiber joint venture. The project has also been successful in the sense that it was upheld when challenged in the European Union, and has now created the model for potential municipal investment in next generation infrastructure even in the presence of robust market-based competition, on the market-investor principal; and because its success was one of the factors that apparently led the Dutch government to reverse an earlier reticence to allow similar municipal investments elsewhere in the Netherlands.

The plan initially called for connecting 37,000 households, with longer term plans to roll out to all 400,000 households in Amsterdam (comprising about 5.5% of Dutch households). The network was to be a point-to-point fiber network, in which about 10,000 households would be connected directly, each by its own fiber, to each point of presence (POP). The system was to operate in three distinct layers. The first layer was called the "passive network infrastructure." It included ducts, fiber, and street cabinets. The second layer was the active wholesale layer. It included network management, control, and maintenance systems such as switches, routers, and optical splitters. It was to be managed and maintained by a wholesale network operator working on a contract from the city. The third layer was the retail layer, which would consist of providers who would buy capacity, on a non-discriminatory basis, from the two lower layers, and provide retail services to customers. They would invest each in their own service platform: equipment, services, and billing/customer care. The first, passive layer, is owned by a partnership called Glasvezelnet Amsterdam (GNA). Its members are: the City of Amsterdam, with a one-third share; five social housing corporations (a non-profit model of housing ownership of apartment buildings), which owned about one-third of the apartments in the covered area, owned a one-third share of GNA; and the remaining third was equally divided in two one-sixth shares between two for-profit investors, ING real-estate, a subsidiary of ING, and Reggefiber, a Dutch company whose business it has been to build open fiber networks. The shares reflected the actual share of investments made by each of the parties in the EUR 18 million equity investment of the EUR30 million project.

GNA issued a tender to construct passive networks to dig and construct the ducts, and pull the fiber. This tender was issued to construction companies, and GNA retained ownership over the ducts, fiber, and cabinets. GNA also issued a public tender for the concession to operate the wholesale layer. The contract was awarded to a subsidiary of Telecom Italia, BBned. BBned was to invest in active wholesale layer components, which it would then own and operate while also operating, but not owning, the passive layer. The contract required BBned to remit fees per connected household to GNA, and to sell wholesale access services to third party service providers on an open access, nondiscriminatory basis. These retail providers would sell services to end users and pay fees. BBned itself had retail affiliates that would sell such services.

331 Sources: EC c(2007) 6072, European Commission Final Decision on the State Aid Case C 53/2006, Investment by the City of Amsterdam in a fiber-to-the-home (FTTH) network; Herman Wagter, BH_CityNet presentation, 2009;

In the European Union case, Dutch, Spanish, and Swedish cable operators UPC, ONO, and Com Hem, as well as France Telecom, intervened to persuade the Commission that the public investment would undermine market provisioning and that, unlike in smaller and more remote municipalities, the investment was unjustified in an urban center already served by commercial operators. European cases on state aid arise from the concern that states will undermine the common market purposes of the Union by helping their own companies against potential entrants from other countries. Given the substantial history of state enterprises in several European countries, the Commission polices government investments fairly closely to assure an efficient, pan-European market. One strand of investment permitted is where the state invests on terms that would have been reasonable for a market investor (even if the particular market investors serving the same market did not choose to make a similarly-structured investment).

Factors that helped persuade the European Commission that Amsterdam's investment in GNA was a kind of investment that a private company might have made provide useful insight into what a model of legitimate municipal investment might look like. The elements that the Commission reviewed included:

a) the co-investment by two private companies, on equal terms, one a real-estate development firm that had plausible reason to invest in improving the broadband infrastructure of its real estate holdings and the other a company specializing in open fiber infrastructure;

b) the fact that the investment was in passive elements, which were expected to last for thirty years and therefore could be sustained with the relatively lower rates of return expected by GNA;

c) the fact that the City of Amsterdam was to be reimbursed all of its pre-project investments, with interest, as part of the project costs, all of which were ultimately intended to be paid from user fees paid by the wholesale users, and ultimately the retail subscribers;

d) a close review of the business plan: the Commission submitted the GNA business plans to one independent review by PriceWaterhouseCoopers, and the Dutch authorities submitted a report from a consulting firm and Delft University, both of which confirmed that the GNA business plan was sound, that the internal rate of return for the project was "within the market expectations for companies active in the telecommunications market," and that it was robust to a wide range of sensitivity tests based on penetration rates, cost evaluations, and other market contingencies.

The nature of the European Commission's decision provided, perhaps unsurprisingly, a boost to the model of municipal fiber-to-the-home investments in the Netherlands. Following the battles over Amsterdam, the cable companies in the Netherlands persuaded the Dutch parliament to limit the ability of municipalities to invest in fiber-to-the-home facilities where there were market actors in the market already. The Commission's decision has made it easier for the Dutch government to pursue a course to reverse that decision, and to initiate a process to support municipal efforts built on the Amsterdam model.

6.4 The new European guidelines

In part as a result of the Dutch experience and experiences elsewhere, like in Sweden, and in part in response to the new wave of stimulus investments, the European Commission took up more generally the problem of state aid to broadband deployment. It published its final decision on September 17th,

2009.[332] The general starting point of the European Commission is that it has "taken an overwhelmingly favorable view towards State measures for broadband deployment for rural and underserved areas, whilst being more critical for aid measures in areas where a broadband infrastructure already exists and competition takes place."[333] The Commission appeared particularly concerned to prevent crowding out of market provisioning where market provisioning was feasible.

One arm of acceptable public investment is the arm established in the City of Amsterdam case: that is to say, where the municipality is investing pursuant to a business plan that is within what would be normal for a market actor in this market to do. This can be proven either by co-investment by private, commercial actors on equally advantageous and risk-susceptible terms (that is, the public investor cannot seek to attract complementary investments by absorbing an unfair share of the risk not reflected in the distribution of returns), or by an independent evaluation of the municipality's business plan as consistent with industry practices.

The second arm of acceptable public investment occurs where a public investment, municipal or by a higher-level of government, is justified as provisioning a public good, or in the language of EU law, a "service of general economic interest" (SGEI). This is primarily intended to apply to investments in unserved and underserved areas. Indeed, the decision very clearly states that it will have a strong presumption against treating a publicly-owned and invested network intended to create a third network alongside two already-existing facilities-based competitors, each offering triple-play offerings (so called "black areas") as acceptable under this arm of the public-goods-provisioning rationale . To the contrary, it sees so called "white areas," areas with no provider, as a proper target of state investment. As such, this section seems applicable precisely to the kinds of investments in unserved and underserved areas that are the core of the American Recovery and Reinvestment Act. (In "gray areas," where there is only one provider and no real prospect of a second one entering within three years, the Commission takes an intermediate view, preferring access regulation where feasible, and public investment in an alternative network as a fall back option where *de facto* monopoly in an area cannot be attenuated by effective regulation.) The Commission's requirements for such an investment are particularly enlightening, both about the assumptions they exhibit regarding where competition is likely and most productive, and because of the way in which they integrate the task of transposing the lessons of the first generation broadband transition to the next generation investments.

One important requirement that the EC places on even those investments it deems acceptable is that they not be coupled with a formal promise of exclusivity, or monopoly licensing provision. The opinion rejects the idea that, over and above subsidies, any company providing service in these unserved or underserved areas needs a monopoly right over provisioning. It also requires technological neutrality, and open tenders for any such investments.

One of the most interesting aspects of these guidelines is their effort to limit the range of what is offered publicly, and use it, to the extent possible, to provide a platform over which competitive, market-based services higher up in the stack will be offered. This part of the EC opinion therefore serves as a particularly interesting window into current European thinking about integrating the natural-monopoly attributes of at least some broadband markets with the possibility that at least some layer of services will be competitive, riding on top of a shared platform. It also provides a window into current thinking about access, competition, and transposition of the first generation transition with the next generation

332 17.9.2009 Community Guidelines for the application of State aid rules in relation to rapid deployment of broadband networks, available http://ec.europa.eu/competition/state_aid/legislation/guidelines_broadband_en.pdf.

333 *Id*. Section 2.1.

transition. We reproduce here the whole of the relevant part of the holding, including its very interesting footnotes.

> (27) Given the state of competition that has been achieved since the liberalisation of the electronic communications sector in the Community, and in particular the competition that exists today on the retail broadband market, a publicly-funded network set up within the context of an SGEI should be available for all interested operators. Accordingly, the recognition of an SGEI mission for broadband deployment should be based on the provision of a passive, neutral34 and open access infrastructure. Such a network should provide access seekers with all possible forms of network access and allow effective competition at the retail level, ensuring the provision of competitive and affordable services to end-users.35 Therefore, the SGEI mission should only cover the deployment of a broadband network providing universal connectivity and the provision of the related wholesale access services, without including retail communication services36. Where the provider of the SGEI mission is also a vertically integrated broadband operator, adequate safeguards should be put in place to avoid any conflict of interest, undue discrimination and any other hidden indirect advantages.37
>
> Notes:
>
> 34 A network should be technologically neutral and thus enable access seekers to use any of the available technologies to provide services to end users. Although such a requirement may be of limited application in relation to the deployment of an ADSL network infrastructure, this may not be the case in relation to a NGA, fibre-based network where operators may use different fibre technologies to provide services to end- users (i.e., point-to-point or G-PON).
>
> 35 For example, an ADSL network should provide bitstream and full unbundling, whereas a NGA fibre-based network should provide at least access to dark fibre, bitstream, and if a FTTC network is being deployed, access to sub loop unbundling.
>
> 36 This limitation is justified by the fact that, once a broadband network providing universal connectivity has been deployed, the market forces are normally sufficient to provide communication services to all users at a competitive price.
>
> 37 Such safeguards may include, in particular, an obligation of accounting separation, and may also include the setting up of a structurally and legally separate entity from the vertically integrated operator. Such entity should have sole responsibility for complying with and delivering the SGEI mission assigned to it.

To justify a public investment, the EC requires that states engage in detailed local mapping of availability, need, and rollout; that they use an open tender process; that they accept the most economically advantageous offer (which need not be the lowest bid); that the tenders be technologically neutral; that, where possible, they use existing infrastructure (except where the recalcitrance of the local monopolist is part of the problem); that the successful bidder offer its network for wholesale services to other providers at rates that are benchmarked against wholesale rates in other, competitive areas, and; that the tenders or laws pursuant to which a tender is made include claw back provisions allowing the state to seek restitution of profits found to have been excessive following such price benchmarking exercises.

Finally, the newly-minted European decision explicitly embraces the dual-goals approach taken by some countries, which seek, independently, to reach their entire population with broadband networks, and large portions of their populations with next generation connectivity. The Commission accepts as legitimate the possibility that European countries will invest in next generation access networks, beyond their investments in bringing first generation broadband to their entire populations, even in urban areas,

where doing so is seen as speeding up deployment and acquiring the social spillover benefits on a faster schedule than current private firms appear ready to follow. The Commission treats the presence or absence of immediate plans to deploy such Next Generation Access networks (NGAs) in the near (three year) future as a distinct "market" for purposes of designating "black," "white," and "gray" areas—in other words, making it much easier, for many more regions and municipalities, to claim "white" or "gray" status than would have been possible were the measure the existence of two facilities-based competitors offering first-generation broadband networks, like xDSL (and presumably less-than DOCSIS 3.0 cable, though that is not made explicit in the opinion; the opinion does explicitly treat ADSL 2+ that provides 24Mbps service as not falling within the definition of "next generation"). One path the Commission envisions for this process is the passage of rules: rules requiring new construction buildings or infrastructure (like roads, sewage plants, energy, or transportation projects) to include fiber connections; acquisition of rights of way for use by communications networks; requirements on existing private network operators to coordinate their civil works or share infrastructure; or requirements to share poles and ducts. Moreover, the Commission contemplates that investments in civil works like pulling ducts, as well as regional investments intended to increase the competitive attractiveness of either under-developed or technology-cluster regions, by providing high-end infrastructure, will also be considered acceptable as long as they comply with the other constraints placed by the Commission.

The critical point of this part of the opinion however, is that the European Commission will treat investment in speeding up deployment of networks capable of very high speed service as a distinct market, and as justifying investment to speed up deployment even in areas where there are two facilities-based competitors who are offering triple-play packages over networks that offer below 24Mbps service. (The precise cutoff between what counts as NGAs and what does not is not clearly specified; but 24Mbps is clearly not treated as NGA.) The Commission will presume that these existing providers do have such plans, but member states can rebut that presumption by showing that those existing competitors do not have explicit business plans to upgrade their service to next generation levels within three years. In that case, the Commission will treat even such areas as "gray" or "white" areas (as appropriate given the actual plans of the present broadband providers) in terms of next generation access networks.

In all events, the networks constructed with public aid will have to comply with all the requirements stated above, with the Commission's special emphasis that:

> An "open access" obligation is all the more crucial in order to deal with the temporary substitution between the services offered by existing ADSL operators and those offered by future NGA network operators. An open access obligation will ensure that ADSL operators can migrate their customers to a NGA network as soon as a subsidised network is in place and thus start planning their own future investments without suffering any real competitive handicap.
>
> In addition, whatever the type of the NGA network architecture that will benefit from State aid, it should support effective and full unbundling and satisfy all different types of network access that operators may seek (including but not limited to access to ducts, fibre and bitstream). In this respect it should be noted that "multiple fibre" architecture allows full independence between access seekers to provide high-speed broadband offers and is therefore conducive to long-term sustainable competition. In addition, the deployment of NGA networks based on multiple fibre lines supports both "point-to-point" and "point- to-multipoint" topologies and is therefore technology neutral. [334]

334 EU Guidelines, English version, page 23-24.

6.5 Demand side programs: Subsidies and skills training

In addition to the supply-side subsidies, several of the countries we have studied have developed various demand-side interventions to increase not only the supply of broadband, but demand for it as well.

As on the supply side, the most systematic and extensive demand-side program was implemented in South Korea. Its elements included:

- Extensive skills training to large swaths of the population, free or on highly subsidized terms. The relevant populations included the elderly, military personnel, and farmers.

- Most extensive and visible among the adult population training programs was the Cyber 21 training program that targeted housewives.[335] The program consisted of a week-long, 20 hour course, subsidized through over a thousand training institutions so that courses cost about USD30.[336] Take up was dramatic, with one report noting over 70,000 participants in the first ten days. Several discussions of South Korean programs at the time seem to mention this program as one that had a serious impact.

- Funding and constructing thousands of public access sites, where residents were given free access and training

- Subsidized provision of personal computers to low income families. Initially, this was done through low-cost loans, and later the government directly purchased computers and leased them for four years to low income families, while at the same time paying the full cost of broadband service for these families for five years

- Free personal computers in every school in the country

- 50,000 free computers were given to low-income students with good grades

- Curriculum and school assignments were developed so that having a connection and knowing how to use it became an integral part of going to school. It was how you got your homework done

- Including digital literacy measures in college entry metrics, so that having high performance on digital literacy metrics enhanced one's likelihood of getting a better higher education

- In the housing market, the government initiated a building certification program whereby it issued a certificate of connectivity to buildings that were well wired and ready to receive and distribute broadband. These became the basis for building owners to compete in the real estate market

No other country that we observed has engaged in as extensive a set of policies. In various countries we saw bits and pieces of programs reminiscent of elements of the South Korean program. These include:

- *Adult skills training*: in the United Kingdom, the Train to Gain program, which is a workplace training program, has worked with over 127,000 employers and provided training for over a million workers. The Swedish government ran training programs for small business owners

335 Kushida and Oh.
336 Atkinson et al, 2008, p. 38.

about use of ICTs in their business. The German government too offers consulting and prizes for innovative uses of ICTs and training in them for small and medium businesses.

- *Funding and constructing public access sites in various communities*: Canada's Community Access Program constructs and offers training through community technology centers

- *Subsidies for home personal computers*: The Swedish government throughout the early 2000s allowed employers to provide personal computers to employees on a pre-tax basis; the British government provided cheap financing for families to lease computers over a four year period

- *School-based interventions*:

    - *Broadband connections and computers at school*: Sweden, Canada, France, the United Kingdom Germany, and Australia all fund connections for schools, which are made available to the schools either free or at very low rates

    - *Schoolteacher training*: Sweden and the United Kingdom both invested heavily in teacher training programs

    - *Curriculum development and digital learning objects*: Sweden, the United Kingdom, and Australia have all invested in developing online curriculum offerings and learning tools

    - *Real-estate market deployment*: On the housing side, France worked not through carrots—like the South Korean certification program—but through requirements: of installation of open wires in new construction, and of requirements of shared facilities whenever an existing building is wired under contract with one of the fiber providers.

While the United States adopted subsidies to school deployment of Internet connectivity through the E-rate program since the Telecommunications Act of 1996, the heavy emphasis on skills training is an important lesson carried by these international studies. Least known in the American debate have been the heavy investments in adult education. One important pathway seems to have been investment in workplace-based training programs, both for employees and for small and medium sized business owners is an interesting observation. Better known and clearly important is the extent to which investment in skills training, including intensive teacher training, rather than merely in hardware and connectivity, was central in several other countries to the school-based programs.