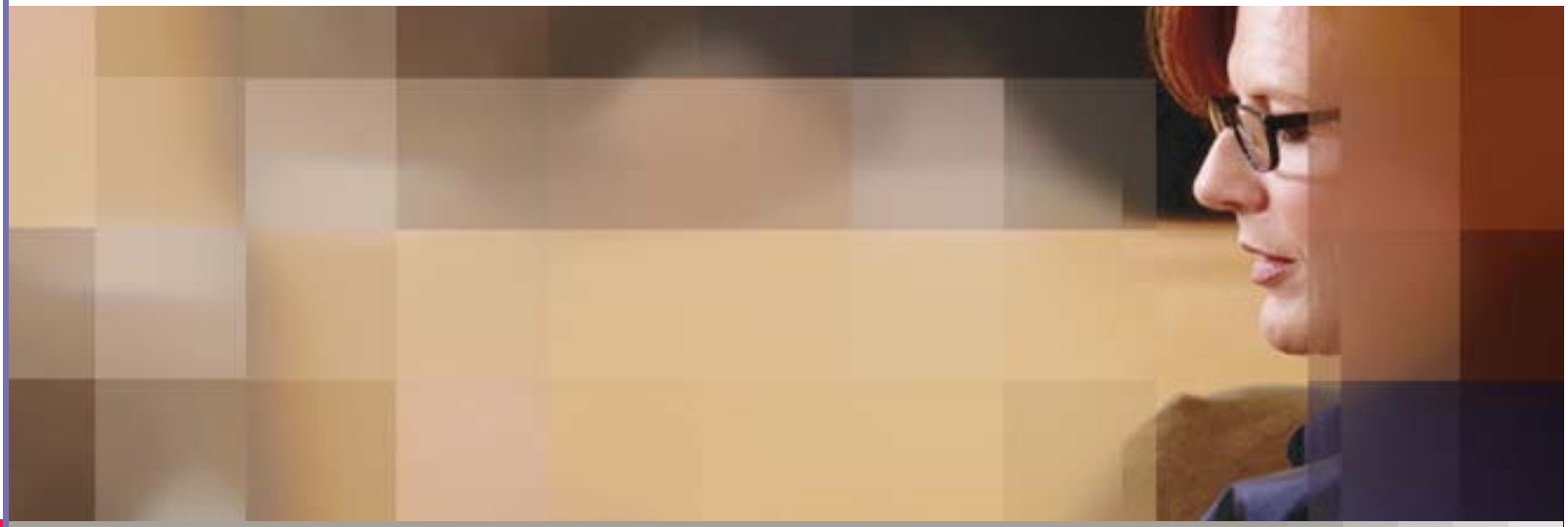

Fibre: the socio-economic benefits

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Agenda

1. Study: aim and scope
2. Key findings
3. Conclusions

What benefits does fibre bring? Study scope and components

1) Choose an appropriate market

- history of fibre
- significant fibre penetration
- smaller towns with fibre

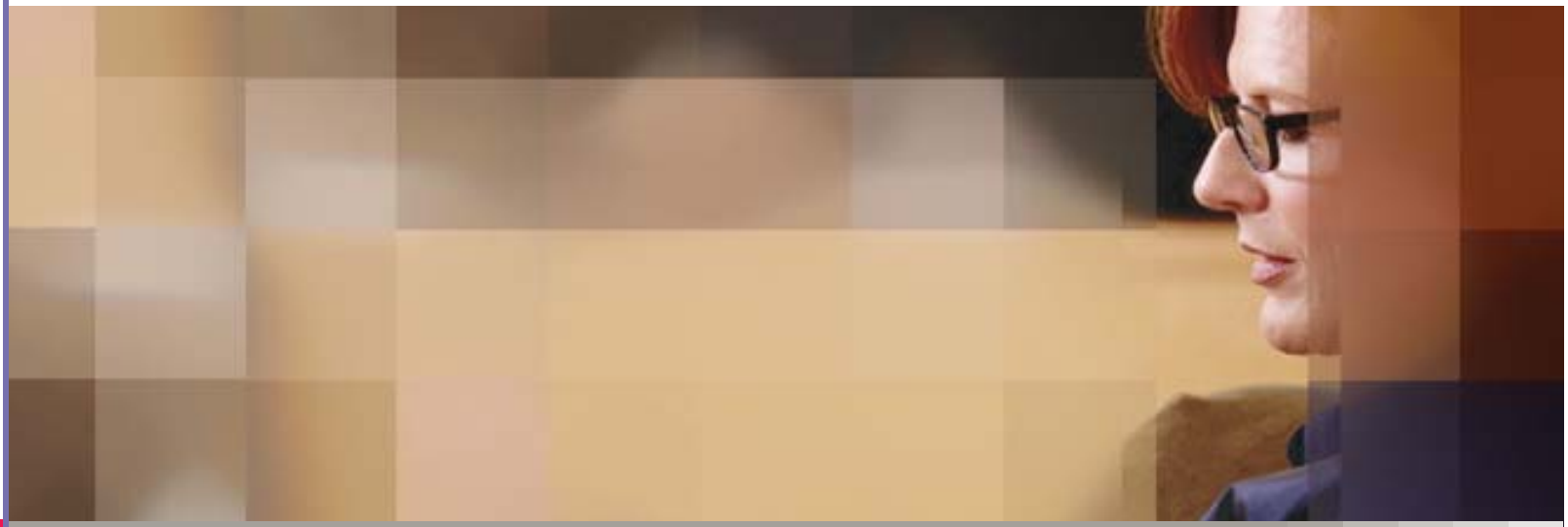
SWEDEN: outside Stockholm

2) Focus on social and economic impact

- exclude entertainment e.g. HDTV
- look at: impact on business/local economy
- impact on services and community

3) Combination of research tools

- end-user survey
- face to face interviews
- analysis of previous study on Eindhoven (Netherlands)



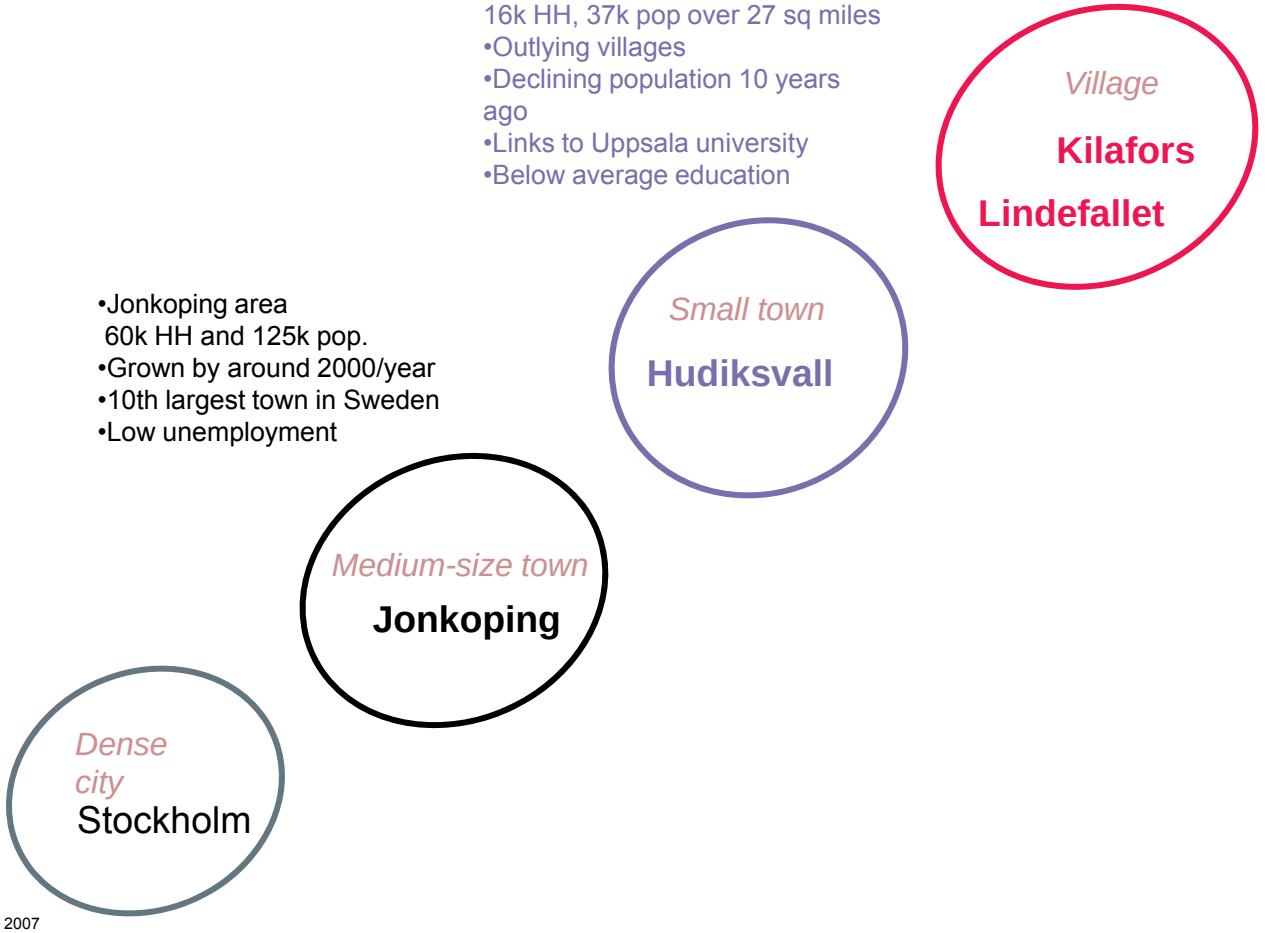
Key Findings

How does the benefit of fibre differ across the country? Focus outside of urban areas

•Lindefallet: 227 inhabitants
•No school/hospital
•Self installation of fibre

•Hudisksvall town: 15k pop.
16k HH, 37k pop over 27 sq miles
•Outlying villages
•Declining population 10 years ago
•Links to Uppsala university
•Below average education

•Jonkoping area
60k HH and 125k pop.
•Grown by around 2000/year
•10th largest town in Sweden
•Low unemployment



Telecom costs and education services

1 Significant reduction in telecoms costs

- own-build fibre networks between public buildings/municipalities
- cheaper costs due to technology
- adoption of open access model leading to more competitive prices

"Market deregulation provided an opportunity for municipalities to bring their telecoms costs down by building their own networks where there was an undersupply of NGA"

Norbotten: Telecoms cost savings: 50% reduction and x50 times faster connection for health services

Jonkoping: Saved 10-15 % on annual telecoms costs. Aound Euro 400k/year. Price per meg is now a 20th of what it is. 500KR down to 25KR per meg.

2 Improvements in educational facilities and services

- Enables video-based e-learning for home students
- Key to development of "digital schools" strategy
- pooling of educational resources/budget

"The educational level in Hudiksvall is below average: we see fibre investment and associated projects as a way of improving this"

Hudiksvall: developed digital school strategy, videolinking schools/adult ed. Colleges. All classrooms have 100 Mbps integrated into teaching

Norbotten region: Inter-school teaching in rural schools: pooling teaching resources via virtual learning between small schools

Healthcare and long-term care

3 Improved healthcare: new services; increased efficiency

- Fibre enabling much larger/faster connections between hospitals
- More efficient sharing of larger range of vital information
- Remote diagnostics

"The challenge for more ubiquitous telemedicine is how it is financed. The first step is fibre-based comms between hospitals and surgeries. Fibre is essential for HD videoconferencing. Then you need to link healthcare into private homes

National: All X-ray images now digitised and shared via national fibre network. Much faster transmission and reduced costs

Norrbotten: 5 hospitals, 33 health centres and 34 dental clinics connected. Digitised patient records, X-rays, digital prescription and video communications

4 Improved care and reduced care costs

- Remote monitoring of chronic health conditions
- "Care in place" – co-ordination/delivery of care for elderly
- Improved quality of life for long-term sick

"It took time to get carers to use the equipment and services. But once they did were enthusiastic adopters and would not go back to old system. Now they are training others and communicating benefits"

Hudiksvall: Old@Home and Open Care projects. Developing new services for remote care: positive trials and feedback from users

Norrbotten: estimated Euro 30,000/year savings by caring for elderly at home rather than care homes

Business and local economy

5 Positive impact in rural/lower GDP areas with specific verticals

- Increase in population/businesses in local area
- Attracting key verticals dependent on high bandwidth/cheaper costs
- Attracting small businesses/remote workers

"Its common knowledge or even common sense that having an advanced fibre-based infrastructure is attractive to companies"

Hudiksvall: Number of companies in the region has grown between 6 and 14% y/y since 2004. Developing as fibre-optic industry hub

Lindefallet/Kilafors: population increase by 7%. Number of home-working individuals in verticals like content production

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6 Negligible in areas already thriving with specific verticals

- Fibre expected as "standard" for larger businesses: no differentiation
- Economic growth driven by location of manufacturing businesses
- High level of education and geographical location key factors

"Jonkoping has a history of entrepreneurs and low unemployment. South of town, there's an area with a lot of small businesses that have a history of collaboration"

Jonkoping::logistics hub in Southern Sweden: number of manufacturing companies located here like Electrolux and VHM. Home-working rare.

Jonkoping: Existing level of high employment before fibre. Population growing by 2000/year before extensive fibre rollout

Hudiksvall: businesses in more detail….

- ***Sverige Bygger.*** *Company selling construction information categorised into databases. Sells internationally, but retains office and staff in Hudiksvall. For example, for expansion to Norway, hired Norwegian sales people stationed in Hudiksvall.*

➢ Doubled turnover between 2000 and 2004. “We are leading in our market thanks to the fibre infrastructure in Hudiksvall. It made it possible for us to offer our services online at four times the speed of our competitors, at a lower cost. It gave us a clear technical advantage”, Roger Svensk, former President of Sverige Bygger.

- ***Nonin Medical*** *American medical technology company based in Plymouth, Minnesota producing instruments to check patient status in medical settings, with 200 employees. Acquired Hudiksvall based Medair, company engaged in development and sale of equipment to monitor breathing in August 2006.*

➢ Original intention was to retain production only in Sweden. But following visit by American team to Hudiksvall decided to make town European headquarters due to advanced telecoms infrastructure and value-add of region. The worksforce is expected to grow tenfold in coming years. “The Fiber Optic Valley environment clearly played an important role. Now we’re responsible for managing all of Nonin’s sales, marketing and service throughout Europe”, CEO Medair, Sigvard Weisbjerg.

Common view that there are wider benefits of fibre

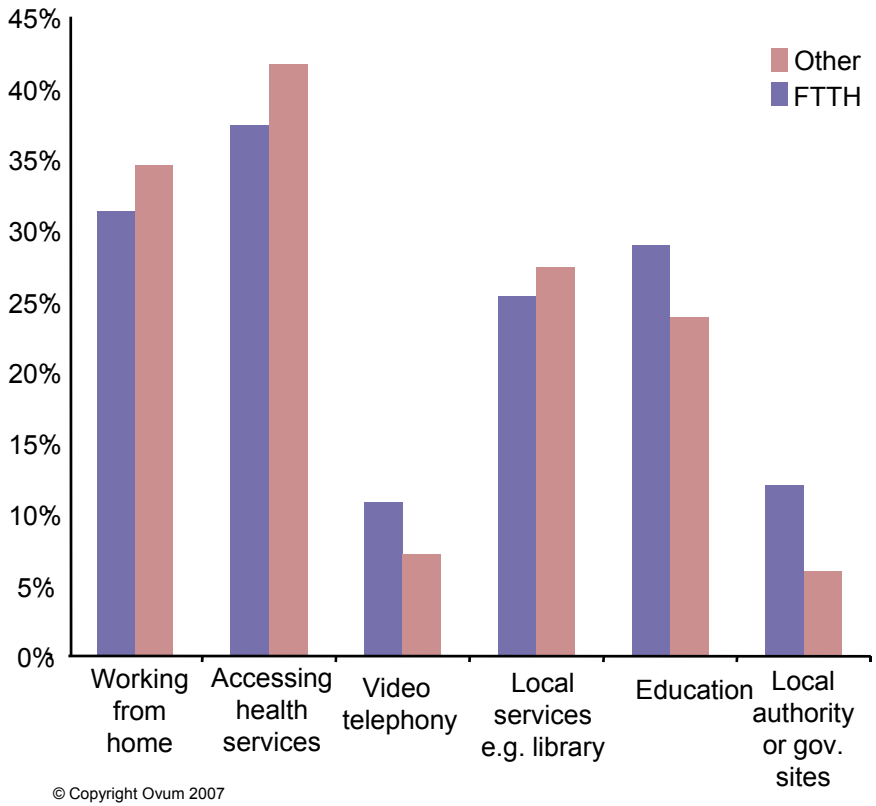
- **Stimulates closer collaboration between municipalities, public bodies and communities**
  - Over 150 municipalities in Sweden have built out their own fibre networks and are linking these up in regional networks to provide a platform for new business opportunities and more networked public services. Fibre efforts in smaller communities join individuals around a common goal and stimulate new relationships (business and social)
- **Important role in wider innovation/R&D in developing ICT for industry**
  - Fibre has been an important ingredient in overall investment and regional strategies to grow knowledge economy and ICT industries. For example, partnerships between Ericsson, Hudiksvall municipality and other ICT companies
- **New services dependent on very-high speed broadband stimulate new working practices**
  - Development of new services dependent on high-speed broadband in sectors like health hit substantial non-technical barriers. These projects thereby force new collaboration and stimulate adoption of new ways of working exemplified in the Old@Home project
- **Rollout of high-speed broadband stimulating further innovation in public services**
  - Hudkisvall/Gavle region: started new forum/network called Niuo to develop new services and innovation in care for the elderly: future could see private companies joining and using it as test-bed. Number of new services in Norbotten region.

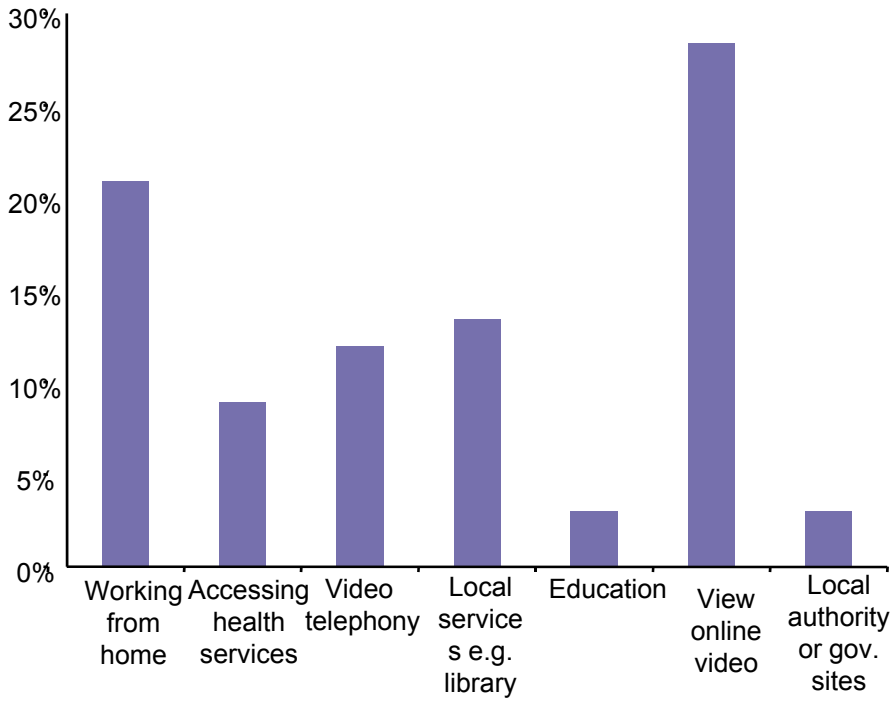
Limited impact of fibre to the *home* on *services* (excluding entertainment)

- No new services dependent *specifically* on fibre
  - Services like e-learning and remote care delivery require high-speed, reliable broadband connections to the home, but not necessarily fibre. In a number of cases they are running over xDSL/cable broadband
- Increased competition/lower consumer tariffs due to adoption of open access model
  - The majority of fibre rollout has been via an open access model. This has resulted in increased consumer choice and overall, lower broadband tariffs from national ISPs like Bahnhof (Euro 12/month for 100 Mbps) and local ISPs
- Noticeable difference in TV (HD) quality and upstream performance
  - TV quality is significantly better over fibre. One end-user has 5 TVs connected. Traffic analysis shows higher P2P usage amongst fibre users
- Improved performance of services dependent on high-speed broadband e.g. distance-learning, video communications
  - However, top-end fibre (i.e. above 40 Mbps) delivers higher-speed Internet and better quality video-conferencing. Performance differences evident for users of bandwidth hungry and QoS sensitive applications.

This was backed up by our end-user survey

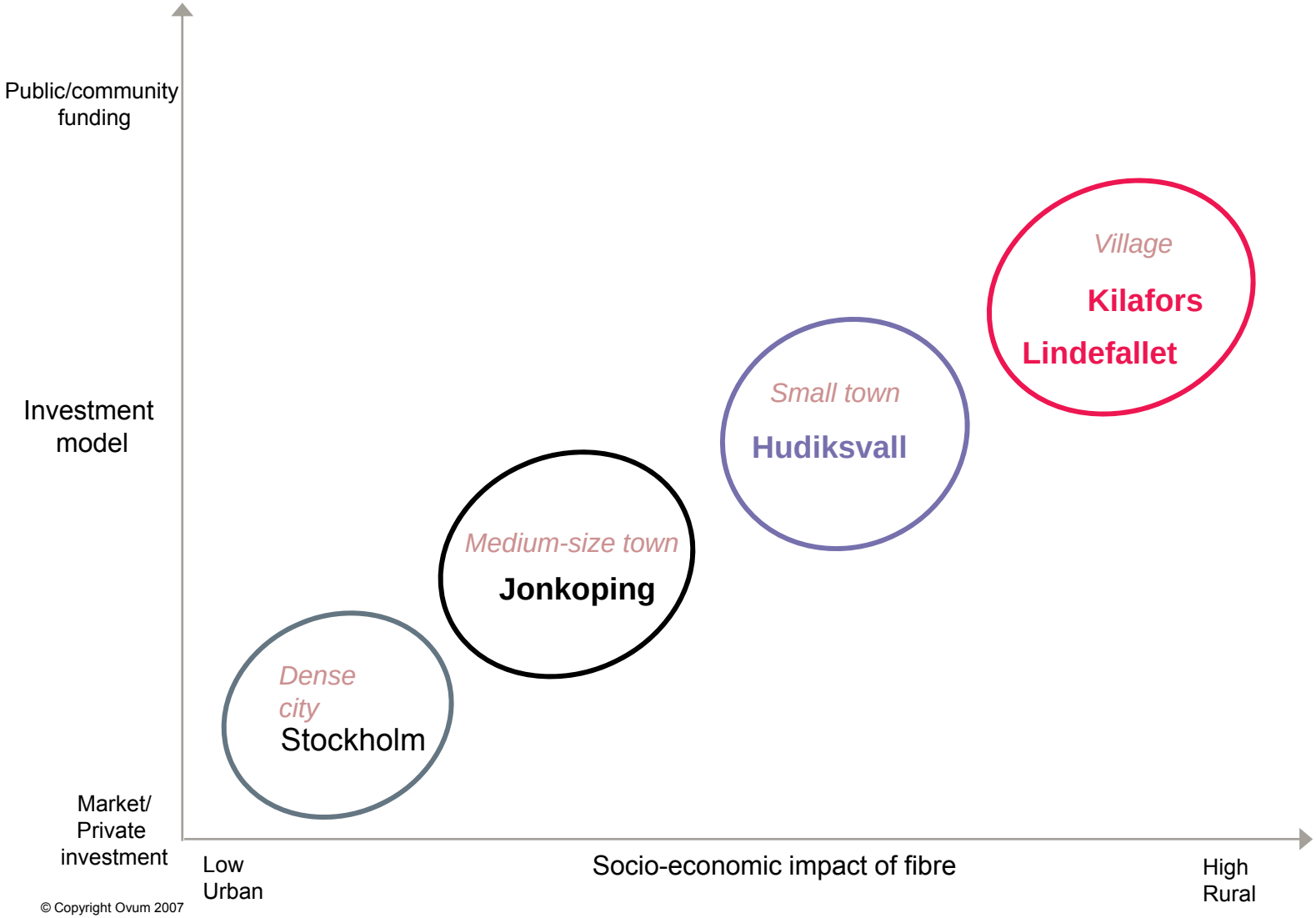
No major differences in the kinds of non-entertainment services accessed between fibre and non-fibre users





But fibre users report higher usage of these services. For example, most people who work from home do it more often

The impact of fibre varies according to geographic and economic factors



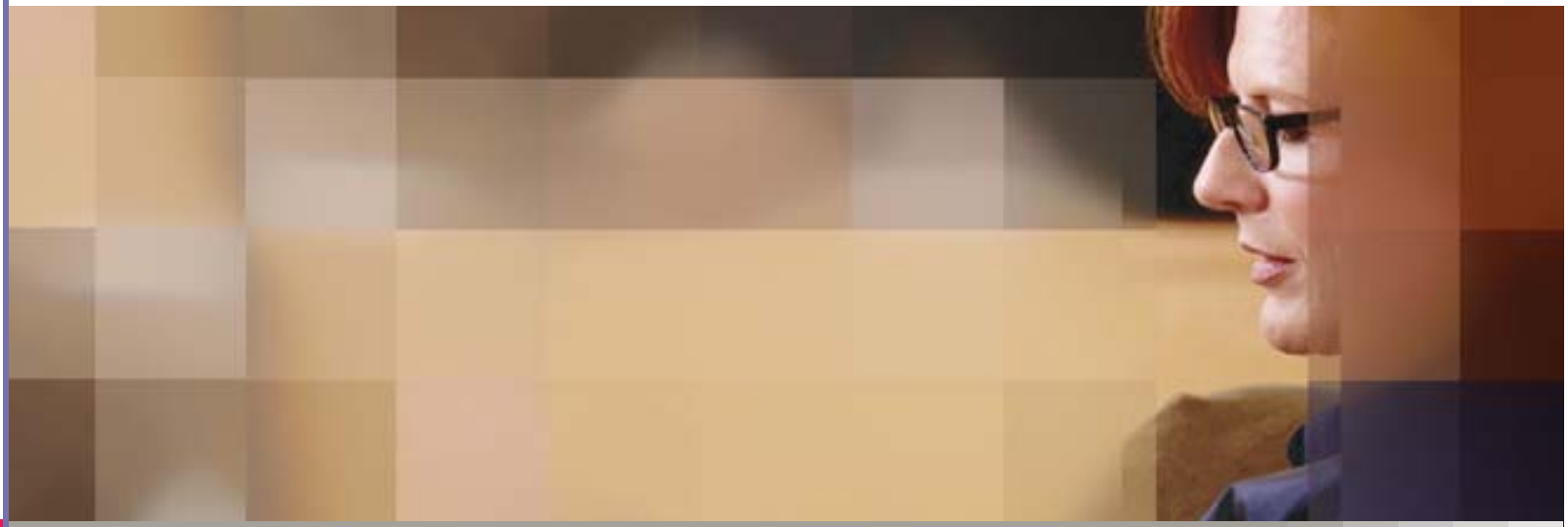
What have we learnt? In summary….

1. The provision of fibre at a municipal level is regarded as having positive benefits on health, education and other public services. These benefits range from reduced telecom costs to more efficient and new services. This is particularly true in rural areas where limited resources and distance are barriers to service quality

2. There is a strong belief that there are a number of indirect benefits derived from fibre rollout. These range from bringing communities closer together to stimulating new ways of working. This is particularly true in more isolated areas

3. To date, there is very limited evidence of any distinct social or economic benefit on any significant scale from fibre provision to individuals' *homes*. Today, there are virtually no services that can *only* be delivered over fibre-based broadband. But fibre is regarded as essential for *future-proofing*

4. However, there are a handful of cases where FTTH is linked to improvements specifically in rural areas, where very high-speed broadband is key for remote workers in certain verticals or the relocation of higher GDP individuals who are fibre advocates



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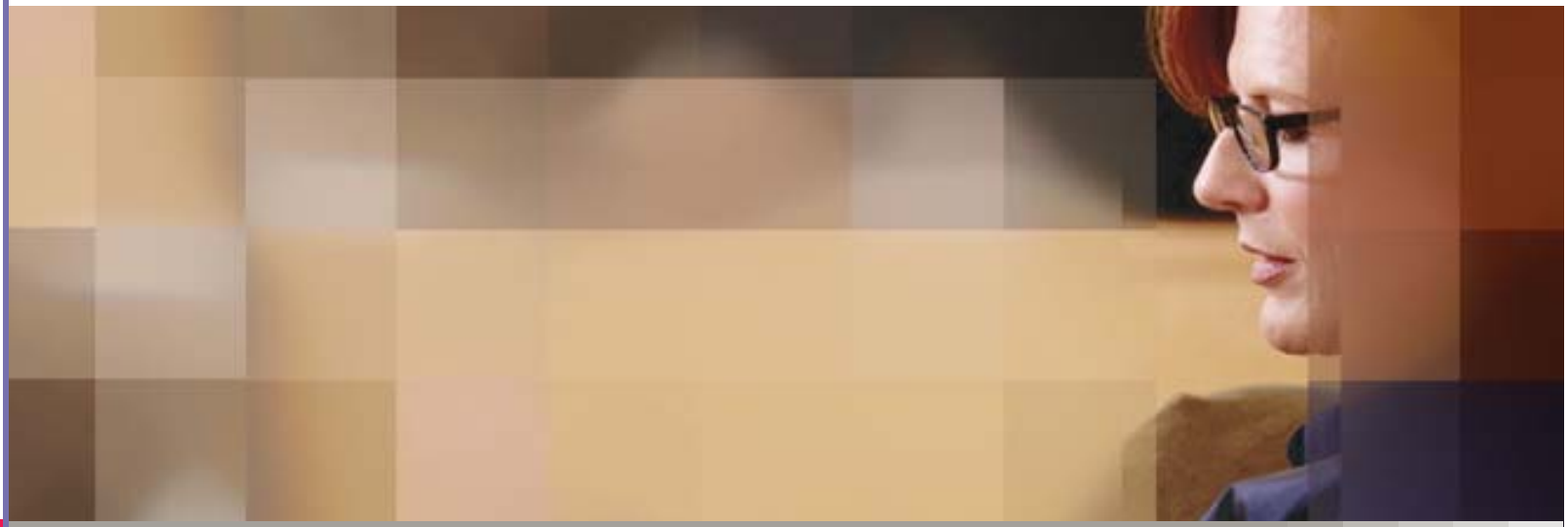

Reference/back-up

Why fibre? Aggregate view

- *Best of breed technology.* “you cannot get better than optical fibre”. It will act as the future platform for services like HDTV, video-conferencing, home automation and cancel out requirement for any additional upgrades i.e. future proof
- *Energy efficient.* Fibre consumes a lot less energy. One estimate quoted equates use of fibre as equivalent to saving Sweden one nuclear power station worth of energy if it was deployed on a wide-spread basis
- *Resilient technology*. Much more robust to weather fluctuations/extreme temperatures, which are common in Sweden. Additionally, copper connections are degrading over time and QoS lower where loop lengths are longer (less densely populated areas)
- *Stimulates competition*. The adoption of an open access model has led to greater competition and cheaper prices for consumers
- *Positive image/cachet.* Perceived as enabling closer links between communities, providing economic advantage and enabling new regional networks

High impact of fibre on small number of communities

- Clear link between rollout of fibre in limited number of communities and attraction of new business to area
  - This is occurring in rural areas with small communities. Definitively linked to individuals seeking to relocate for a) quality of life b) cheaper business costs. Teleworking is key factor. Lindesfallet and Kilafors are two key examples
- Fibre key to enabling geographical dispersion of certain verticals e.g. content production
  - Bandwidth capability and resilience of fibre attractive to certain verticals seeking to relocate e.g. film production
- Fibre is successful tool in attracting technology advocates to certain rural areas
  - There are a number of examples of high GDP individuals relocating to rural areas due to combination of attractiveness of area and fibre i.e. very high speed broadband connections
- “Halo” impact of fibre in attracting service businesses to area
  - Relocation of individuals to these areas drives demand for more service businesses e.g. new restaurant, new stores.

Background

- Installation of FTTH networks started in 2004 in Nuenen (outskirts of Eindhoven) with a broadband cooperative financed by a housing developer, a private investor, a bank and a government subsidy
- Project was called OnsNet which means Our Net
- Prior to OnsNet Nuenen had a choice of ADSL or CMTS broadband service and had a high take rate
- Proposition to the residents was that connection and access to the OnsNet network was free for the first year
  - After first year charges would be €20 for membership to the cooperative, €16 for internet, €10 for telephony and €14 for TV
  - 97% take rate for the first year
  - 80% take rate the second year (2005)
  - 75% take rate the fourth year (2007)
  - P2P two fibers to each residence
  - 10 Mbps symmetrical

Open Care Project

Municipal Real-estate Company Gävle and Sandviken

Muncipal elderly care Gävle och Sandviken

COUNTY COUNCIL Primary Care

REGIONAL PARLAMENT

UNIVERSITY Uppsala and Gävle

COMMERCIAL ENTITIES

MOBILA ENHETER

WEBB - DATOR

TV PRES.

A COMMON APPLICATION & INTEGRATION PLATFORM BASED ON OPEN SOURCE

phoniro

STT CARE

SYSteam

Time Care

ASSA

WM-data

TietoEnator

Vivago

Hudiksvall

Hudisksvall area spread over 27 sq miles with 37,000 pop (16k HH)
1500-1700 companies in area. 10-15 have more than 75 employees, the rest are small businesses
Decision taken in mid 1990s by political leadership to make fibre optic technology cornerstone of town's economic development plans

- Negative population trend in town. In December 1994, population was 38,828. By December 2002, it had declined to 37,048 (down 4%). Decline halted in 2002, when a significant number of homes received fibre
- Number of companies in the region has grown between 6 and 14% y/y since 2004
- Mean educational level in Hudiksvall is below average: they see fibre investment and project off the back of this as way of raising this. Now alot of high-tech companies in an area which was originally known for paper mills, but now gaining a reputation as a hub for fiber-optic development

Old@Home project

Background: Old@Home project. One of Sweden's largest research projects within home nursing started in 2002 by Uppsala university/Ericsson carried out in Hudiksvall. Aim to make life easier for patient/caregiver and ease demands on hospital system.

Developed mobile digital information system supplying care providers with information they need to make medical decisions at point of care
Home care workers equipped with handheld devices connected to secure computer network enabling access to virtual health record that contains information shared by primary care workers

- Encountered significant barriers: legacy systems, restrictions on use of personal data, co-ordination of different stakeholders and end-user resistance
- Caregivers (actual users) eventually saw benefits of system (simplification of record-holding, flexibility in care-giving) and became enthusiastic advocates. Now train others and speak on benefits
- Fibre is not essential for service delivery in home, but QoS and speed of network is highly important.

Lindefallet

Small village of 227 inhabitants between Soderhamn and Hudiksvall. Villagers installed fibre themselves, digging, installing, setting up nodes.

Cost was divided equally between those who chose to install fibre. Around 50% initially, but by end of 2004, whole village was connected. 98% fibre penetration

- No school or hospital, but experiencing growth in population accredited to fibre rollout, which started in 2004. Since then population increased by 7%
- Number of examples of primarily young, professional families relocating here due to quality of life and advanced telecoms infrastructure

- Peter Engstrom, 34 and Linn Sjoberg, 30. Peter works from home on a part-time basis "When my contractions started and our son Nils was about to be born, it was nice to have Peter right here at his home office"
- Peter and Heather Nilsson from California moved here to raise children in safe environment
- Olle Person: "people trust their childrens' judgement when they say it's important to the village" "In the future, when we look back at the introduction of broadband it will probably be considered the most important factor for being able to live, work and participate in society from a small town such as ours"
- Journalist Marie Sandberg and writer Georg Johansson moved here from Brussels

Jonkoping

Jonkoping area has 60k households and around 125k inhabitants
Population has grown by around 2000/year is now 10th largest town in Sweden
In 1998 started rolling out fibre to public buildings. Central area public buildings are now all connected over fibre. Nearly every school now has 100 mbps
Connected to 3 different municipalities

- Over the last few years, fibre connections have become standard for larger businesses. Demand is now coming from smaller businesses as they want to benefit from better, lower cost services like IP telephony
- Jonkoping has a high level of employment. Fibre has not made a tangible difference to businesses: it is the businesses and industry that already exist here for example, now know as a logistics hub in Southern Sweden and there are a number of manufacturing companies located here like Electrolux and VHM
- Teleworking does not feature high up the agenda here, partly due to the nature of businesses in the area i.e. predominately manufacturing

Lumiora network

Norrbotten region in North of Sweden
252k population: density 2/square km (Swedish average 22/km)
Lumiora municipal owned network offers fibre infrastructure for public service and business communications

- Healthcare: 5 hospitals, 33 health centres and 34 dental clinics. Reduced communications costs by half and fifty times faster network. Created systems for digitalised patient records, transmission of digital X-rays, digital prescriptions, videoconferencing and IP-telephony
- Enabled collaboration between municipalities in the following areas: School admissions: Boden, Luleå, Piteå and Älvsbyn. IP alarm system: Haparanda, Kalix, Överkalix and Övertorneå.
- Lulea University of Technology: Videoconferencing and e-meeting technology for distance-spanning teaching, research and development
- Inter-school teaching in rural schools: virtual merging of student groups has provided equal access to teachers

Interviews

- Claus Larsen, project manager, Acreo
  - Acreo has been involved for a number of years in FTTH projects in Sweden
- Magnus Burvall, managing director, Fiber Optic Valley
  - Active in co-ordinating fibre rollout/investment: Gavle and Hudiksvall
- Jan Elvedid, managing director, World Internet Institute
  - Attached to fiber optic valley. Primarily end-user research
- Lars Hedberg, secretary general, Swedish Urban Network Association
  - Stokab founder, involved in number of fibre initiatives
- Karin Skalman, Vinnova (Swedish gov agency for innovation systems)
  - Was involved in development and rollout of Old@Home project
- Kristina Mickelsson, Hudiksvall town council
  - Involved in fibre investment plans and town development
- Network manager, Jonkoping Energi plus team member
  - Formerly worked for Telia, involved in development of municipality owned network
  - Company employee with fibre installed at home