The Application of Evolutionary Economics to Infrastructure Systems

Infrastructure as an evolutionary, dynamic and adaptive system

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ITRC Work Stream 3

Managing Infrastructure as a Complex Adaptive System

WS3 explores a variety of approaches to simulate and interpret the long term interactions between infrastructure, society and economy

*Using the tools of **evolutionary economics** we shall explore the dynamic relationship between **infrastructure provision** and **structural change** in the economy*

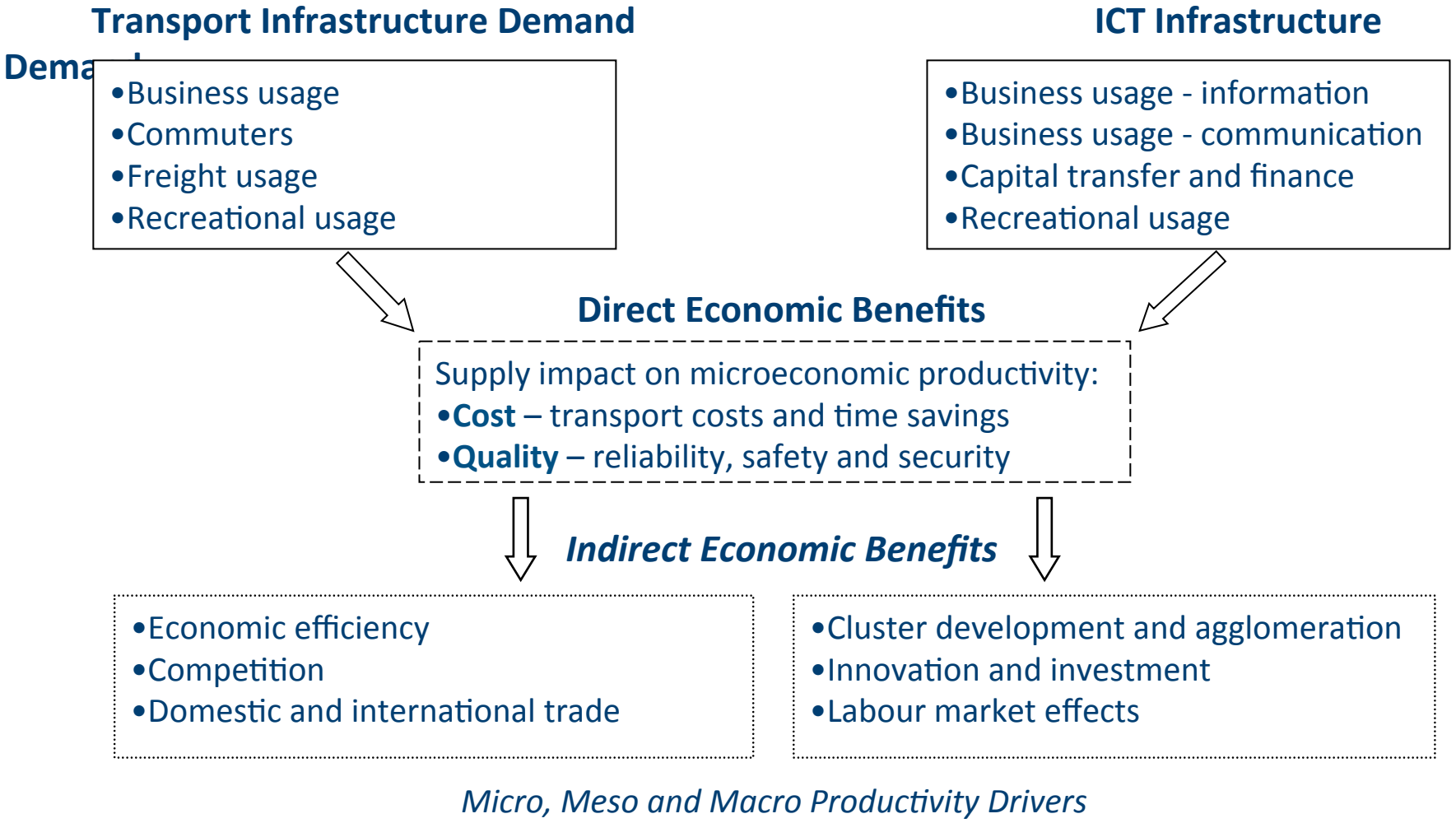
Research Motivation

- To gain a greater spatial understanding of infrastructure
- Informing decision making
- Innovation and changing spatial effects
- Desire to combine systematic analysis with research on new, micro-foundation behaviours
- Infrastructure at a cross roads…
- Longevity (HM Treasury, 2011; 2012)
- Causation
- External environment and evolutionary economics

Economic Aspects of Infrastructure

- Transportation and communication systems have a *direct effect* on unlocking additional investment and raising levels of productivity (Eddington, 2006; Égert et al. 2009; HM Treasury, 2011; 2012)
- With transport infrastructure, the wider indirect benefits ripple through an inter-connected economy causing *dynamic development effects* (Lakshmanan, 2011:9)
- This yields a range of sectoral, spatial and regional effects which augment productivity (echoing Schumpeter's observations in Business Cycles, 1939)
- In the information economy, telecommunication systems have been found to cause similar positive economic effects (Czernich, 2011; Kolko, 2010; Koutroumpis, 2009; Crandall et al. 2007)

The Economic Impacts of Infrastructure on Cities



The Research Focus

1. How does infrastructure and the connectivity it provides, influence growth and economic development?
2. What is the role of connectivity in influencing location decisions?
3. Does infrastructure connectivity influence the degree of innovation which takes place in different spatialities?
4. How does **supply and demand co-evolve** over time, and what are the **implications of change** in these sub-systems?

Focus on ICT infrastructure in the UK

Transportation systems shall be used in a reflective manner

General Tenets of Evolutionary Economics

	Classical Economics	Neoclassical Economics	Evolutionary Economics	
Analytical horizon	Long run perspective	Comparative static view	Long run perspective	*Necessary for infrastructure*
Incorporation of change	Endogenous technical and social explanatory variables	Exogenous technical and social explanatory variables	Endogenous technical and social explanatory variables	*Changed created from within*
System state	In equilibrium	In equilibrium	Out-of-equilibrium	*Innovating out of equilibrium*
Information	Perfect and symmetrical	Perfect and symmetrical	Imperfect and asymmetrical	*Limited foresight and uncertainty*
Type of rationality	Rational agent	Rational agent	Bounded rationality	
Determinant laws	Immutable objective laws	Immutable subjective laws	Co-evolution of subjective and objective laws	*Reciprocal learning and adaptation*

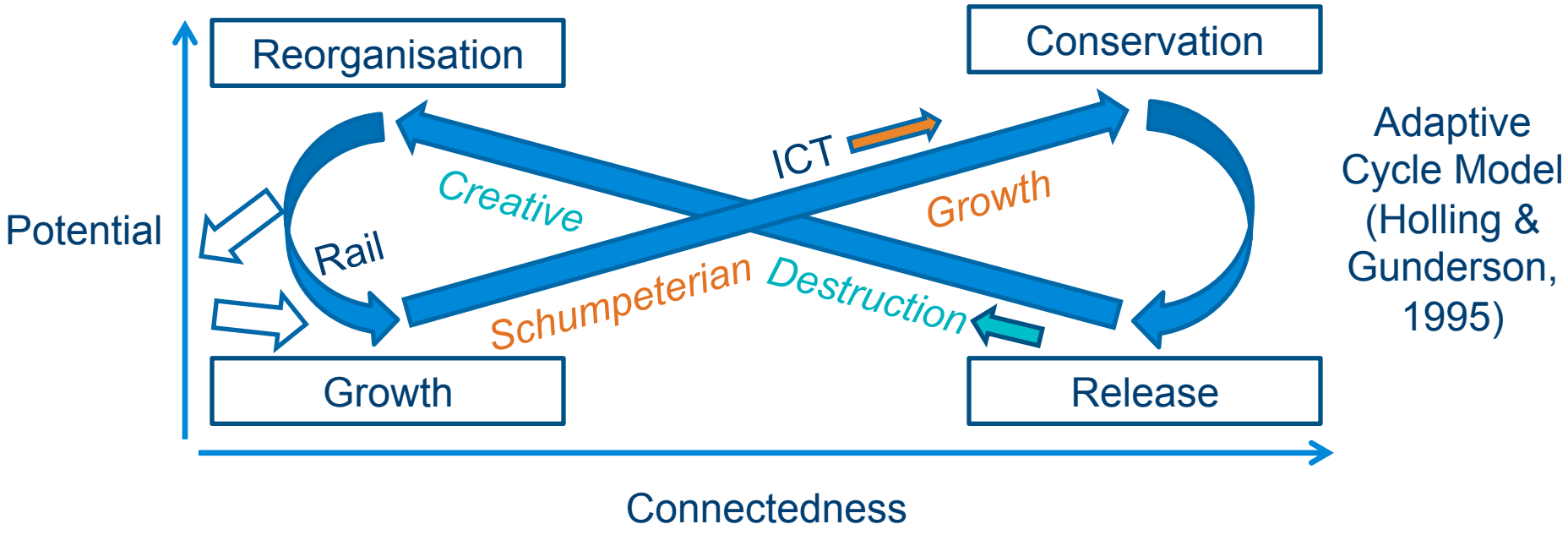
(Dopfer and Potts, 2008)

Using an Evolutionary Lens to Understand Change...

- The Schumpeterian legacy
- Evolution: novelty, dynamics, irreversibility and discontinuity
- The adaptive nature of infrastructure supply and demand
- The importance of ***connectivity*** – the degree to which different entities are linked – to the development of different places
- Connectivity a ***dynamic process***, and therefore competitive advantage as a ***dynamic process***
- Feedback evident in the delivery of infrastructure across space

The National Infrastructure (NI) System as a CAS

- Change is not life cycle based
- Succession



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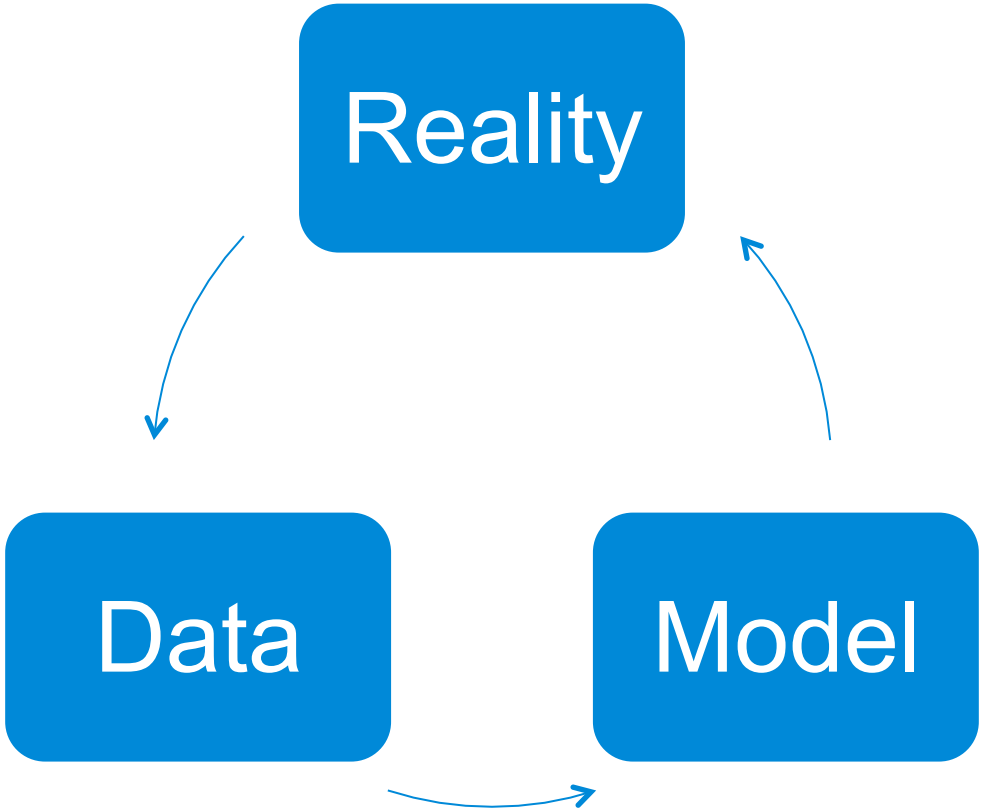
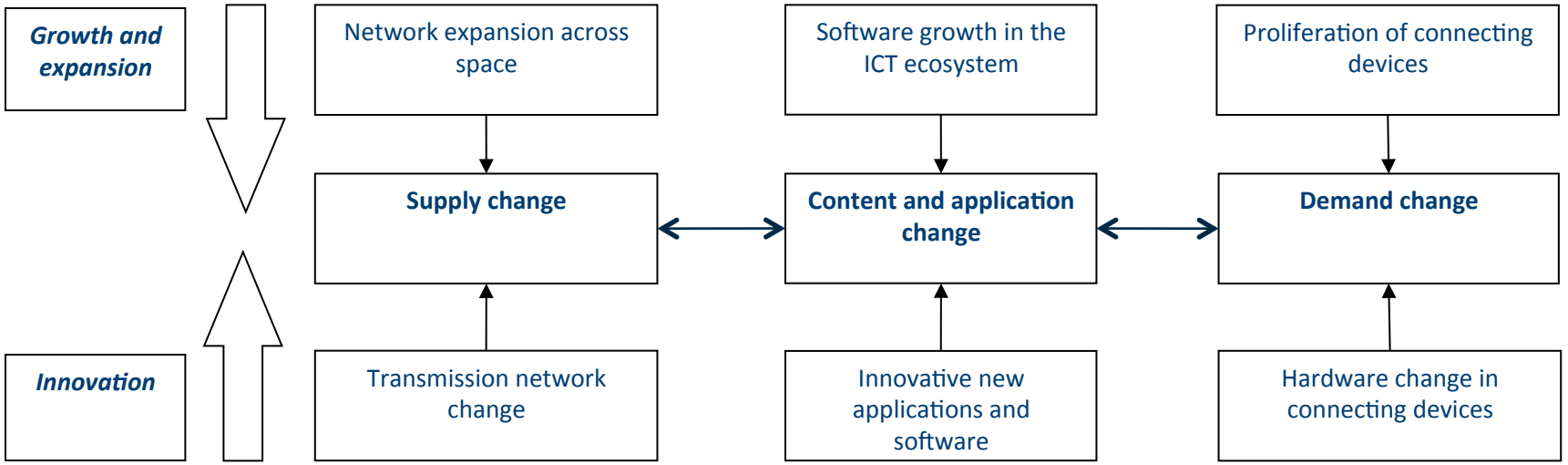
Research Agenda



Co-evolving Supply and Demand

*How does **supply and demand co-evolve** over time, and what are the implications of perpetual change in these sub-systems?*

Picking up the **behavioural responses** of infrastructure **providers** and those **demanding connectivity** through a **mixed methods** approach



Growth and Economic Development

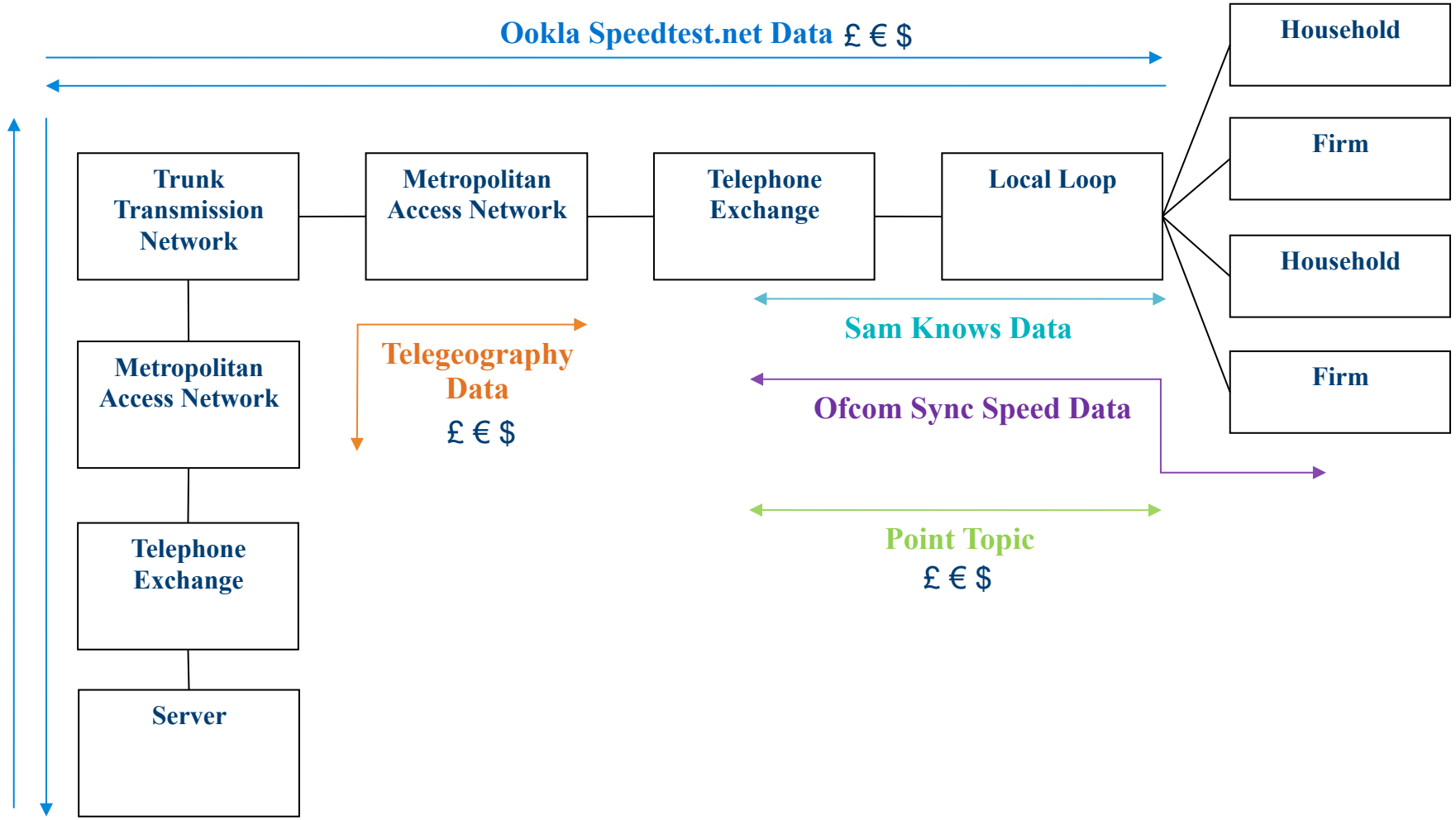
How does infrastructure and the connectivity it provides, influence growth and economic development?

- Macroeconomic research by Koutroumpis (2009) identified an average 0.26% impact of broadband deployment on UK GDP between 2002-2007
- Kolko (2012) finds a positive relationship between broadband expansion and local economic growth in the U.S. for the period of 1999-2006.
- Research on European city regions by Tranos (2012:334) found “that the Internet infrastructure does not follow, but precedes, economic development”

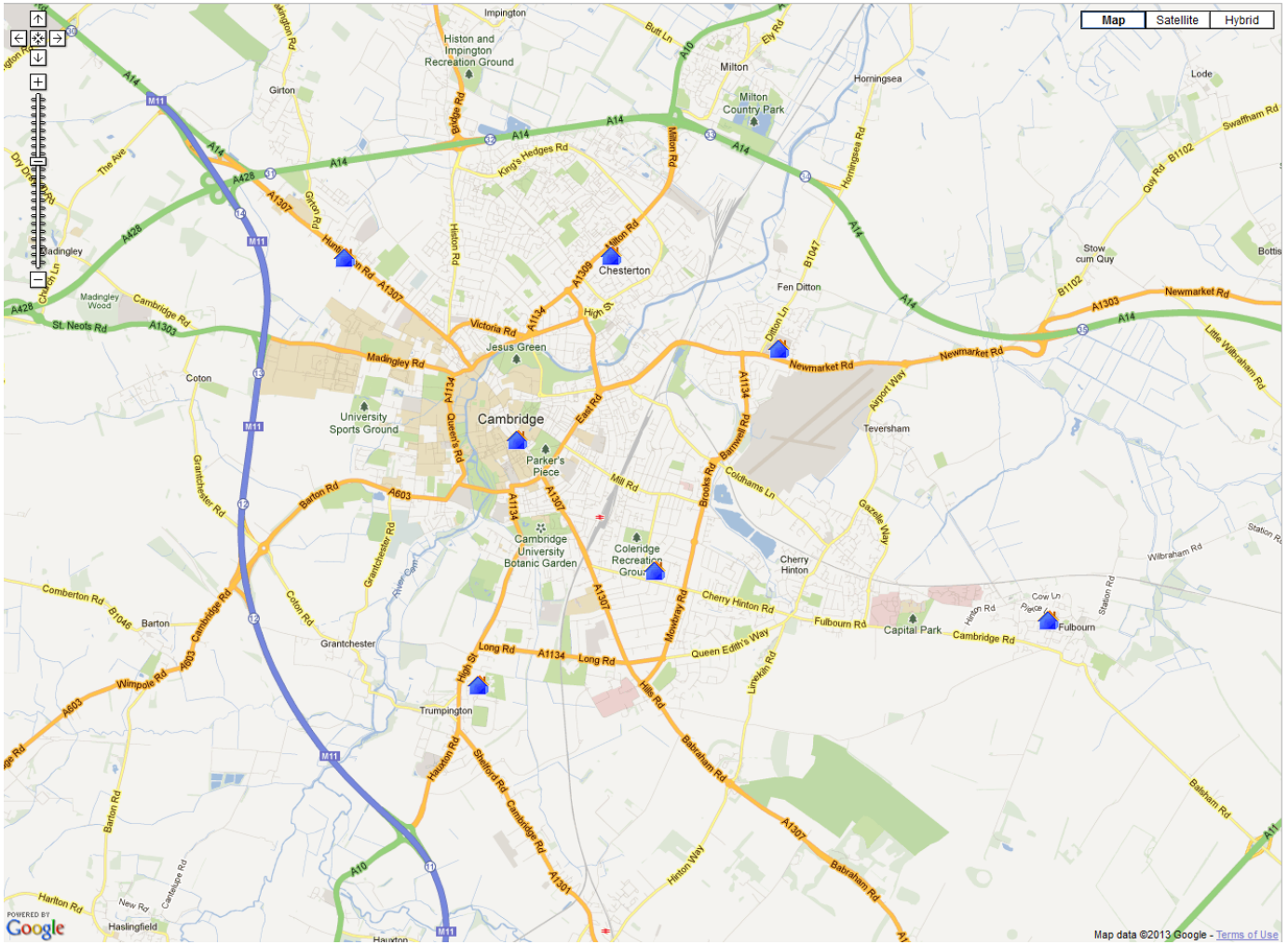
Hypothesis 1:

The degree of connectivity provided impacts on the growth and development of different spatialities

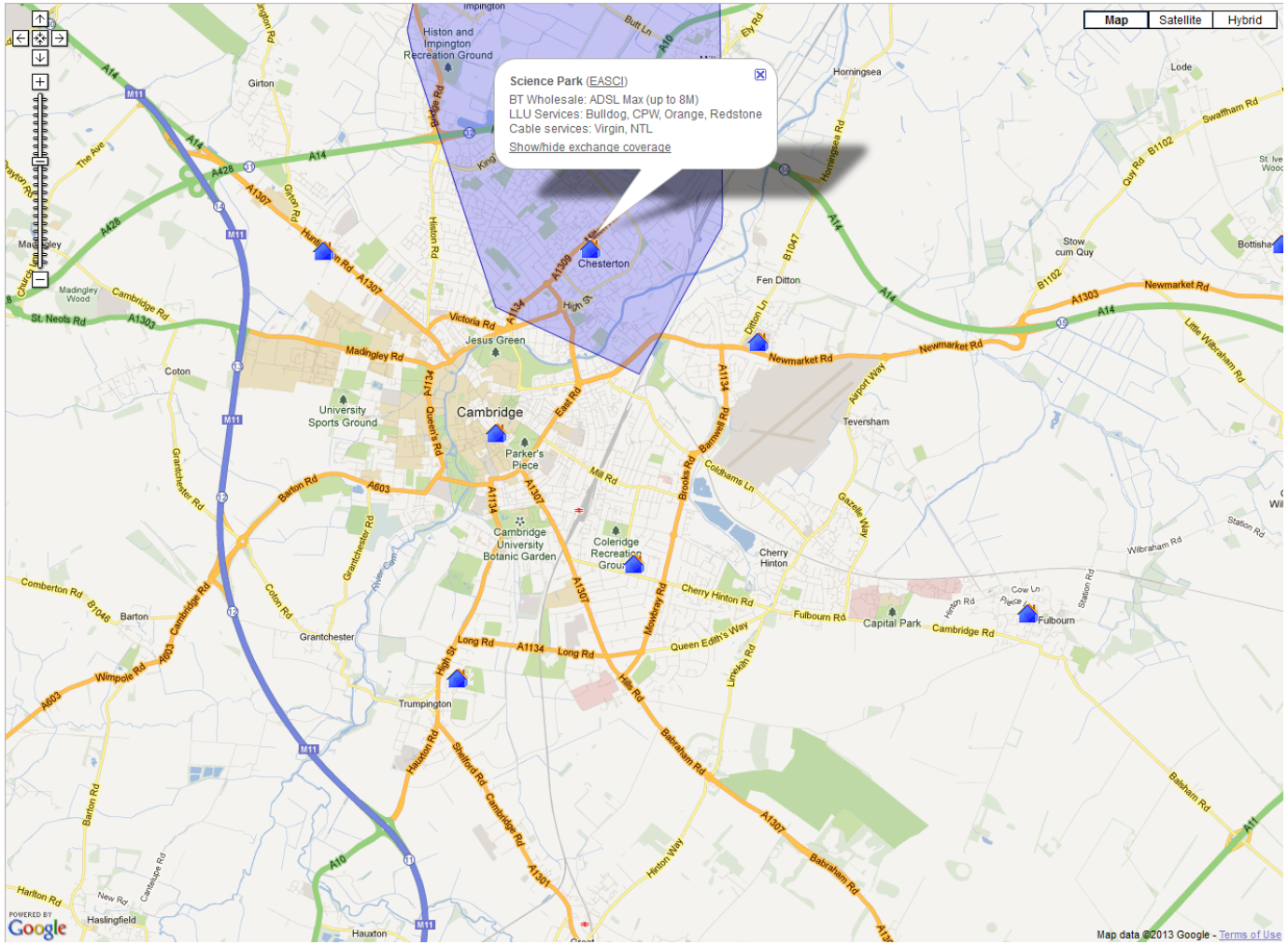
Broadband Supply: What the Available Data Measure



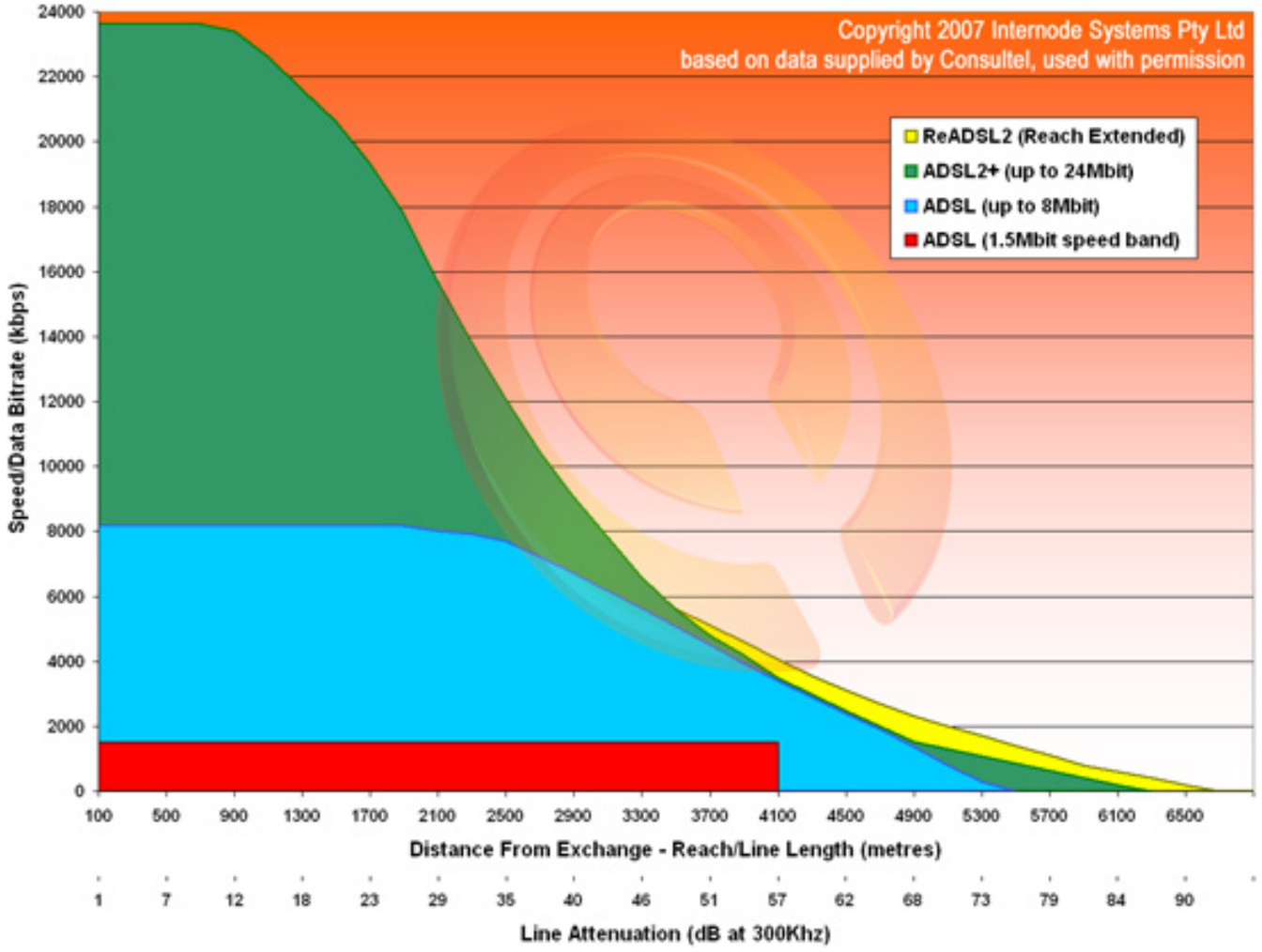
Geo-locating Telephone Exchanges



Telephone Exchange Coverage



Calculating Maximum Speed/Data Bitrate (kbps)



Location Analysis

What is the role of connectivity in influencing location decisions?

- Mack & Grubesic (2008) found no relationship between firm location and broadband provision in Ohio between 1999-2004
- Mack et al. (2011) found that broadband provision was important for the location of information intensive firms in the US, but there was a significant variation across the metropolitan areas examined

Hypothesis 2:

The degree of connectivity provided by different places influences location decisions

Location Analysis

What is the role of connectivity in influencing location decisions?

Who?	Purpose?	Number of Interviews?
Internet Exchange Points (LINX)	To gauge the experts' thoughts on this matter. Perhaps they have an answer to this question.	5
Data Centres	To identify how connectivity influences the location choices of data centres	5
Financial Services	To identify how they connect into the network given the amount of resources they have at their disposal	5
SME Knowledge Intensive Businesses	To identify how connectivity influences their location decisions	5

This research needs to be able to inform further quantitative research

Innovation and the Information Economy

Does infrastructure connectivity influence the degree of innovation which takes place in different spatialities?

Hypothesis 3:

Infrastructure connectivity influences the degree of innovation which takes place in different spatialities

In Conclusion

- A need for understanding how infrastructure systems dynamically adapt and change
- This requires a step change in how we think, and evolutionary economics provides a lens for helping us to understand this change
- Co-evolutionary change
  - Network growth / expansion and innovation
  - Productivity and growth, location change and innovation
- Picking up supply and demand behavioural responses
- Supply data has been problematic but the outlook is improving

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Questions?

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