Smart Cities

Session I: Lecture 1:
A Walk Through the Smart City

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Let me begin by showing you some of the content of what we are going to be talking about in this course – the smart city.

And a good start would be to define the smart city – we will come back to this time and again because smart cities are cities that use technology in innovative ways and this is about how we as human beings not only invent fancy technology but how we use it to best purpose. Every aspect of the city can be improved and structured using technology and thus there are countless definitions of smart cities

Here we will begin with a narrow one and then gradually broaden it. A smart city is one where computation is embedded in the fabric of the built (and even natural) environment so that users of the city can provide a better quality of life using that technology.

In this sense, we start with technology and in some senses, we will assume that these technologies are digital. We will see that throughout history, new technologies have had a major impact on cities but here we will focus on digital computation.

And we will not stop at hardware for routine operation of city functions. We are interested in what that hardware tells us and this is data. In fact we have always had data and basic technologies have been used for millennia to generate and process data – cf the 1890 US Census – but here we are talking more narrowly to start with about data that is streamed from sensors in real time and space.

And in the last 10 years computers are being used this way to generate data which is 'big' –hence the concern for 'big data'

In fact I will show you a short movie if I can get it to load which sketches ideas about smart cities

There is a very useful background course online called Technicity developed by Thomas Sanchez and Jennifer Cowley-Cooper at Ohio State University and you can see all the material for the lecture and videos at http://coursera.org/course/techcity

In fact I am not going to go through the course other than pick out some videos because it is different from our course here in that it is a little less historical and more contemporary and technics based but it has a good video on what the smart city is so let us load it and see what it tells us

https://class.coursera.org/techcity-001/wiki/view?page=week1walkthrough

It is useful to show you some examples to begin with and we will return to these in detail later.

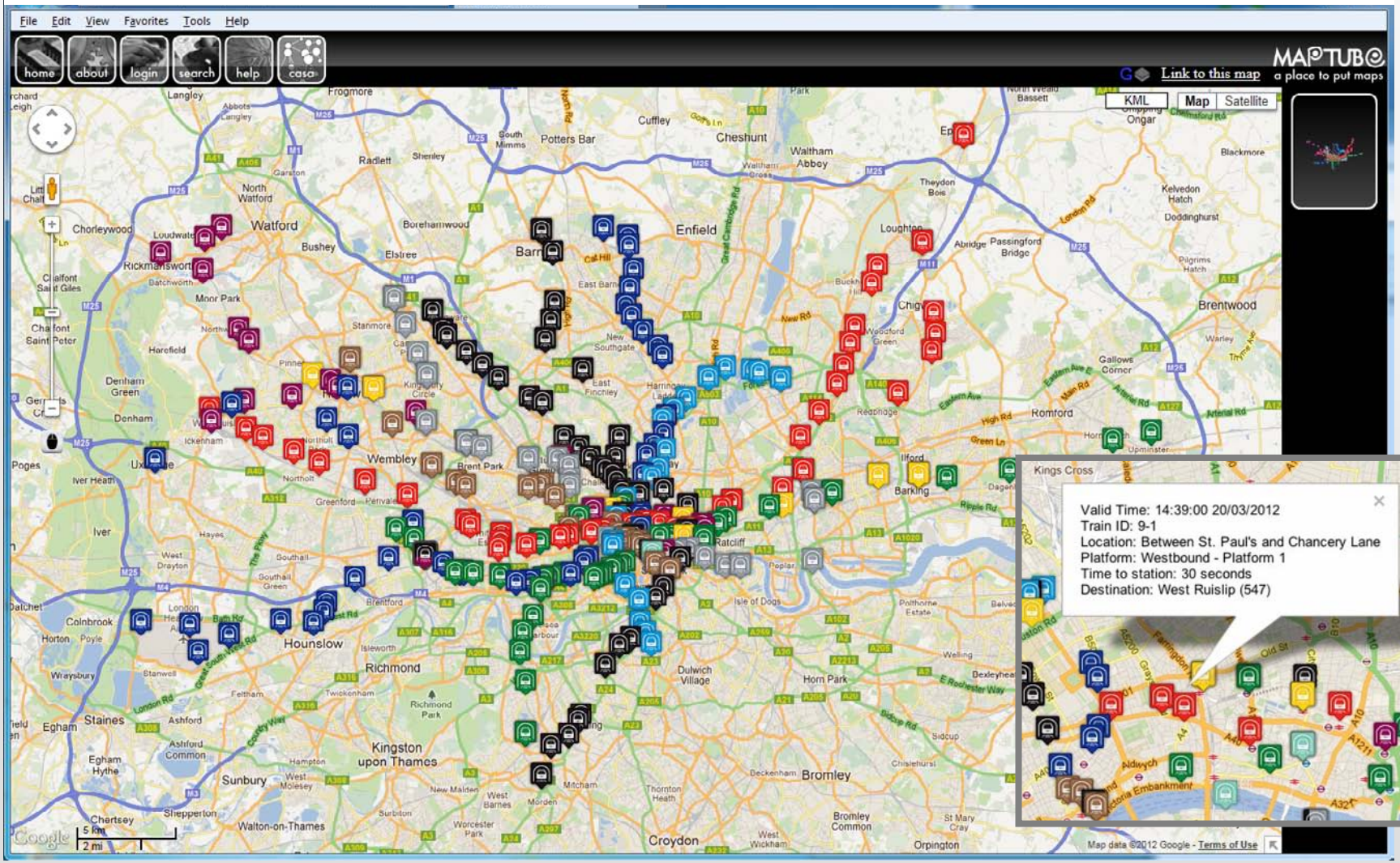
Much of this is about how we are collecting real time data on how people move around and this is the tip of the iceberg in terms of the sort of data we are getting about the city.

Basically I am going to begin by showing you the tap in and tap out data from the smart card used on London's public transport systems – the Oyster card – this is generating massive amounts of new data – Big Data. And is being complemented with data about where and when the actual vehicles are on these networks

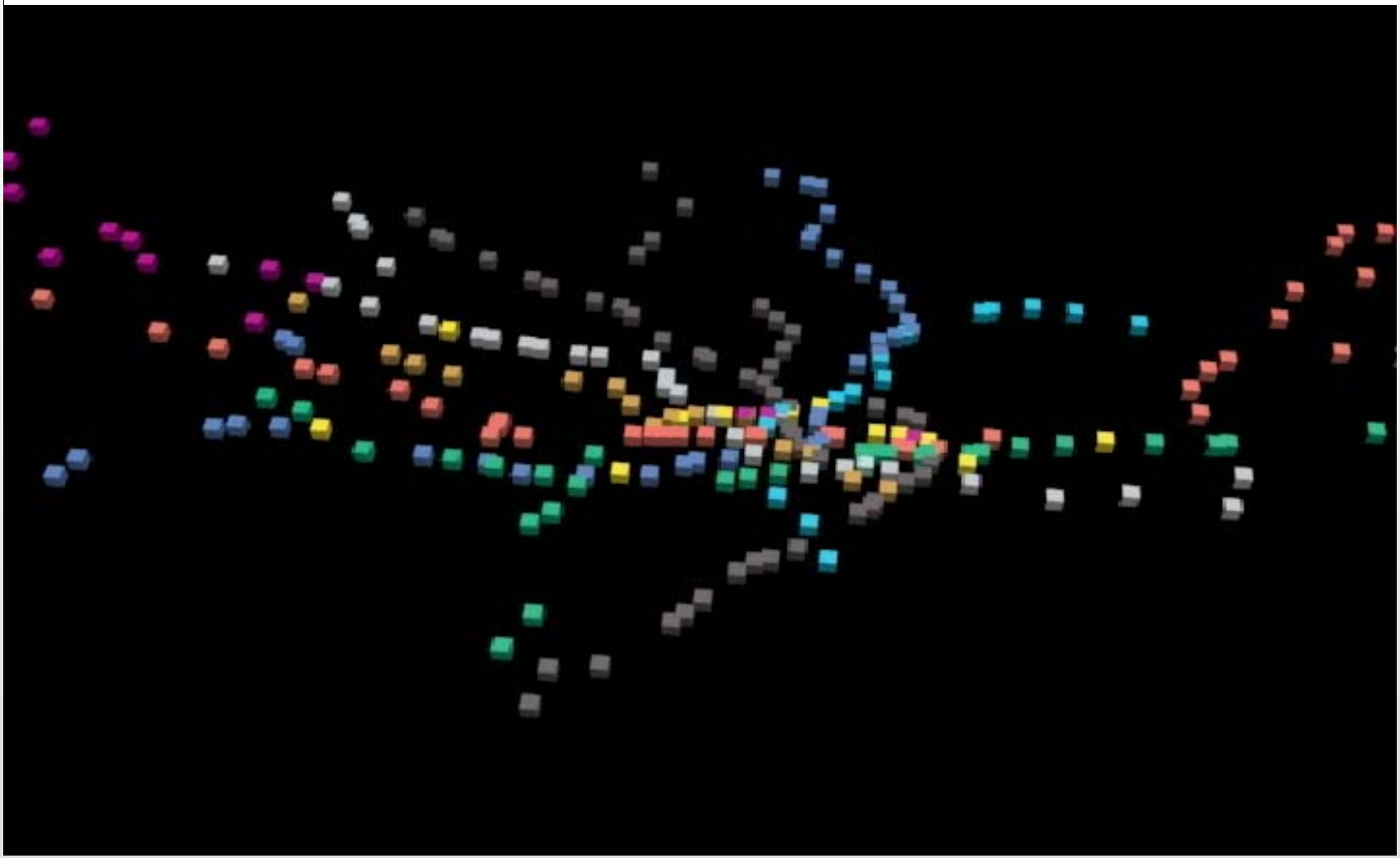
The same is true for planes in the sky, and like movement phenomena – all sensed in real time and automatically. First the tube data for London ….

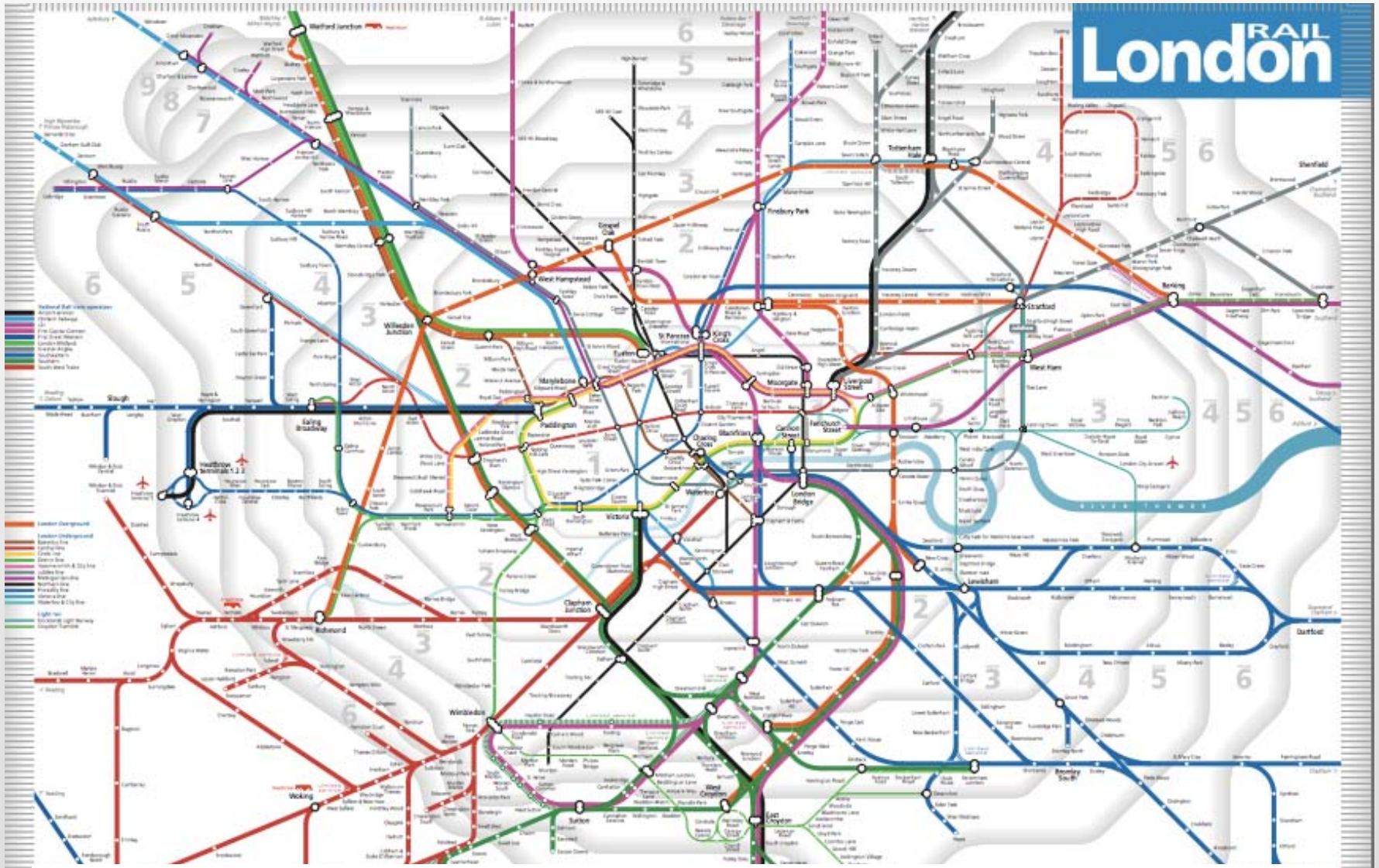
This is taken by aggregating the smart card tap-in-tap-out Oyster data which is about 7 million records each day

This is from the Tube API Trackernet which records position and delay and time on any tube train

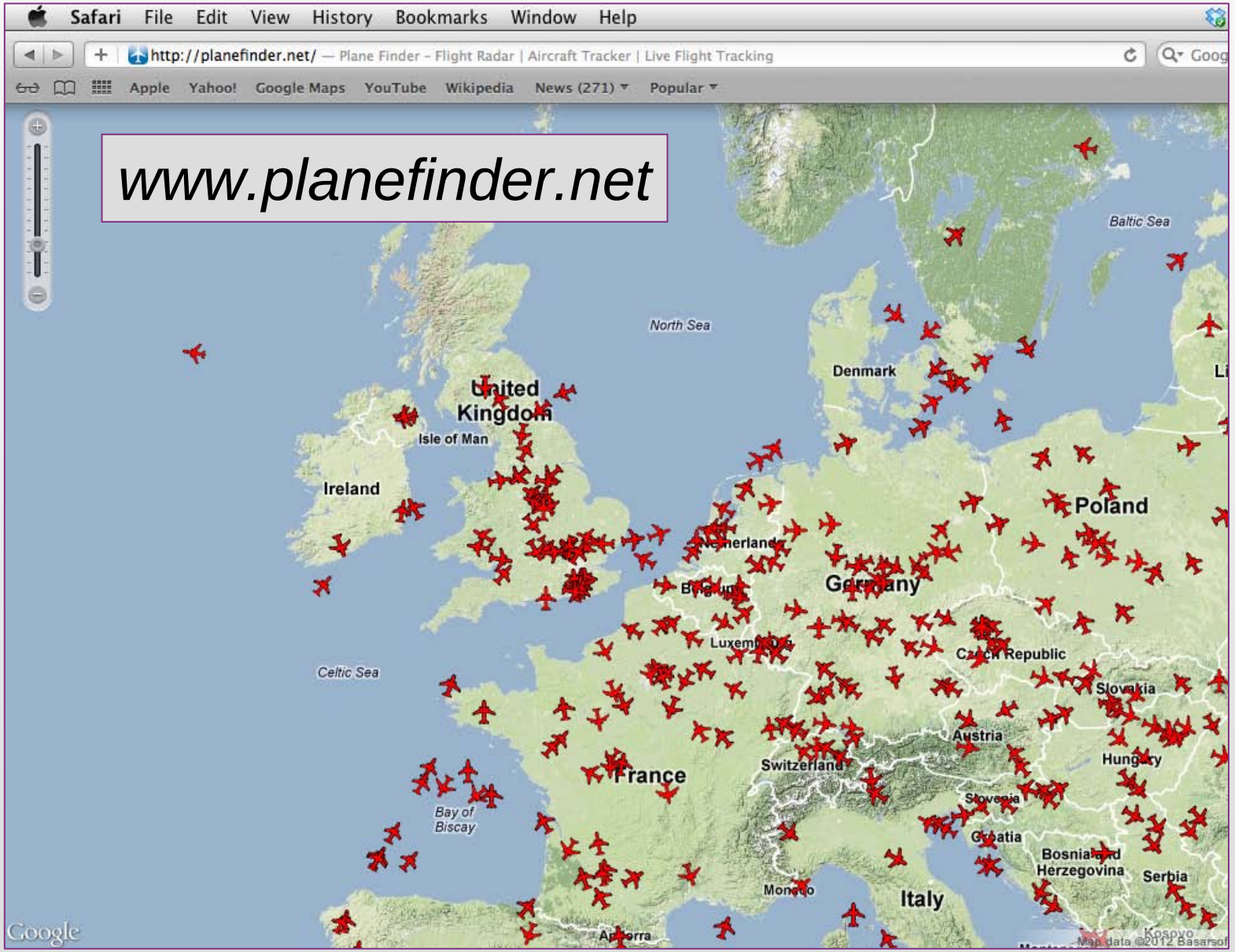


Animation over 24 hours of speeded up position/time of tubes





Tube, Overground and National Rail Networks in London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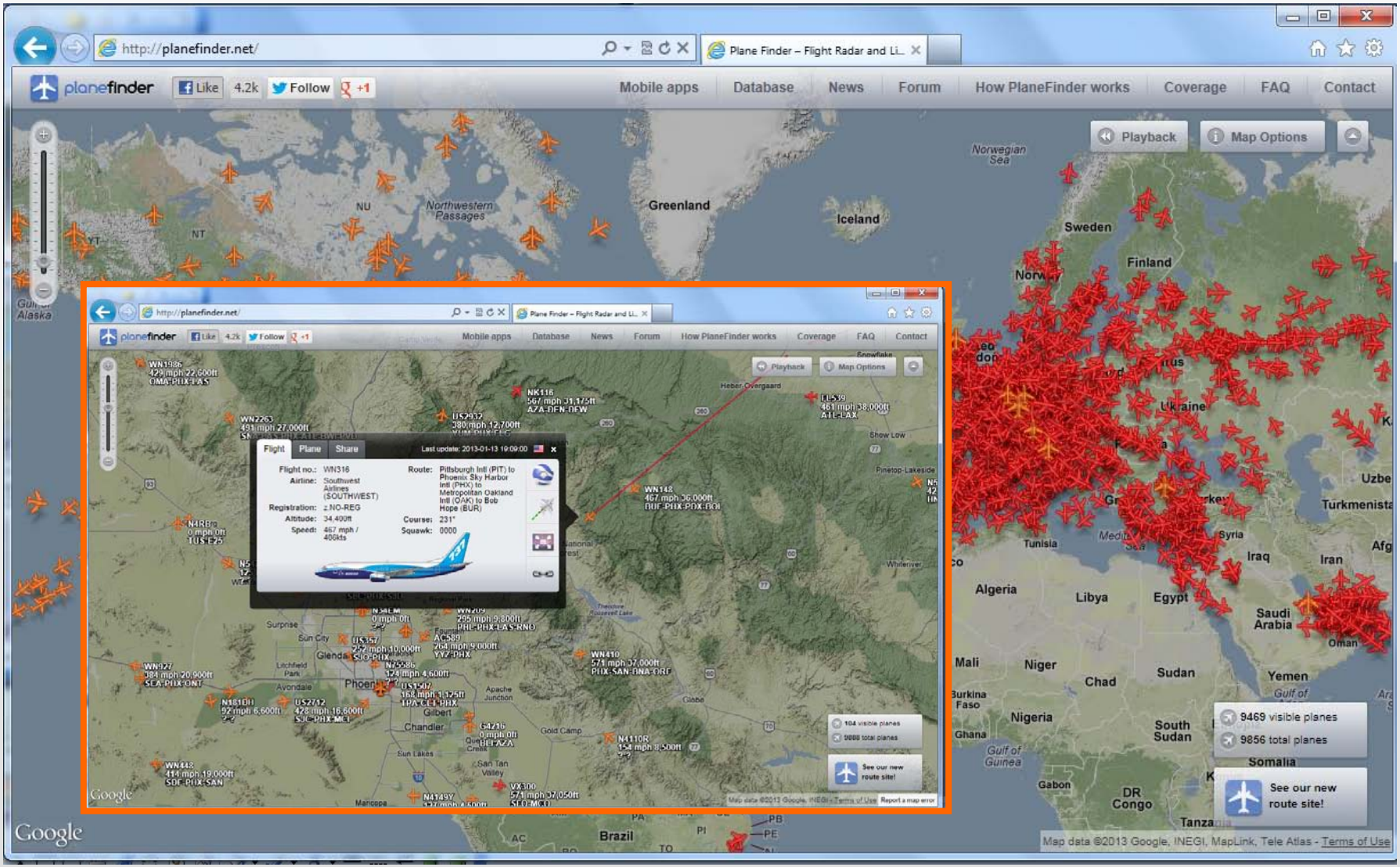


Position of Planes in Europe and America Sunday 13th Jan 2013 with Zoom in on Phoenix Area about 2-30pm EST

A Walk Through the Smart City

I want to begin in these first three lectures today telling you about technology and the city for everything we do with respect to technology relates to space and place and time and much of this takes place in cities.

In fact most digital computation is invented and disseminated in large cities and I want to begin by walking you through a couple of kilometres of the City of London, showing you where the kinds of things that are very basic and which we now take for granted were invented. Besides being very interesting, it serves to tell us too about cities a little.

One basic premise in all of this is that electrical technologies are absolutely fundamental to computation and communications and these were really only discovered in the last 150 years

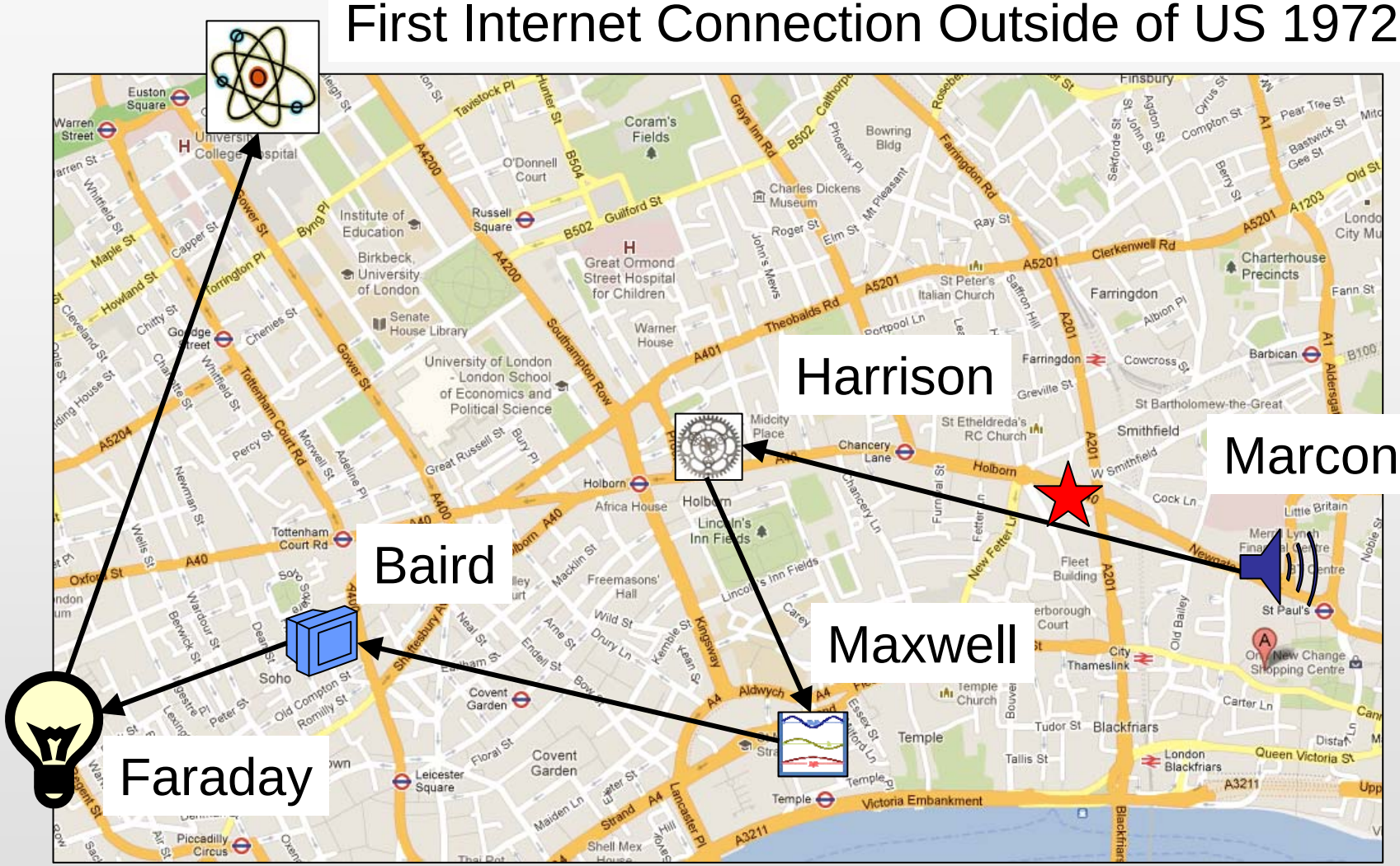
Ok I am going to walk your through the smart city, giving you a potted history about how we got to where we are today but all the rudiments of digital information are there in the past

I am going to walk from St Paul's Cathedral in the City of London, close to where I live – in the financial quarter – to the West End and on the way point out all the discoveries about information technologies that are associated with this little bit of a world city. And of course the implications that these have for ICT – information & communications technologies – our collective term for all of this. The implications are:

a) about information, soft not hard, and

b) about how local things are suddenly beginning to spill out everywhere. The smart city in fact is about this widespread application of computers to information. About the global city

First Internet Connection Outside of US 1972



Worth noting that after I had presented this talk, I found out that the Edison Electric Company installed the world's first (little) power station at Holborn to light nearby buildings such the central criminal court and the GPO

Marconi, 1890s

Marconi made the first public wireless transmission from the General PO Office to PO Office South in 1896

John Harrison, Clockmaker to the Board of Longitude, 1750s

John Harrison invented mechanical clocks that worked at sea so position could be determined accurately

Maxwell, Physicist, 1860s

$$dU = TdS - PdV \implies \left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

$$dA = -SdT - PdV \implies \left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

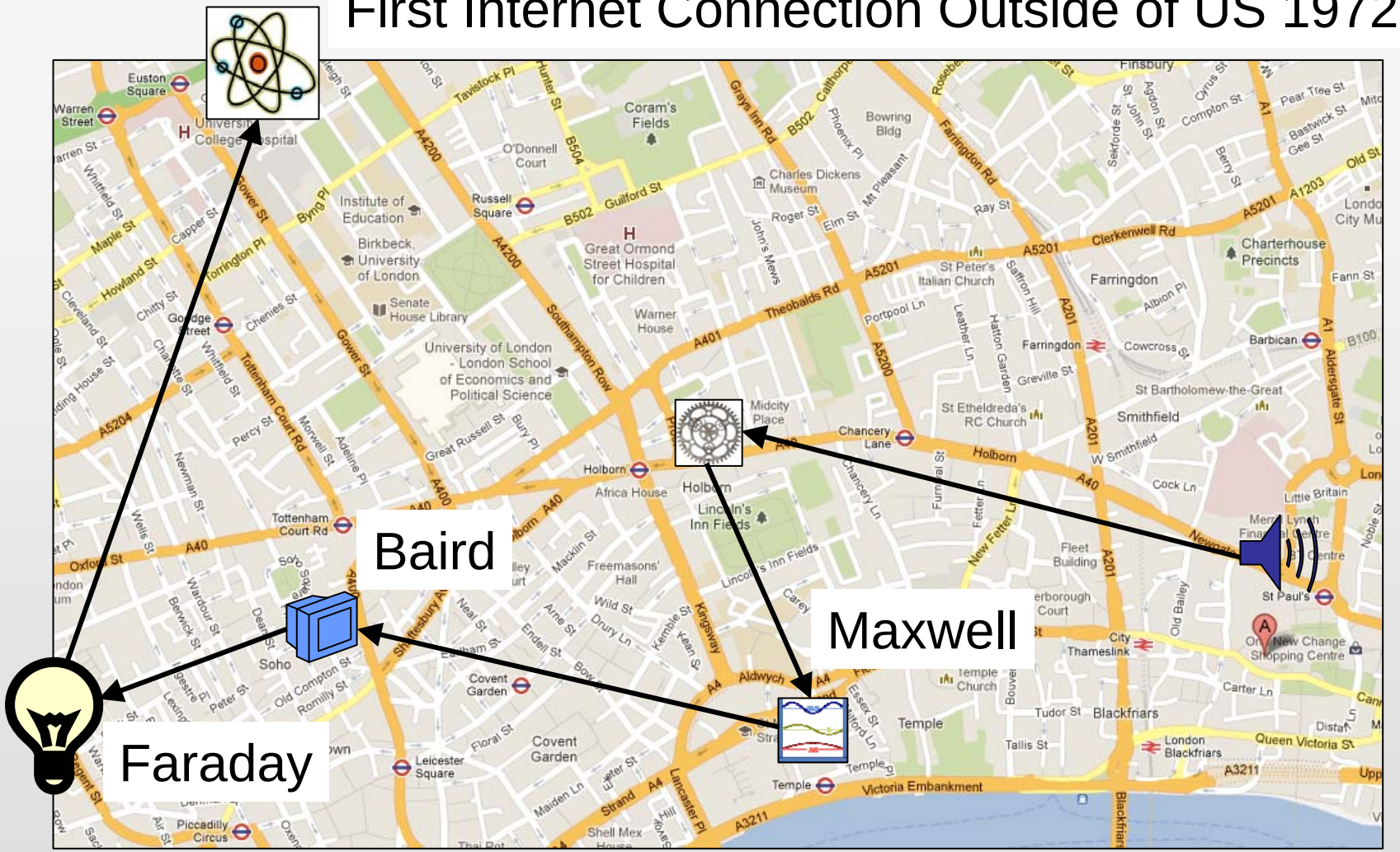
$$dH = TdS + VdP \implies \left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

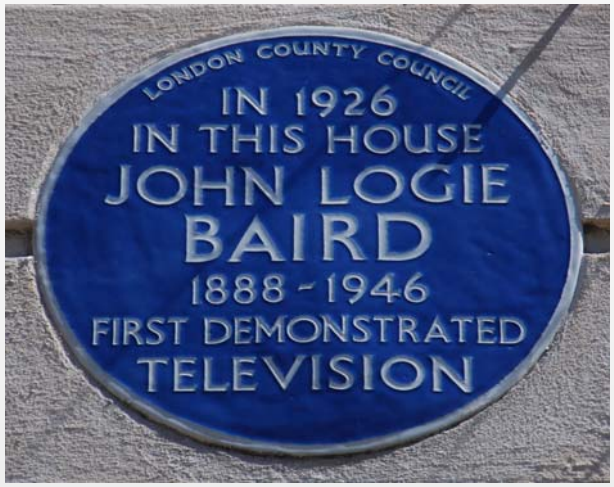
$$dG = -SdT + VdP \implies -\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$$

Maxwell pulled it all together at Kings in 1860

Note Bush House, the original home of the BBC is nearby

First Internet Connection Outside of US 1972





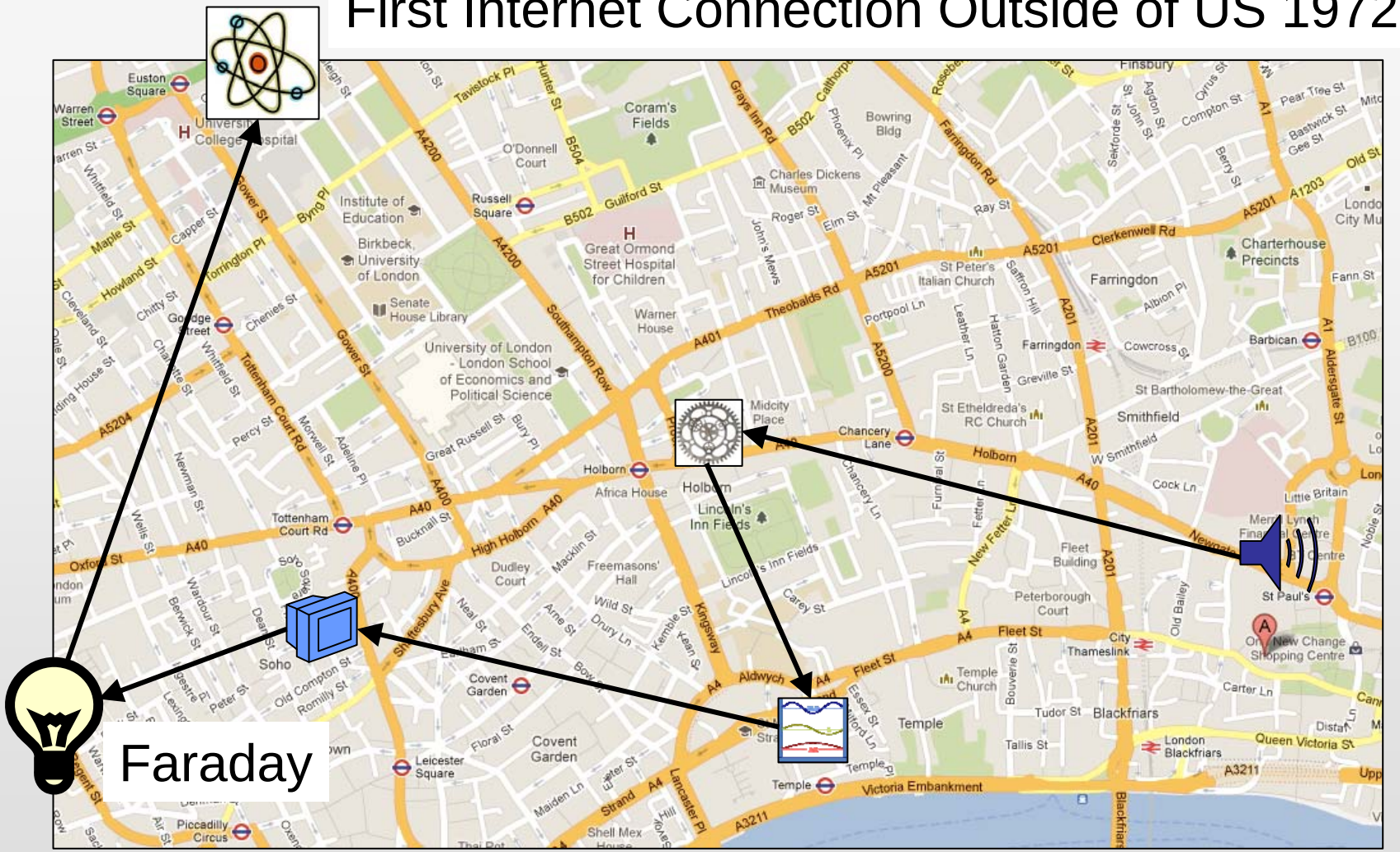
Baird, Inventor of TV, 1926

John Logie Baird demonstrated TV for the first time in 1925-1927 in London's Soho

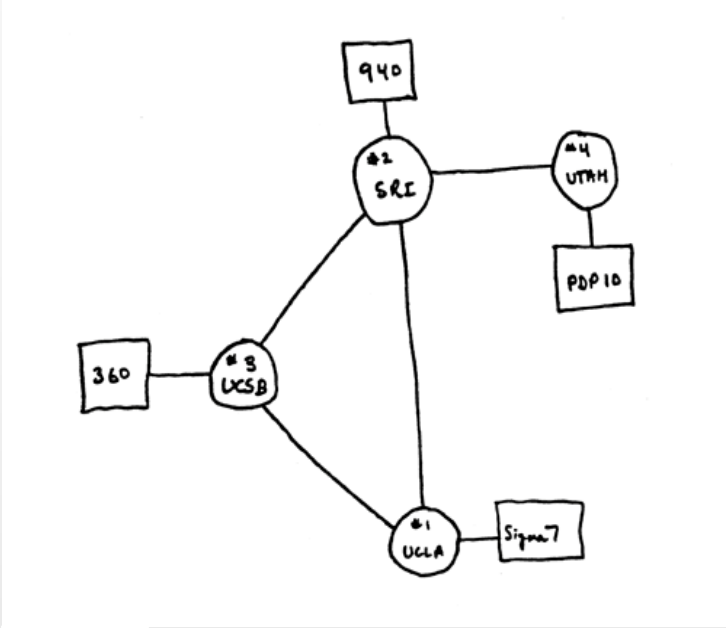
Faraday, Electromagnetism, 1820s

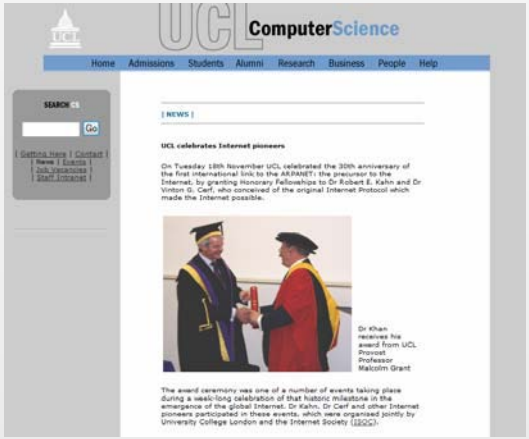
Michael Faraday explores electromagnetism in the 1820-30's at the Royal Institution

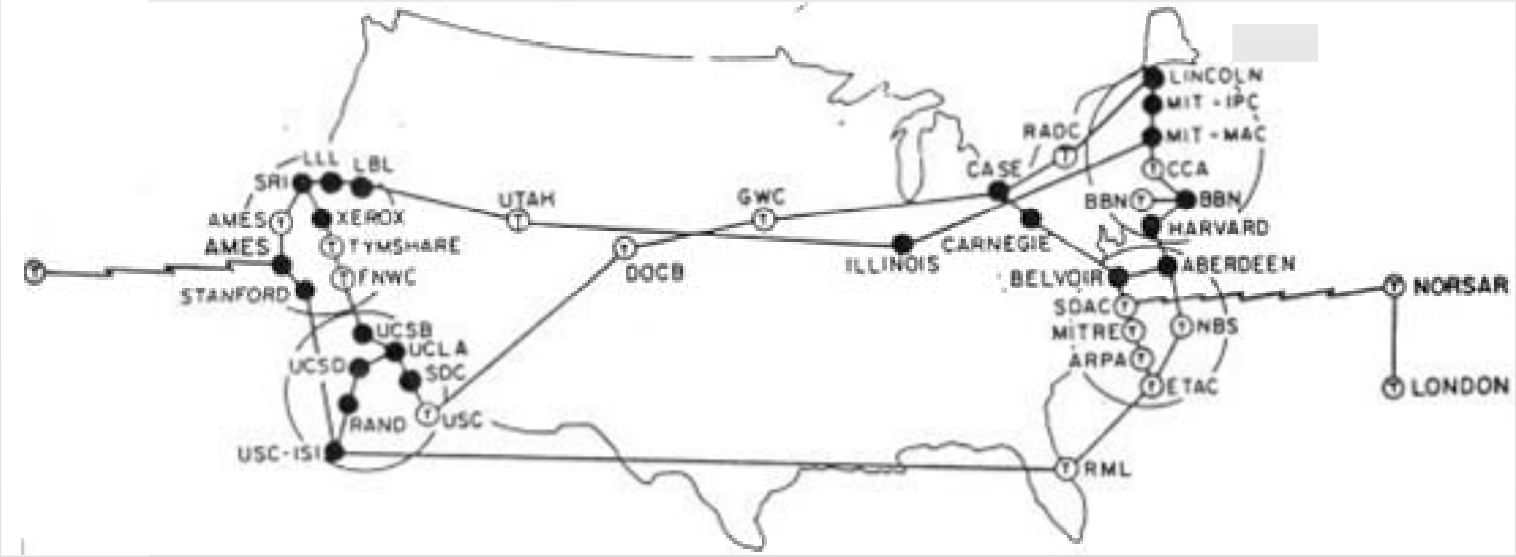
First Internet Connection Outside of US 1972



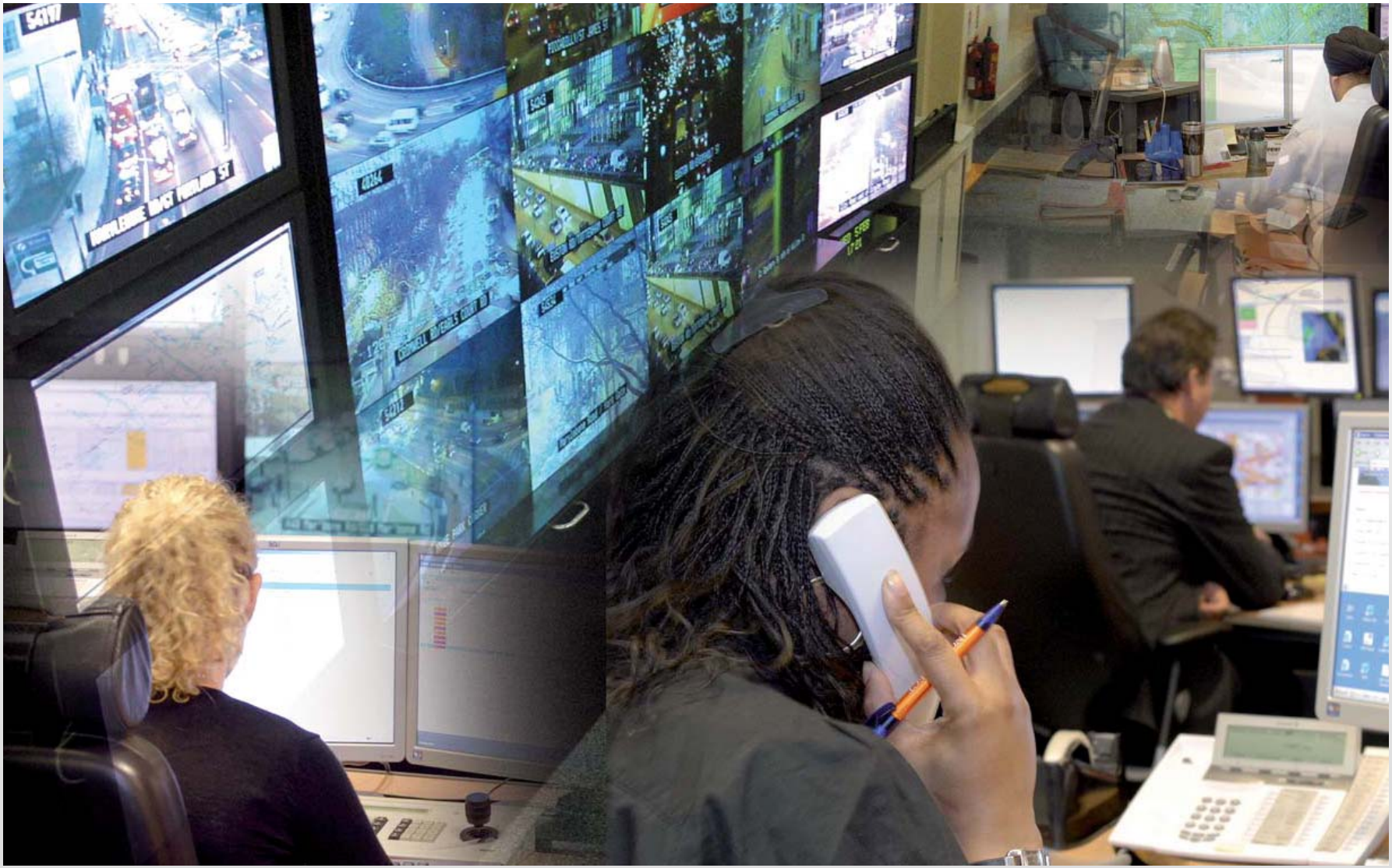
The first internet connection outside the US at UCL in 1972

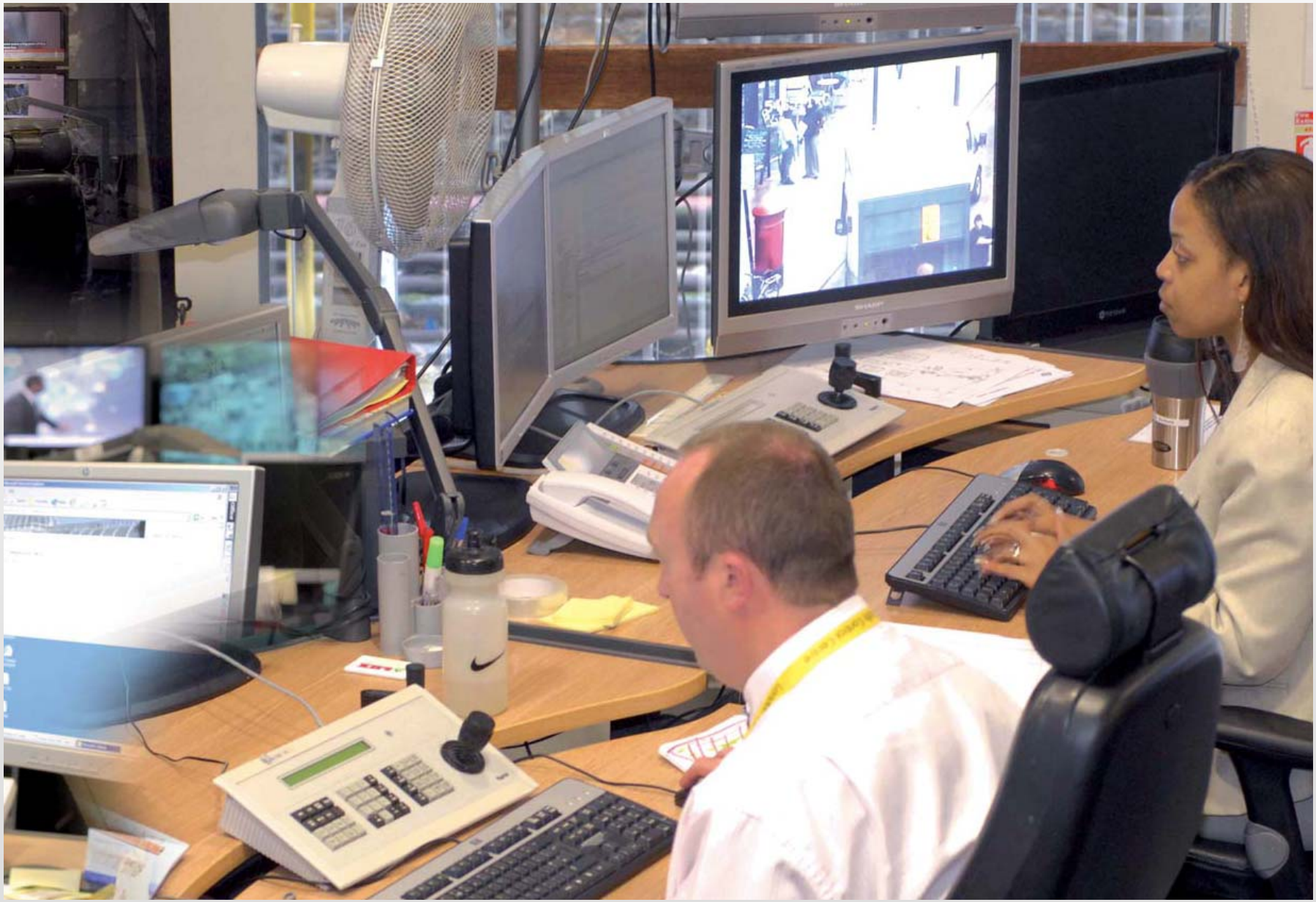






The modern day – traffic control systems in London





The key messages of this course can be easily seen from our walk through the city and we will list ***five essential themes*** that recur again and again.

1. Cities are about information and ***smart cities in this context are about digital information, not about hardware per se*** – how cities are shaped is about how we use information.
2. Information is comparatively invisible compared to past technologies and our second theme is that ***smart cities tend to be invisible*** – ICT is invisible –wires in the road and wires in the sky are not so easy to figure out in terms of what is being transmitted but of even greater invisibility are wireless communications, particularly social communications. Thus the study of smart cities is not like watching traffic on subway or the road system. We need instruments to sense it.

3. Cities grow from the bottom up by and large. There are millions of decisions that lead to cities, and ICT is being introduced from the bottom up – cities grow from the bottom up – ***cities and their ICT evolve and grow organically from the bottom up*** – there are lots of examples like new towns which are model smart cities like Masdar in UAE, these are the exception. Smart cities tend to be the bigger cities where ICT is being introduced slowly insidiously and quietly

4. Smart cities are not really just about computers in the built environment, not just about what have been called Wired Cities in the past. They are more about how we, not the city, use information, and how cities becoming smart which means us becoming smarter. So a fourth message is that ***smart cities are about how information services are best delivered*** and how citizens use those services.

5. Information is essentially costless – or the cost of transmission is very small compared to physical movements and transactions. Thus cities and citizens can acquire information from anywhere – that makes it global – ICT is intrinsically about the global city and ***the smart city is thus a global city***.

To figure out how all this works need to know something about how ICT is physically configured in cities but this is only a bit of smart cities. ICT makes cities more efficient, we think, but it is unclear if it makes them more equitable – it might. Clearly all sorts of past technologies have increased productivity in cities but this is the third industrial revolution that deals with ICT is tending to generate lower productivity gains that the previous two revolutions. At this point we pause and then come back for our second lecture in this first session which about the origins of digital information.