PARLIAMENT BREAKFAST

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Good morning everybody! Very nice to welcome you here to breakfast of the European foundation and TPN.

It's particularly welcome that I can be here to introduce our speaker this morning having just stepped off the plane from Washington I get a feeling that sometimes it's just lucky if you happen to be at the right place at the right time as my plane was half an hour early than I can seem if I just cruised in from the suburbs of Brussels and not seem to be phased by it. It's a particularly pleasure because Craig you've been a strong supporter of many of the things which are looking at ideas in the future and this one where we have this part of our series which we have on going now at the European foundation not only the end of this month but the early next month as the Parliament will act on campaign. We've been looking at the digital world in 20-25 and this particular title of talk is "Prospectus for the European software industry". We're particularly interested in this theme and your …effort comes just absolutely perfectly at the junction of our discussions because we divided up looking into this digital world in 20-25 into technological aspects, economic aspects, and socio-political implications and what we were intending to do as this package is put together we're certainly not going to be better than those in the private sector to predict what's going to be coming down the road but the purpose of this particular exercise is to throw out some ideas so we can actually see what's going to relevant now we have seen what the long term trends are and it therefore within the new Parliament to pick this up in the autumn time with the document from the foundation to be able to stimulate thinking in the new Parliament of the kinds of issues we should be looking at.

Mr X is now chief research instructor officer Microsoft to be able to step up to our platform and contribute to this debate. But anyway as I say, it gives me a great pleasure in terms of the substance and I think the timing is perfect.

He is also someone I knew very well for the last few years for the contributions that you make. I remember the one of the first times I met you, you gave me the reassuring news that in 50 years it will be possible that in the trends that you were that every part of one's body we'll be repaired so in theory one will be able to live for eternity but that applied to people under 50 so that didn't applied to me so that was not necessary so

direct good news but the interest that I had in the technological advances and how Microsoft in particular is looking at all different types, in the health or the environment or other sectors to see how IT is going to be applied there. So I look very much as we all do to your comments and we'll follow with a QA. Thank you.

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Good morning everyone.

It's good to be back in Brussels again. I'm going to start in just frame a few things that are happening in the world of information technology. As a precursor to some comments I'll offer and how Microsoft is moving to apply some of these new technologies in areas that are new for us at least.

Over the last 30 or 40 years, as the computer industry has evolved and tends to evolve in waves or cycles, there are really two things that work here. One is the steady investment in research and development globally which builds up capacity, new capacity in a technical sense, and then there is the occasional coalescence of these technologies into creating a new platform and level of capability and each time this coalescence happens is usually driven by the broad grassroots of acceptance of some new interesting applications of computing.

So Microsoft was one of the beneficiaries of one of these phase shifts when the word processors became popular in the spreadsheet. And the personal computer was really driven in popularity by those programmes. Along the way, the next one of these platforms I think that has emerged was what we now call the Internet or the World Wide Web and there were two things that were really very popular that made it become diffused in the society: email clients and web browsers. And each of these killer apps as they're called tends to create awareness, a broad acceptance of these particular technologies and from that, many many people come forward and build on them and so now these things are just part of our daily life. And so the question arises is "what is the next one"? Because, as it is true in other industries, many fortunes rise and fall with the ability to either predict or create these big shifts and they only tend to occur every 10 to 15 years or so. So it seems quite obvious now what the accruing technological change is on and preparing us to make this next shift and probably I would say there are two. One is that we're going in the next few years see the large scale introduction of a completely new class of micro processor architecture. To some extent, all computing that we are

familiar with today really changed what the introduction of the original micro processor concepts and before that we are looking at big machines built out of more discrete components, that was the micro processor revolution that led the birth of Microsoft and let other companies become prominent on the back of that invention.

So now we can see a need to re-architect the micro processors. We ran into some physics problems, which have become apparent in the last few years, that the way in which computers will get faster is going to change. Instead of making their clocks go faster and faster, we really cannot do that to the same degree we did in the past so we were forced to move in the direction of making the machines more parallel.

Over the very long term you can say the machines are trending in the direction of Mother Nature. All the biological systems we know today and all the large scale natural phenomena are intrinsically parallel. You know, there's no central processor that controls everything, it's all a fully distributed system, and at a scale that's at first unbelievably complex.

So computing I think is beginning to take a step in this direction, where we're going to see machines made out of micro processors that are different in two ways. One, they will be intrinsically much more parallel and the architecture of the machines will be more heterogeneous than the architectures we've known in the past. This is both a problem and an opportunity. It creates a situation where in roughly 2012-2013 these new chips will arrive and will be placed in virtually everything, from your microwave oven and cell phones to the biggest clock computing complexes that we make. Each of these chips has the potential prorata to be 50 to100 times more powerful than the ones we know today. So same power consumption so to speak, same cost, 50 to 100 times more powerful. So it really begs the question of what do you do with all that power? And it's obvious that for Microsoft if we just said our Excel and PowerPoint they will be 50 times faster. It really isn't by itself that interesting. We could think of many things to improve them but it will have to be a quality of improvement and obviously we will seek to do that.

But I think there are broader objectives that we have to be in search of when we see these kind of monumental changes. The other thing is that if the personal computer was the harbinger of this now much more diverse world of client devices, computers that are close to you, then the Internet was really the harbinger what people generally are referring to as the Cloud.

The Cloud is an undefined term but I tend to think of it as what happens when you scale a lot the computing capacity of these Internet hosted computational facilities also by two decimals more as in magnitude, increasing their connectivity and then make them more programmable. Up to this point, the Internet has been largely a publishing vehicle and not a programming environment and so the question is when it really becomes a programmable environment, then what do you get? So my prediction, and I think it's driving Microsoft far from a planning point of view, we actually think what will emerge in this time period, is a new composite computing environment, composite in the sense is neither just the clients' nor the Cloud taken one at a time but it's in fact the union of these two things in some new hybridized platform, that will be the genesis of these new computing applications. And so the Cloud plus the client is the right way in my view to think about what's about to happen. So, as we have looked at this problem, and so for example this change in the underlined architecture has been well identified at least in our research work from the better part of the decade, and we've actually been doing development work on the tools to support that the programming challenge in this environment for about the last 7 years. So all that goes on while the traditional development of our normal lines of business have continued as well. And so today we are at the point where we are quite confident that we will be able to bring forward technology that allows people to programme their super scale composite platform where the application of the future will be highly concurrent and very distributive in nature.

It's true also that this comes at a time where our society is increasingly dependent on these technologies, they have, even in their current form, become a part of our infrastructure, the society today could no more walk backwards from its use of computing than it could from its use of electricity or transportation or any of the other things that are truly transformational in the society today. And yet the information technologies are arguably even more malleable in their application to many of these future societal challenges. So in my role Microsoft for the last few years, we've not only been driving the research in the development agenda to prepare for the arrival of these new things but we are at our own hunt for some killer applications of this new kind of computing architecture and that requires not only that you think about how to do the traditional tasks within this new context but it also requires that we think about "are there more things that the computer should do"? For Microsoft, it seems to us fairly

obvious that there are two incremental directions in which we can apply ourselves above and beyond the traditional operating system business and some of the other traditional business productivity applications. Further, we have been moving in the entertainment, that are the communication activities but I think there's really two large ways that we will move in addition.

The first is to recognize that today the planet has about six and a half billion people and only one and a half to two billion of these people have any benefit at all of advanced information technology. So all of us live in a society that has developed well and uses these things on an every day basis but the reality is that less than 25% of the planet is using this stuff. It is clear that there is an appetite to use it and the best indicators are the cell phones and it's very rapid and at this point very deep penetration within that broader community and today that penetration is to a little over 50% of the global population but still only half. What is interesting is that we now know that computing as we know it will come in more and more advanced ways to all these devices that are the cell phone, the car, the game console, the television as well as traditional things that we call computers. And with that comes the potential to address a much broader segment of the global population. Of course, one of the reasons that those people don't use this technology is that they don't have enough themselves to have some of the basic services that are required to move beyond the rural agrarian life style and they lack the training in many cases and the investment capacity to bootstrap themselves up.

And many people, I am among them, believe that the root of a lot of the planet's geo political problems, in fact lies in the fact that there is such a gulf between the people who have great wealth and good infrastructure and training and the people who really don't have any at all. And any attempt that we can make to try to bring that forward that would be good. In the current economic condition, it becomes even more obvious that the traditional rich world models of health care and education and dropping more productivity tools I don't think can scale to another today five billion people. We also know that the planet's on a trajectory to go to about a total of 9 billion people in the next 30 to 50 years. That is unavoidable at this point. So arguably, our problem of how many people will be out there and will have this need and desire to improve is growing much more quickly than the wealthy part of the planet's ability to fund it on a welfare basis. So I approach this, and the company does, with the idea that you must address this with more of a view that there has to be a grassroots' adoption that tends to bootstrap these

people into improve productivity and capability by themselves, not through the idea that's strictly a welfare operation for the bulk of the planet paid by the wealthy. But I think even if people thought that it may have been somehow the right strategy in the past, even if the current economic malaise makes it even more clear, we will struggle to pay our own debts, to our respective geographically local societies without thinking too much about how we're going to deal with these lingering problems of the poor.

I think there are two other tasks related to this that I think we also see to apply these new technologies to, and this is in fact, you can say two or three but the two biggest ones that we've been investigating with Microsoft now are in the areas of health care and education. These two things are of course essential to improving the quality of life for the world's less fortunate but arguably there are critical problems that we have to solve even in the wealthiest countries of the world. And the reason is that today and almost in every country the largest percentages of GDP are invested in health care and education. Those percentages tend to be under pressure on the upside simply because there are more potential ways to do that investment, and no one is particularly happy with the outcomes so we spend more and get less, and we're less happy about it in these two areas than in any other sector of our society and economy. I think there are some obvious reasons why that has been true, why our heath care and education despite their size and importance have been the most recalcitrant sectors in the economy in terms of their whole sale adoption of information technology to improve that. But I think in part they tend to not be run broadly with the same profit motive that has driven industry to make these progressive investments on a regular basis and to completely and quite dramatically change their productivity and capability. And so now we found ourselves asking the question "how do we reform these capabilities" and I think importantly we have to ask the question "can we reform the middle way that not only improves efficacy in the rich world but can we do it in a way that might in fact facilitate the bootstrap of the rural poor where education and health are fundamental to improving their own broad condition and their ability to be more productive"?

So we've started a few years ago to think what could Microsoft bring and why would we embark on it now in these two critical areas of education and health.

Our traditional product lines have been of course used as an infrastructure within both of these sectors for many years and I think that would continue in a normal course but we never really had decided to apply ourselves to the question could we write software

specifically in these two fields that would tend to promote change and to make a good business out of it along the way. And so we did decided that there were things that were endemic in the current situation that would lend themselves to some type of disrupted approach in these two critical fields. Let me talk briefly about how we have thought about each one of these, there are some parallels between them.

In the case of education, we see a lot of research now that shows that many of the issues we face in the efficacy of education come from a model which has evolved over a long period of time. Today, many studies, at least the ones we looked at, show that perhaps the least effective way of teaching people is to lecture to them and yet the most basic model of education is a lecture and with some passive reception. The statistics we look at now show that the basic retention in the lecture model of education is about 35% of the material presented. So you teach it, then you task and basically people retain only about 35%. If you take the same teacher's students and basic material and add a level of interactivity between the student and the professor, the retention goes up to 65%. So one could argue if you can just figure up how to make everything we do and just have an interactive component you could argue you get twice the benefit of the investment in education which would be pretty significant. And so the question is "Why haven't we done that? How could we do it? Part of it may be historical culture but of course the other part was if you view the information technology as a key to this type of interactive participation, it was just too expensive, even in the wealthiest places with computers and expensive components, it just seemed to be a not broadly achievable goal to put a computer in the hand of every kid. And so we have thought deeply about how could we alter that and we applied our research groups in Bengal or India to think about what's the simplest form of that and as you have more money to spend and people have more access to technology, how can you ratchet up this idea of using the computer ultimately to create a one-on-one interactivity between the computing mechanism and the tutoring of the student himself. And so we got some pretty good ideas about doing that. I just show you an example of novel ways, when you get to understand the objective, to get this interactive participation what's the simplest way to do it, or the least expensive way. Our team in India invented a mechanism where you can take a single personal computer. Today for a couple hundred dollars you can buy a little projector so you can project on a wall in a classroom and literally just for several hundred dollars, maybe four or five hundred dollars, you can buy a computer and a projector. And almost every government

in the world has already made the commitment "I'll have to put at least a computer and some connections in the classroom". The question is "is that just the replacement for the foil projector" and if you don't do anything that's essentially what happens, the teacher says: "PowerPoints are better than foils but the method is unchanged". So invented now where you can plug up to 50 mice into one computer and the software to do that and it's fascinating now to watch in this rural village schools where they basically buy one mouse per kid and they put them all around the table with a projector at the end. Each kid's mouse has their own unique curser which can be either colour coded or can have a little picture of their face on it and so each one can manipulate something and it's been fascinating to watch the creativity both by the teachers and the people who are making curriculum to support this of how even the most basic form of participation brings the kids much more actively involved in the education learning process. So they can collaborate by moving their cursers, they can vote, they can essentially come to some type of interactive collaboration and solving problems and all of them just sitting and looking at the same screen, just manipulating their mouse. So a mouse today costs a few dollars so you can introduce for a couple of dollars per kid the most basic form of communal interactivity and you can build classroom training around that and even these simple steps begin to show a significant change in the level of participation and learning. And so we are now developing a full spectrum of these capabilities. In early 2010, we'll introduce three new lines of software: one designed for the school, one designed for the teacher and one designed for the student. And they basically will have an appropriate interaction among them. And I think each of these seeks to address what we think are the fundamental challenges that the institution, the teacher and the student face in this world of digitally supported environment for education.

Let me just shift over to the field of health care. We look broadly at the question of health and the underlined biology and medical activity. And believe that we are at the transition point for medicine, perhaps the biggest in a hundred years where in some sense, you could say that medicine is about to go from analogue to digital just like so many other things. The digital form of medicine is a little different in the way people think about the 1s and 0s of the computer but to some extent the letters of the genome are just a different alphabet, that is a digital alphabet and similarly proteomics are another way of thinking about digital form of medicine. And these two very powerful technologies are unapproachable in the large and certainly in an individual sense

without a very aggressive use of information technology just because the amount of information embedded there is so large and yet the ability to master this is something that now is clearly demonstrated and with these gains that I talked about in the underlined platform or perhaps another decimal orders of magnitude of capability in the next couple of years. For the first time we can think about doing some of these problems on an economical basis in ways which were unapproachable in the past. And so we thought about what are the some of the other challenges broadly in health care? One of the biggest challenges is of course the record keeping in health has been one that is extremely diverse in its nature, in terms of the sources and uses of information and never really was aggressively unified, and many people realized there's a huge amount of waste associated with the failure to do that. It turns out it becomes even more critical though if you believe in this transition from the analogue to the digital and the way to get benefit out of the new digital medicine is derived in part by your ability to cross correlate the genetic and proteomic information with the history of the population. And to do that, you would really love to have all the data in one place with all the history of all the people in your society and then be able to mind it against the new technologies. But of course there's no way to do that because we've never put it in one place and no one has actually addressed some of the technical challenges of maintaining privacy and other concerns people have.

We decided we would embark in that challenge.

Another key issue in health is that health care is really almost exclusively focused on remediation. You don't get health care until you get sick and then we try to fix you. The reality is much of the burden of disease, economically, comes from chronic disease, and chronic disease we increasingly know stems from behaviour and environmental factors that impinge on people who have certain genetic predispositions and if those factors are not managed early in life, the manifest themselves later in life as chronic disease and then we pay that cost. We pay it personally and the society pays it economically on your behalf. And so one of the real issues is "shouldn't we be focusing at least as much on wellness and prevention and education around these things as we are around fixing them and after we let them occur,

And of course there are acute illnesses and you break bones and other things and that's a certain class but when you look at it that's the most insignificant part of the total cost of health care. And so we said what could we do since we historically we are not a player

in the field of health care that would allow us to add value in this environment? In a similar way to education, when we thought about the school, the teacher and the student, we stood back and said "in this transition, who will be the players and how can we support them?" To some extent, there are maybe four players in this case: there's the research community, who has to figure out what the ultimate answers are in this transition, there's the practitioners, that's the health care institutions, the doctors, the nurses and professionals who work in that environment, and there's the patients. We decided to create a system that would take many things we have learned in the era of the traditional personal computing software and to move it in that direction. Today we have actually delivered products in the US and we are now starting to move them more broadly around the world, in Europe and Asia where we have now two products for the institution. One is for advanced existing institutions which integrates all the known data sources and puts them into a new common data structure which allows this future work and data processing into a current scale. The second is a preintegrated version of that which we've called "hospital in a box" where in clinics and rural environments and for many of the world hospitals that have no IT professionals and no advanced information technology will be able to sell them just an à la carte menu of the preintegrated solutions where they can just drop it in and turn it on and they can move from having none to having the state-of-the-art capability in this space. We also decided that for the consumer, the patients themselves, we needed to create a place where an ecosystem of companies who provide both services and devices associated with home health care and wellness and ultimately perhaps importantly in the emerging markets where do-it-yourself health care may be the only kind of health care for some times. We created a thing we call "HealthVault" which is an online web scale service which is a secure private repository for both your clinical medical record which we are now able to take out from the traditional health care institution and put it in the hands of the patients themselves but also the creation of a continuous medical record which derives from the devices in your daily life. So today we have 65 companies who have new products that deposit there information in your "HealthVault". All this information is controlled exclusively by the patient themselves, there's no use of it, other than through the authorized use by the patient. But together we think we can use these communities who seek to help and inform each other, get people to make elections and participate more broadly in their transition to digital health care and to have a lot more focus on wellness as opposed to

only remediation at the end. The last step in this will be the introduction of a new tool kit, designed to use the most advance information data mining in process and techniques and put them in the hands of researchers who essentially now are now tasked with this question of correlating the increasing body of information that we know about people and their historical health situation with the advances technologically in genomics, proteomics and other advanced diagnostic facilities in order to come up with a future for medicine that we think is one that is more based on prediction, participation, prevention and as such has the potential to dramatically alter outcomes and reduce costs.
So let me stop there with my introduction and leave the remaining time for any question that you have on this or any subject you would like my thoughts on this morning.

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Well that was a marvellous "tour d'horizon" and very interesting questions and issues were raised. Just as we come up with the questions, I think I'll take them in three so you can ball rolling.
I'd like to recognize my two colleagues who've been here this morning. Also, I think that coming from your wonderful range of comments, Craig, it was very nice and when it came to this one with lectures which you said is a wonderful means of passing information between the lecturer and the student but without going through the minds of either. Thank you for thinking in different ways to make people interactive. Who would like ask a question? Please, could you say who you are?

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Thank you for the tour d'horizon. I am from the European federation of PC and video games. I just wanted to make three points about health care versus education or maybe not versus, and education. It is a general observation that I-cities have been much more in use in health care than in education and it's even more true if you don't focus on software. I mean I-cities are brought through revolution in health care lot remains to be done but you have a true revolution in health care over the last two or three decades and you are still expecting this revolution especially if you are a parent to happen in education. So there is more room to grow in the educational area, I think.

Second point is that precisely, because there is more improvement to make in education, our federation together with the European school net, which is a network of 31 ministries of education, have spotted the survey in depth on how video games are used in schools and with I must say the strong support of the European Commission. And this survey has done a lot of amazing outcomes, which are been kept hidden so far, but which will be made public on the 5th of May in Strasbourg in a big conference, and people who will be there will be amazed by the results of this inventory of use of games at school in 8 member states. And the last point is when you were asking this last question, what for are these improvements that you announced in software, I think one part of the answer lies with users, you see a lot of user generated content this name has still to be pronounced but virtual worlds. If you give every user the tools to develop, to access and to develop their own virtual world, I think there's practically no limit to what you can have in the good use of those virtual worlds. The only limit would be that European Parliament and policies would put some limits in the time spent in virtual world. But I think there's a lot of room to go by the main lines you've just described this morning. Thank you.

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Sorry, very good talk and can I just ask you one easy question: are there any differences here in Europe between the outlook to the future here in Europe as opposed to America?

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Anyone else would wish to ask a question?

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Yes, I am from Ericsson I will ask a little bit more technical question perhaps. You mentioned in the first part of the speech on the parallel computing and the cloud revolution over the Internet, do you foresee a sort of a network operating system on the applications when the operating system will be integrated across this cloud and will the application of the operational system be predominantly on the devices so the issues I assume you will see that this network type of operating system. Have you though about how to resolve privacy, security, quality of service and access to staff? Of course in that sense you will see what is good to be done by application service to be glued together

into a more intelligent cloud. I would very much appreciate to hear Microsoft. Thank you.

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With respect to the first three points, in the education versus health care, I would actually tell you that health care has so far seen an introduction of information technology for the most part only through its diagnostic equipment but that's where the revolution in medicine has been in the last few decades in a non invasive imaging, more advanced testing capabilities but almost every other aspect is extremely weak in terms of its use of information technology in large and certainly weak relative to any advance use of software. None the less, I agree with you that education is arguably further behind, and one can ask the question "why is that?" Many people I think at least in the United States would tell you that while we spend is much on education and health, the moneys tend to flow as entitlements to different activities within the education system in a way that further reduces their capacity to invest in advanced technologies and so the overall efficacy of the system is even weaker. Your comment about games and their role and learning, we tend to agree with that. In a sense the reason kids love games is that they have these three attributes: they are usually discovery driven, they are highly interactive and they provide real time feed back. And because of that it's really quite well known that kids learn an incredible amount through that process. Unfortunately, we haven't found a way broadly to apply those attributes of gaming to the education system because as I said earlier that system has not really embraced the idea that you want a different model of training. Microsoft actually invested, we bank rolled an institute called "The games for learning" institute announced about a year ago in New York University. There are about 5 universities in the North-East part of United States who are working with us to create the first academic rigorous analysis in the United States at least on the efficacy of games and teaching. Right now, you're more likely to finds regulators in parents concerned about the kids' use of games as oppose to think it's a good thing. Many times parents come and say to me "I'm so worried, I look at my kid, I look in the room they're sitting there playing with their Xbox in one hand talking on their cell phone, instant messaging on their PC and writing their term paper on at the same time, how can this possibly work?". And I say "you don't understand, they look at you and don't understand why you can only do one thing at a time".

And the real issue is we are wired differently, our brains literally grow up on this stimulus that we are presented with in our development and so kids are growing up today with the privilege to have this much more highly interactive environment and their brains are actually wired up for parallel processing to a degree that ours aren't and so it's not really unusual we cannot understand that. Our parents look at us and think we're pretty weird compare to what their life was like. And so I think this is a generational thing and the real challenge for us is now not to have the elders who are really incapable of understanding and operating in the same way legislating against that because it doesn't meet our traditional norms. And so I think this is going to be important, and maybe your studies will show this as well, that we actually use these propensities to learn through these mechanisms and reinforce them not outlaw them. With respect to virtual world, I actually don't agree that one of the things that will become broadly used is a sort of personal virtual world or very large number. There's some famous product now broad on the web called "second life" and once it was introduced people thought this it, everybody will be in second life, the reality is it has already peeked and it's and the reality it's very few people have that much interest in creating a completely synthetic world and even given better tools than they had there, it's a quite challenging task. On the other hand the thing we think will be emerging and quite interesting you might name "first life" instead of "second life" and it's the idea that there will be in cyberspace, a mirror world of the real world. And you can see the early indications of this just if you look at the "Virtual Earth" of Microsoft or Google Maps and the evolution of these things. You're essentially moving towards a cyber space environment you can navigate around them. Today it's more a mapping oriented environment than actually a full 3D model of the real world but I'm actually quite confident that one of the things that will happen for every physical place there will be a model of it in the virtual world. And when we develop the capability for that to naturally emerge and be maintained, that that will create an interesting way for people to combine their physical world activities and their mirror world activities and that may be a user interface that links these together.

With respect to the question Europe versus America, when you have these very fundamental changes, opportunity is created and in my view, the way to answer that question is really to ask "Is Europe prepared for the change?" And I would have to tell you that today, it isn't by and large. Even when I look at the reports and consultations

done here recently, they still tend to be widely more focus on the application of the last model than the anticipation of the arrival of the new model. And I think that as in the United States, Europe has been in decline in terms of its willingness to fund basic science research and from that there is both here and in US to some degree a forth shortening of time horizon against which the most advanced development work is being done. The academic community who should be doing the basic science in the survival sense turned to funding from businesses and shorter term products related activity, you know it's more applied research than basic research.

This thing tends to take the pressure off companies, or fund their basic research or advanced work because they cannot source it for cheap to the universities, and so you get the double whammy here where you don't have businesses investing as much as they should and things that have a longer time horizon and you don't have the fundamental science been done out in front of it and I think that is a problem for Europe to even a greater degree than it is in the United States.

With respect to the question of the operating environment, for this future cloud plus client environment, we don't tend to think that this is one big monolithic operating system but rather a very large scale heterogeneous distributive concurrent system. And the Internet you can say has shown a direction in that sense that you move away from the idea that there's one system that the people programmed sort of APIs of that system to a protocol driven world that actually allows these emergent systems to interact with one another and to use software techniques to deal with the inner operation that evolves out of this complex environment.

That said, there are a number of challenges, particularly in the super scale environments of the cloud where you really do have to think carefully about how you architect these things for reliability, survivability as well as privacy and security issues and a great deal of our work in building our platform has gone into that. If you look today, even the first generation or movement toward the cloud has been one where people say I'm building these cloud capabilities to provision services that I then been rent to people, so Microsoft services, Google services, Amazon, eBay. At this point, mostly only Amazon and Microsoft have really declared themselves willing to let other people host things directly on their cloud, as you can rent a cloud. That brings with it a new level of programming complexity and in these areas of security, privacy and reliability, a much higher standard then is required perhaps if you only have to control your own use of the

technology. So a lot of investment is going there. The platform that we announced last fall for Microsoft has the name of "cloud platform". Has been an engineer to deal out of those things on a completely automatic basis. So an example, if you want a sustainable service, let's say in Europe, it's actually a pretty big engineering trick to figure out how could you do that, such that the service can operate 7/24, guaranteed whether you have a rainstorm here, a rainstorm there, a hurricane or what might be, and so geo diversity becomes important and how the links are maintained between these things, the power supply. Many big challenges, very few companies are in a position to do the engineering for today but there are at least several and we are very focused on those questions.

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Anything else, any other issues which people wish to raise? Before we will close the meeting

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It is said we have the best students in Europe. Do you have any equal in America? Schools are computerized, so you can tell us the experience you have. And secondly, my question is since you are making the hospital in a box, could you make one box for bankers and politicians as well? James doesn't need it but it could be useful. Thank you.

-11-

Right, come with more questions. Yes please.

-12-

I am from the European Commission and Enterprising Industry. You discussed about this new programming environment, this new architecture, how will we be able to own all the potential, in terms of development, in terms of rural poor people to develop these applications. This is the first part of the question. The second part has the application of growing sophistication and complexity, can we not find ourselves like in the financial sector that we can't master these things and this could of course create problems for the society?

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Thank you very much, anybody else wishes to ask a question?

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The items I described about students are at the early stage, so there are examples of these new types of schools in the United States, not based on this new type of technology but on the same principles. They are fantastically successful and in the inner city of major US cities with the poorest kids, the weakest backgrounds, they grow from an environment where typically the yield of people who enter high school and finish four-year colleges in urban centres now the yield is only 4%. You can take the same kids, put them in these new schools and the kids who finish high school and go to four-year college go up to 92%. So it shows how you teach and the quality the teachers are critically important. Also what I didn't mention is that the first determinative outcome is the quality of the teacher in any of these particular environments. And today, most societies haven't created an environment that ensures that you have the best quality of teachers, either they don't compensate them well and these things depleted the quality of the teaching pool and that becomes a real problem. So at this point I think it's too early to say that, through some very large tests how the indications would go. A lot of those tests are relative, to the current skill set, as I say it's a business operating on a global basis, and while we just seek to get the best talent, and independent of what shows up in the test, students coming out broadly from places like China, where there is at home and in school much focus on science and math education, those people show up in the elite universities and they do show up in work place as people who ultimately seem better prepared for the world we operate in than those coming from any other part of the world, including United states broadly and Europe. So I do think there are definite issues there and I don't know if those big tests are good indicators of quality that we need in the new world.

With respect to banking and politicians in a box, we'll work on it.

To the question how to harness the cloud environment and what's required to do it, clearly, I think there will be two separate issues here and in a way they mirror but at a different scale the same issues that have always existed in each generation of computing. One is "who are the computer scientists" and infrastructure grade programmers that create the basic fabric and do you have enough of them to basically do the basic work? And secondly, do the tools of IRA allow a broad participation and exploitation of the

platform in ways that people didn't anticipate? With the arrival of desktop publishing, before the PC and the word processors, yes you can get work processed, but you couldn't do the work yourself and eventually you found that anybody can write a letter or print on a printer, and what you need to be thinking about is what is the commensurate step up in the abstraction level and power the tools that individuals use. I think another thing that is going to happen enabled by this huge change in computing power particularly in the devices near you is actually that we'll move the interface between the human and the machine toward a qualitatively different level. The typing, pointing, clicking model will remain important for the traditional types of applications. But when you look broadly at what computing should do for society, I think that the ability to just talk to the computer and have it talk back, robotics whether virtual in their presentation or mechanical, I think are going to become extremely important. My favourite demo for the last six or seven months is actually a soft robot program using our new robotics technology but used to integrate many of our research assets in Man-machine interactions. And so we now build what's called a robotic receptionist as our first test. And in Microsoft if you visit in the lobby most of people who go to the lobbies or the buildings are employees who want to go to another building and so they stop and they need to order a shuttle bus that will take them to another place in the campus. And so the large part of the task of people who sit there everyday is just ordering shuttle buses. So we said what if we made a robot that you could walk to and talk to like a real person and say we're here and we want a shuttle bus to building 34. And so in the last year, we've now built such a robot and it's really quite interesting because you see the face of a woman in this case, we call her Laura, and you walk up and you talk to her and she has manners just like a receptionist, she looks at people, she analyses what they are wearing. So if you look like I do today, she assumes I'm a visitor and asks if I want to register, and if you're dressed more casually she says do you want a shuttle bus, because that's actually what the real people do. And many, many things we've learned by trying to figure how you put computers into these roles where they're helpful, they're doing real work for people, but they're not there. So as Laura gets more computing power, she just gets smarter. So now we build into personal assistant for one of the researchers. So she sits outside the office and when you walk up she talks to you and answers questions about is he here, no, when is he coming back, what can I do, etc.

And every time I give this speech and the demonstration of this, I say my dream for Laura is that pretty soon we'll have Professor Laura and Doctor Laura. Because in fact as we perfect the ability for this completely natural interaction between people and machines, and we keep having more and more horse power in the box, our ability to put more and more sophisticated subject matter expertise in this thing is there. Well, we'll have to work on the politician version of Laura but what's interesting is in this problem I described in the societal challenge on how do you provide health care and education for another five or six billion people, I think it will be impossible to have highly trained people as we know today as professors and doctors who just won't not be enough, we cannot afford them, we cannot incite them to go there. And yet for the cost of a PC we can potentially put a doctor in every village, who for non acute care, might in fact be able to give you better council than anybody or certainly nobody that they have today. So I think as we seek these big solutions to big problems, whether in education, environment, energy or health, this transition to machines that operate at a higher plane that are able to not be a tool which are placed in the hands of a well trained artisan can do incredible things that's why I think of computing today is the thing that will move beyond being a tool to be a helper. And that it will anticipate, and assist with things and that your model of interaction will be at a much higher abstraction level than that which we know today. And so when you think about that, I get very optimistic about that.

The last comment was about complexity. This is one of the fundamental challenges, all of this is now viewed as mission critical for society. And yet the fundamental way that we write programmes and the tools with which that is done, has never actually been designed to ensure correctness at scale. And so the computer industry in large I believe now faces two massive challenges. One I described earlier, I'll call it the concurrency challenge. The world is now highly concurrent, very distributed, and in that concurrent environment, you have inherent complexity in trying to determine programme correctness and none of the tools that we have today are well suited to that problem. As we just talked about the exponential increase in capacity has resulted in the exponential increase in code size which has actually produced hyper exponential increase in complexity, and with that, an inability for us or anyone to predict how software will really perform. So many of the challenges we have today in computer security in some ways derive from an inability no matter how much we try to produce perfect programmes or to reason about their correctness or completeness. So the complexity

challenge in the concurrency challenge both loom large at this point. And I actually think that what we've known about the complexity problem, we've sort been willing to finesse it as the society up to this point because the implication of the cost of that change, to the trained people we currently have is very high. And frankly not enough research has been done on alternative ways to deal with the problem. I think we've made huge progress at least Microsoft in doing that basic research. And we're now faced with, whether we like it or not, this fundamental change in the underlined machine. That's going to accelerate the need for the concurrency solution along with this super scale platform of the Internet. So I think for the first time in 40 or 50 years, we are actually going to have to reboot the computer industry, and all the people who work in it and around it, to deal with this super scale composite platform that's highly concurrent and in a way to introduce tools that not only allow us to gain parallelism but also gain confidence, in a vehicle for dealing with this intrinsic complexity problem we have today. So I'm optimistic about it but it will not come by a tweak to the way that we do the systems, it will require more fundamental change.
So thank you for the opportunity to chat with you this morning. Thank you.

10. Well I'm struck very much Craig by what you have been able to put a cross to us this morning, and what's happening in big events in London today, where the G20 were thinking about how we're going to be able to save the global economy from collapse, and everybody is looking very shocked term because there are going to be some big problems out of that G20 summit like the question how to get people to buy assets, which are toxic, it might help if they didn't call them toxic to allow them to buy them. But I've been discussing over the last couple of days with people in congress about what they think about this and I think they are as scared as we are to walk out of the short term future we have. But in parallel to that, to have given us the kind of vision that you're looking for over the next 10 - 15 years, which is extraordinary rewarding I think. The time when we look at our surrounding environments saying "what will happen there for the next 5 to 10 years", gives us a kind of impact to be able to look forward to the future. This platform has been used by others early in the year like the chief technological officer of Intel who came to tell us that over the next decade they can see still more applying, that the chip will double in its capacity for every two years over the next 10 or more years, which was already quite a mind blower for politicians such as

myself to think that this whole drive and how you will be able to be much, much more efficient, much, much more capable. What you have added to us this morning I think is an extraordinary range of the kind of world we are moving in and the application of these chips to see how we will actually be much better off at the end of the day and so will the global environment as well. But we have to think about the 50% who don't have it. Because I can see it in the every day life, on communication systems and we can't ignore that in our political environment. So I think that what you set up for us today, and I really appreciate that, is that in looking forward to the next mandate of the Parliament, I think we have a pretty clear agenda that you have actually set for us of the kinds of issues we'll be looking, whether is cloud computing or the whether this is how this will then apply to services. I think we are deeply grateful that you spent your time with us and let me look forward at some other time when you are here and tell us quite different things to be thinking about, as to how Microsoft will be enabling the kind of global environment to be a prosperous, and stable environment and a healthy one for us in the future. So Craig thank you very much.

And by the way, about politicians, you said you'd like to be getting the kind of model, I found that, when I'm running ideas of networks the political hierarchy then destroy the networks because they don't like to be told what they should be told, and which they don't wish to listen to and so what the Internet does for politicians is to empower individuals and that's what I found out that the society doesn't like for individuals to have power.