

THE PACE OF THE DEVELOPMENT IN COMMUNICATIONS AND INFORMATION TECHNOLOGIES IS DRIVING THE INFORMATION SOCIETY TO YESTERDAY'S INCREDIBLE STEPS

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Abstract

The paper presents an analysis of the detailed mechanisms and models implied in the actual development of communication and information technologies (CIT), as the main factors which determine the pace of (CIT) and its major consequences on Information Society (IS.)

The main issues of analysis are focused on identifying some deep links between CIT development's models and pace, on one hand, and IS radical progress steps, on the other hand.

The prominent result of this analysis is reflected in a 3-dimensional global influence (volume of changes) on IS as model: horizontal diversity of activity fields, vertical/depth of the changes in the field and time - by the period and speed of the generated influence.

On the issue of CIT development the paper includes the new approach of the 3-D transistor, developed by Intel and other important players, because this model comes with the extension from the planar model (2 dimensions) to the spatial 3-D model and so the number of transistors on chip could be radically increased, as an essential support for the integration capacity on the chip (the storage capacity) that must face the exadata era by speed, memory and computing power.

Among conclusions, the paper points the CIT mechanism and pace which determine, by refining data and producing new knowledge, premises for optimized solutions, irrespective the application but especially where the efficiency and the radical progress in the field were difficult to obtain or long time expected.

Keywords: *communications and information technologies, information society, mobile communications, Moore Law, exadata.*

JEL Classification: *L63, L86, M15, O13, O33*

1. The amazing speed of the processes in the communications and information technologies (CIT) generates premises for social and economical milestone changes

Almost everyday we see how media is presenting new products, services or events which reflect the exponential development of CIT, as smartphones, TV sets and many other applications of the new technologies.

The real dimension of this iceberg is difficult to estimate, but it is obvious that the entire environment which is associated with the information society (IS), from people habitudes to the global social and economical life on Earth, is changing under the tremendous influence of CIT.

A pertinent evaluation of these processes has to remark the fact that CIT are only a part of the relevant technologies or economical fields which generate the mankind development, as energy, chemistry, transportation etc.

The true picture of our World progress factors must also include, among others, the education, the scientific research and eventually all the cultural creation.

At this point one could say that CIT are “just a piece of the puzzle”, along with so many important pieces, which are linked in very complex processes and globally generate the mankind progress.

In fact it is important to notice that even the partial picture, in spite of the appearance that CIT is only one among so many factors, is a clear opportunity to observe an essential true: ***CIT is inside of every other factors*** we have mentioned or not.

This way, the real weight and importance of CIT, in the “puzzle”, is multiplied by all the other factors and the depth of CIT inside each of them, so we also have a relevant image of the mechanisms by which the CIT development is driving the World and eventually the IS.

Therefore we have advanced a first step on the above mentioned evaluation of CIT dimension, as CIT image is very similar with an iceberg, where we can see a piece in the “puzzle”, but under the surface CIT could be largely extended as a ***dynamic support*** for the visible environment.

Although the paper space is not aiming an exhaustive analysis, the next step is to observe, as a consequence of the previous step, that the amazing pace of CIT development will strongly influence all the mankind activity fields by a multiplying mechanism, which will generate this way impressive global changes on IS.

This mechanism could be further evaluated, as a model, if we consider its global effect as depending on 3 dimensions:

- on horizontal, by the number of influenced mankind activity fields – i.e. almost all;
- on vertical, by the depth of the influence inside every field;
- in time, by period and speed of the generated influence.

As a consequence, with this model, one could evaluate/illustrate the global effect of CIT development as a multiplication of the above 3 dimensions and the result could be similar with a “volume” – we may call ***the volume of changes***.

In the same time, it is fair to notice that a further concrete evaluation, with the model, could be done only if we identify some appropriate metrics for each of the 3 dimensions, so this complex analysis could be the aim of other papers.

On the other hand, we may conclude that it is clear now why and how the exponential pace of CIT development could induce real **premises for social and economical milestone changes**, as these premises are directly depending, as a probability to have ***milestone*** consequences/changes, on ***the volume of changes***.

It is also correct to observe that the above conclusion is a qualitative one, because, for every activity field, the concrete consequences of the implemented CIT products and services, which will depend also on the pace of CIT development, could be accurately evaluated only along with the specific stage and challenges of the field.

A common feature of all fields is the fact that CIT models, more than their products and services, have a great power to leverage the human creation in all fields, by the way they refine data and produce new knowledge, as optimized solutions, irrespective the application but ***especially where the efficiency and the radical progress in the field were difficult to obtain or long time expected***.

Now it is also clear how the amazing pace of CIT development could determine the conditions where deep changes in many activity fields will generate the progress of IS on yesterday’s incredible steps.

Usually an example is the shortest way to confirm the theory and what can be more significant than the historical step made by the mankind in the space research than “the man on the moon” in 1969?

Without neglecting the other technologies, where again energy and chemistry would be in top, how that achievement could be imagined without computing and communications even at those distances and in those conditions?

The point of this example comes when we see that the computing power of an actual smartphone is higher than in the case of Apollo mission.

What could we expect tomorrow as a consequence of this speed of change in CIT? Today we look with powerful “eyes” to the next galaxies.

And if the example is not relevant because of those long 40 passed years, we can continue with the Internet in the last 20 years and so on.

As we have earlier mentioned [9], it deserves to watch, even by only some examples, the impressive evolution of CIT, although this is an exercise which becomes more difficult everyday, in order not lose anything but especially notice the milestone changes this evolution will induce to the IS.

2. Tendencies in the development of CIT models and their major impact in the IS

Perhaps the “mobile revolution” is the most prominent class of technologies, products and services, rapidly followed by their amazing consequences on mankind life and eventually on IS.

That is way we consider very relevant the global image of CIT that was presented by the recent Barcelona Mobile World Congress - BMWC (February 2013).

BMWC has clearly described the features of the mobile broadband communications revolution in the next 5 years (2012/2017) by some estimations:

- 6.8/9.7 billions mobile global connexions to Internet (2012/2017);
- exadata mobile traffic: 0.1→11 exabit/month (2012-2017);
- the high efforts for a green CIT model: 1.2 billions saved trees in the next 5 years.

Among the above and an impressive gallery of gadgets, besides facts like the on-line games industry which is going to explode with about 1 billion USD/year, BMWC showed some deep issues like high efforts for spectrum efficiency solutions and already mentioned green CIT.

In general the CIT achievements and tendencies could be observed everyday and they are generated as a response to a global and complex superposition of factors, where the market, the social, political and cultural are the main [9].

Still the last decades proved that the Moore Law (doubling the number of transistors on a chip every 2 years) is generally the main “motor”, or the driving force, of the CIT, without neglecting other CIT mechanisms and models, as we will further present.

On this context it is essential to notice that this “law” could not last forever, as many specialists already said [3], [5], [8]. The last years confirmed these opinions and the CIT estimations for post - 2012 present a decline, as the reference period of 2 years will go to 3 years and perhaps so on.

This situation was for sure considered by the CIT industry, as research and many forecast scenarios were presented.

We already have mentioned [8], that the mankind and so the CIT research has to learn from the nature, because a “research” of millions of years is sedimented there.

As concrete personal opinion, we think that the study of human brain and generally of the biology could give the answers for the future computing and communications models, useful for the post-semiconductors or post-“nano MOS channel” era.

For instance, we notice as prominent a new model, the 3-D transistor, developed by Intel and other important players, because this model comes with the extension from the planar model (2

dimensions) to the spatial 3-D model and so the number of transistors on chip could be radically increased.

Such of improvement could appear not so important as a model of development for CIT, but we remind the huge impact that the processors and the memories – the most largely used and with the maximum impact on performances – have on all applications (the horizontal dimension of *the volume of changes*) [4], [5], [8].

This way Intel has launched three new research centres focused on the same challenge: developing supercomputers with Exa-scale performance levels (1 billion computations per second).

The relevance of such a goal starts from the fact that if about 7 billion people on Earth would solve mathematical problems with a rate of one per second, it would still take more than four years to calculate what an Exa-scale supercomputer could do in a single second.

The integration capacity on the chip (the storage capacity) that must face the exadata era is not independent but strongly linked with speed and computing power.

An other reason for the new supercomputer is the aim to create the complete map of human brain circuitry (about 1 000 000 mm³), but 1mm³ will request about 1 petabyte (1000 terabytes), so eventually about 1000 exabytes.

On the same *depth* level of *the volume of changes*, but at other *horizontal dimension*, in order to simulate the long term climate changes on Earth, it will be necessary a similar computing power as in the above cases.

At this point it is interesting to observe that all the above examples represent *milestones* for the respective fields and *yesterday's incredible steps* for the IS.

On the other hand, the same example has a common essential feature: they would not be conceived, in a foreseen future, without the premises which will be created by the performance of the new *model for the development pace of CIT*.

Perhaps one could naturally ask: how this pace and performance level is still possible, especially taking into account that this race is not starting from scratch (zero).

For somebody the question could contain a contradiction in terms: it is obvious that now CIT is not starting from zero – and this is shortly the answer.

On the other hand, with a little effort we have to recognize that such revolutionary challenges, as these *milestones* appeared impossible to reach in the recent past, represents *new races* even for the “experienced” CIT specialists.

Coming back to the question, a true but very partial answer could come from a relatively simple but essential model of CIT: *reuse knowledge* [1].

A young researcher was recently asked: how can you achieve the job of designing a VLSI chip with more than 2 billions transistors? The young simply responded: “*reusing the knowledge*”, i.e. all the previous research results.

Of course this simple truth is known before CIT and we also observed [9] that the fundamental principle of CIT is to reuse the logic, as well hard and soft, in a practical infinite diversity of structures, applications and *levels of knowledge*. These are the CIT, the power of the IS!

All the above examples may be assigned to the main sphere of CIT progresses, sometimes called “nanotechnologies”, although, as we have mentioned above, the “nano MOS channel” model is only the main but not the only one technology among CIT.

In addition, we have to mention that, especially in the next future, other two “spheres” will grow and grow with the CIT high pace support:

- genetic engineering (GE);
- artificial intelligence (AI).

The complexity and revolutionary consequences of GE and AI need a further larger space than the actual paper, but we shortly have to observe that GE will address *milestone* progresses in health aiming diseases like cancer, diabetes and heart diseases, respectively AI in competing human brain with all unprecedented applications including intelligent robots.

3. Conclusions

Analyzing the CIT development pace and its impact on IS as *milestones steps* for the mankind progress is a complex and difficult approach, but even in a short form we identified some deep links between CIT development's models and pace, on one hand, and IS radical progress steps, on the other hand, reflected in a 3-dimensional global influence (***volume of changes***) on IS: horizontal diversity of activity fields, vertical/depth of the changes in the field and time - by the period and speed of the generated influence.

Among the most prominent tendencies in the development of CIT models we presented, the actual step of "nanotechnologies" based on the new model of 3-D transistor will have a huge impact on processors and memories and further on speed and other performances of CIT applications.

The most significant above presented issue is the CIT mechanism and pace which determine, by refining data and producing new knowledge, premises for optimized solutions, irrespective the application but ***especially where the efficiency and the radical progress in the field were difficult to obtain or long time expected.***

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