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Trusted transactions transforming your life

Information and communication technology has offered a set of new transaction solutions. These can entail inconveniences, vulnerabilities and flaws. The authors predict a move towards instantaneously matching supply and demand supported by a novel transaction paradigm that not only will cope with these deficiencies but will augment interactions in society as well. Today, the number of artificial intelligent agents is growing. The functionality of these avatars will improve. As the relevance of artificial environments is growing, a bridge is needed to establish a connection with the real physical world, to facilitate future transactions. This paper attempts to unravel some of the underlying questions concerning transaction enablers.

Basically, a transaction is an agreement carried out between separate entities, often involving the exchange of information, goods and labour. From an historic perspective people and their organisations can be considered as the prime entities able to transact.

Introduction

In earlier papers[1,2] an outline is given of the functional decomposition of our economy and society in a spectrum of roughly 20 sectors. Among others, technological developments and science have been instrumental in this. The decomposition has brought us specialisation and tremendous efficiency. Today it has evolved towards a global scale and globalisation. Certainly, our relatively young telecom sector can claim a prominent role in the more recent developments where communication and computational powers appear to accelerate and explode in exponential way.[3] However, 'how much globalisation can we bear?' [4] and are there limits to this accelerating efficiency and scale? Are these developments autonomous or do they collectively reflect what we really want to happen?

It is obvious that in the current paradigm in which the tone of efficiency and prosperity prevail, we reach the physical boundaries of our finite natural resources as well as the limits of the absorption capacity of our planet. One may not without cause associate this with the unpleasant foresight of a 'red ocean'.[5] This has led us to the conviction that the transition from a nodal- towards a network model is imperative. In our world of ICT, where we are already gradually shifting from an infrastructure and network services centricity towards value added services, this implies a required transition towards integrative ICT-solutions for the major challenges in all sectors of our economy and society. Thus, we claim that on the aggregation level of the sectors, the combination of a trans-sectoral network approach, with sophisticated transactional solutions supported by peer-to-peer broadband networks, will lead us to a vast blue ocean.

Jeremy Rifkin[6] states that a third industrial revolution will start in Europe and that the crucial pivot will be the axis of the energy sector and the telecom sector providing ICT means. Obviously, today especially energy worldwide fuels the thoughts of a red ocean both in terms of increasing scarcity, and exploding price levels of our fossil supplies and the enormous CO_2 emissions that we need to cope with. However, given the 175,000 Terawatts of 'free' solar energy that our sun donates us constantly over a distance of roughly 170 million kilometres and will do so for at least 5 billion years and of which we use only 14 Terawatts, (i.e. less than 0.1 per mille), the situation almost starts to appear ludicrous, in today's status quo of technology . The least we could say is that the matching of supply and demand seems not optimal. What can we do to improve this and what does this have to do which crucial developments in our transactional behaviour and technologies? In this paper we try and shed some light on these fundamental questions.

History of transactions

From various viewpoints researchers studied the Bronze Age uncovering important human achievements, events and developments. Still being researched intensively, the significant evolution of money proved to be a major Bronze Age breakthrough. As trade and transactions took place long before the Bronze Age this section starts at the end of the preceding Stone Age.

Before colonisation, nomadic tribes were entirely self-responsible, almost completely self-sustaining clusters performing all necessary tasks in order to survive as a group.

Roughly 11.000 years ago at the very beginning of the Neolithic part of the Stone

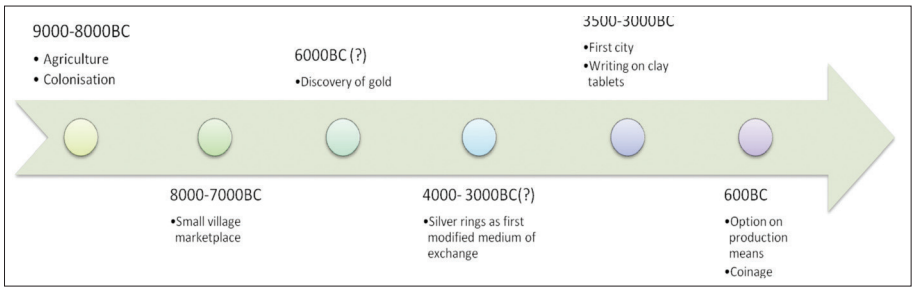

Fig 1: proto-money era

Age, nomadic families started to permanently settle down and became colonists. The first villages emerged, hosting several families. This early colonist era was characterised by the introduction of agriculture and cattle breeding.

Bartering, being the common transaction method long before the emergence of coinage, still exists today. Compared to today's practice, in the past a successful barter transaction required even more effort and complexity to overcome. A barter transaction between the involved actors could only take place when at least the following conditions where simultaneously met:

1. The actors had to physically meet each other, presenting their offered goods and labour
2. At this exact moment in time the offers had to match the needs in two directions
3. Actors needed to reach an agreement in which bartered goods, proto-money[7] and labour were valued equally.

During the early colonisation era people commenced to divide up tasks, for sake of efficiency, allowing other people to take over vital tasks they used to perform themselves. Specialisation implicated a growing array of different goods and skills resulting in higher production and better possibilities to trade their goods and labour. An important effect of forming a substantial concentration of people in large villages / small cities is that they jointly created a marketplace fulfilling a boundary condition for more voluminous trade. New complexity occurred because in a barter economy each good is priced in terms of all other goods. People needed some standard way of stating value. A common reference for defining value would help bridging supply and demand more easily.[8,9]

Over time, the transactions' average success ratio improved due to the introduction of:

- standard tokens for counting and identifying various goods
- communication over distance and time using written information captured in clay (3300 BC)
- predecessors of coins (e.g. gold or silver rings) enabling the storage of wealth and defining value (at least as early as 2500 BC).[8,10,11,12]

Around 610 BC the Lydians struck the world's first coins. Figure 2 shows a specimen, minted during the reign of King Alyattes in Sardis (present-day Turkey).[13] For the first time in history authentication marks were added. Pre-coins lack an essential feature of coins: a 'type', or mark, of a recognised issuing authority. Concerning money in general, a visible guarantee of authenticity is needed.

Fig 2: Lydian third stater

In 7th century China local issues of paper currency occurred for the first time. By 960 AD the Song Dynasty, facing a shortage of copper for striking coins, issued the first generally circulating notes.[14] Fig. 3 shows the evolution from the first paper currency and related milestones to our present situation.

After the first bank was founded in Italy (Genoa 1406), it took nearly 200 years to establish paper-based currency in Europe. In Leiden, The Netherlands, during the Spanish siege of 1574, the first paper money consisted of paper 'coins'. About 100 years later the first regular European banknotes were issued in Sweden. Until the reign of Louis XIV (1643-1715), banknotes were issued by small creditors, had limited circulation, and were not backed by the authority of the state. Economist John Law helped establish banknotes as formal currency, backed by capital consisting of French government bills and government accepted notes.[14]

Summarising it took mankind:

- far more than 10.000 years from bartering and proto money to coinage
- 1600 years from coinage to banknotes
- 1000 years from banknotes and coinage to digital currency
- 15 years from digital currency to artificial marketplaces.

Future transactions

Basically, a transaction is an agreement carried out between separate entities, often involving the exchange of information, goods and labour. From an historic perspective people and their organisations can be considered as the prime entities able to transact. Recently, automated systems powered with artificial intelligence have commenced to transact on a limited scale on behalf of their owners.

While the means to support transactions drastically changed over time, the transaction basics did not change. Still people use their knowledge to assess the value and the perceived benefit of any transaction. Still they mutually exchange information about their needs, the offered goods and labour, relying on mutual willingness to trust.

Figure 4 shows actors being surrounded by two generic resource types (the nouns natural resources and information) and three generic functions (verbs) that together comprise all human activities. These three functions are universally captured by the verbs:

- to transform: changing natural resources into goods to be traded and maintained
- to transfer: moving any item physically or artificially (over distance and time)

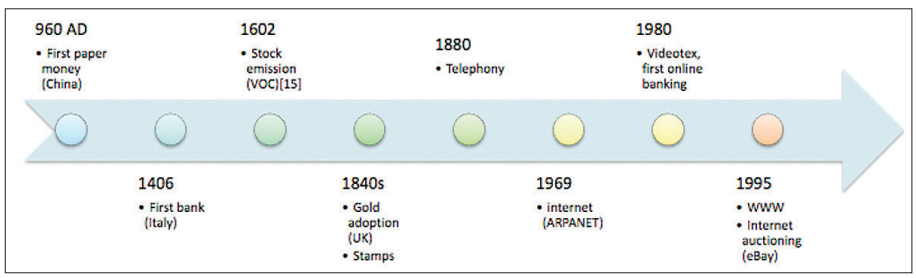

Fig 3: From paper money to digital currency in our "global village"

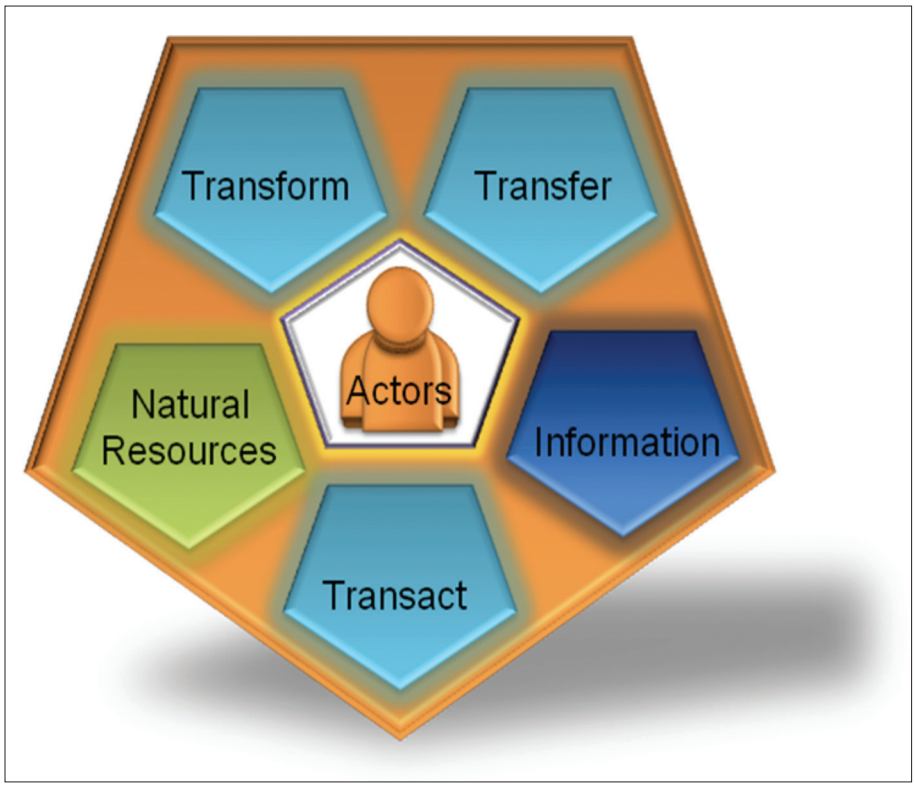

Fig 4: generic functions and resources

– o transact: bridging supply and demand, using trusted value symbols (e.g. money).

Physical marketplaces, coins and banknotes have not disappeared. Today, actors still seem to highly value physical contacts having real-life conversations while examining the merchandise. Over the last 30 years new transaction enablers have been added to the traditional set of transaction enablers. Prominent examples are electronic financial infrastructure, broadband communication networks, ICT means, digital currency & paying applications and Internet based trade portals. Actors gradually embraced these relatively new means for:

– effectiveness reasons: finding the right offer and transaction interface
– efficiency reasons: avoiding physical travelling thus saving time, energy and money
– security reasons: minimising the risk of being robbed or mistreated
– privacy reasons: anonymous orientation, looking around for transaction potential

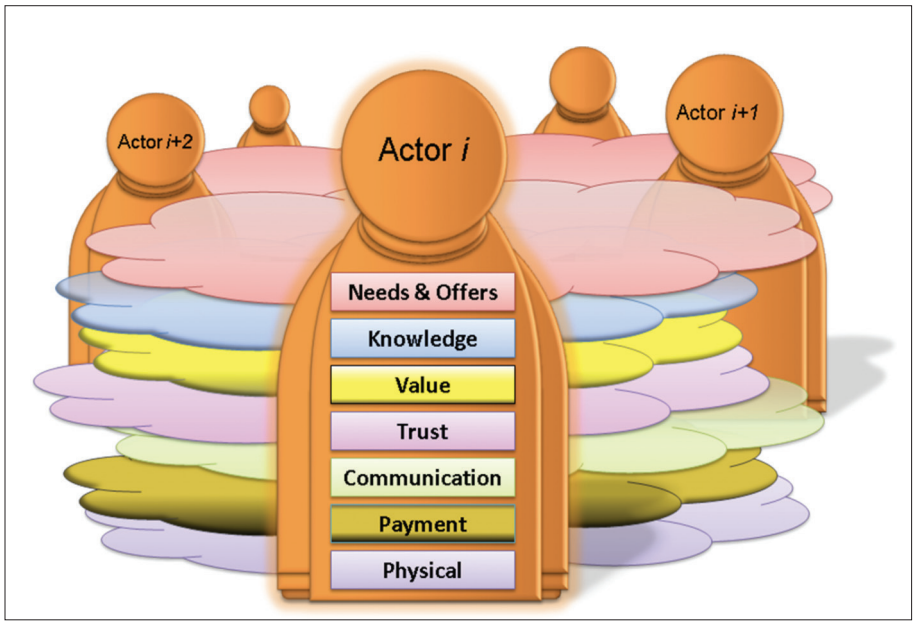

Fig 5: multi-actor transaction model

Figure 5 below shows a simplified multi-actor transaction model that builds on the following propositions. An actor can be human or any other artificial intelligent entity that have needs and offers and can fulfil some or all of the indicated layers in order to have a successful transaction. An actor can act from his private role (e.g. consumer) or representing an organisation (e.g. producer). An actor being a private person can offer goods and labour as well. They too are value producers commonly referred to as 'prosumers'.[16,17]

Typical transaction enablers are; trust, communication networks carrying information, financial infrastructure transferring trusted value symbols and physical transport networks. Figure 5 implies that using all enablers is not always obligatory for each transaction. When for example a barter transaction takes place no payment is needed. When e.g. digital content is purchased the physical transport network is not involved in the transaction. In this sense the layered model above is not an OSI like stack.

In 1985 Michael Porter[18] described the value chain concept defining it as a chain of activities. Products pass through all activities of the chain gaining value at each step. As over the last two decades complexity increased and decomposition took place, the value chain concept now seems to be

Example 1: Primary actor 1 (a private consumer) sniffing for a new digital camera, selects an artificially intelligent search actor 2 (enabled by a transaction engine) that starts looking for recent information and consumer experiences. After entering his need and budget, actor 1 is linked by actor 2 to actor 3 that offers recent surveys on quality and performance assessment of digital cameras. Actor 1 being influenced by a positive quote of actor 4 who purchased Model X a few months ago, decides to look for this type at the portal of the camera manufacturer. Actor 1, discovering brand new releases at higher prices decides to perform a search for Model X. Artificial search actor 2 now points at an offer on sale at eBay. Finally, actor 1 buys a second hand camera offered by an owning actor, after having had an agreement reached during a video session enabled by a communication network. Subsequently, actor 1 uses a paying application. As agreed on, the owning actor sends his camera three months later to actor 1 via DHL traversing the public road system (transport network).

Example 2: The multi-actor example could also be scaled up to programmes coping with the challenges as outlined in section 1, e.g. the energy challenge. Let us become very concrete and outline a multi-actor trans-sectoral scenario for The Netherlands (with minor changes it will also pertain other European countries). If we look at the average Dutchman, we calculate that, today, his energy costs amount to two months of his net salary and are rising for 1300 litres of petrol for his car, 1700 cubic metres of gas and 3400 kWh. FTTH and the installation of a broadband standardised in-home network connected to a fuel cell, his domotics and ICT devices, would substantially decrease his energy and healthcare costs to such a degree that the financing costs are smaller than the savings. This looks like a complex value network involving a host of actors, but what would be the integrated outcome? Seven million households can be offered a contract such that they see stability in their vital costs for the coming 15 years, a new industry, worth at least 150 billion euros, takes off, saving 200 million tons of CO_2 emission, sophisticated healthcare and a nation that becomes by far the most innovative in Europe … isn't that sustainability!? How do we start this innovative engine?

gradually giving shape to the value network or value grid concept.[19] In addition to figure 5, two future multi-actor examples are described below, demonstrating 1) A transaction process in which circa 10 actors can be identified; and 2) A smart home image.

Trust factor

The Jericho Forum[20] has established a series of commandments regarding security, providing focus on confidence in a customer and multi level trust models. They state that: "All people, processes and technologies must have declared and transparent levels of trust for any transaction to happen".

For any transaction, the key factor trust unfolds into:

- The actors' willingness to trust each other
- Trust concerning the quality of the offered goods and labour
- Trust in all enabling networks, ICT means and supporting processes

Establishing and measuring a sufficient trust level in artificial (online) marketplaces proved to be a complex matter. The trust factor mainly dictates which online services to select. If an actor does not trust a particular payment method on a website, this actor will not engage in a transaction, no matter how appealing the transaction might seem. The trust factor also has a massive effect on the cost of transactions, furthermore its importance can make it an enabler in transactions, since without sufficient amount of trust many transactions would not even be initialised.

General observations show that countries with 1) a higher internet adoption level and 2) stable financial infrastructure tend to have a higher technology trust level, and vice versa. The difference in trust might further result in digital divide between different countries. This digital divide might also lead to development divide. From this perspective a higher trust level positively impacts economic growth because it results in reduction of transaction cost and time.[21,22]

Doing transactions the traditional way, actors can rely on authorisation methods that prove the actors' real identities. However, this is not the case on internet since there is not one single authorisation point to verify actor identities. Given this situation a substitute is arising to bridge the trust gap. This gap is being gradually filled by relying on the reputation of an actor instead of looking for an identity insurance which is hard or impossible to obtain.

However, the trust factor becomes much more complex when put into the context of real transactions. The size of transaction or the size of bargain, for example, affects the willingness to trust on each factor differently.

Section 4:

Future technology characteristics and requirements

More and more actors transact without physically meeting in real life. Artificial environments will accompany our physical society. Initially, some traditional items will be more or less copied into these innovative environments (e.g. Lynden dollars, the currency being used in second life which can be exchanged with traditional money).

Later on, new items/concepts exclusively arising in artificial environments will influence (behaviour in) real physical life. Actors that adopt and interact with these new means will drastically empower and extend their social networks. Adding these artificial intelligent entities to their personal networks they can for example enjoy peer-to-peer access to any transaction engine worldwide.

A future transaction ecosystem could have the following characteristics:

- Networked transaction engines and avatars/agents representing the engine owner(s)
- Higher volume of peer-to-peer Consumer 2 Consumer relations (prosumers)
- Higher degree of process automation among the actors
- Actors' transaction environments being interconnected according to advanced identity2identity machine language and product structures[23]
- Context aware technology
- Artificial actors' reputations might become as strong as the traditional ID based insurance, especially when other actors publicly support this actor giving positive performance feedback.
- Cyber-crime, now hard to fight, is being dealt with
- A secure and robust sector network offering regulated confidentiality, integrity and privacy

Taking the previous characteristics and the current status quo in mind, future transaction enablers are subject to the following requirements:

- Minimise energy consumption of electronic networks and devices
- Avoiding the waste of valuable resources
- Real-time information exchange improving transaction success rates
- The factor 'time to fulfilment' will become a common transaction item because the value of a good or labour is estimated and determined at a given moment in time (e.g. the value of a car two months later)
- A refined business model added to the current Internet business model ensuring sustainability in the long term. Premium Quality & Experience at premium tariff (not best-effort only)
- Regulations, law enforcement and trans-sectoral governance concerning artificial environments
- A personal "secondary brain" helping human actors making complex decisions, very fast
- i2i relations supported by artificial Identities and Management
- Multi-Actor discovery and solution resolving
- Scalable authentication, authorisation and addressing systems

In order to facilitate future transactions we envisage sophisticated context aware transaction engines instantaneously matching supply and demand. These engines (and their avatars) take the actual actors' status into account and as such are capable of generating personalised offerings instead of brute force SPAM/broadcast approach. The actors' status comprises items such as; identity, role, needs, budgets, activities and geographic location (see figure 6.[24]

Personal devices must be able to register (e.g. GPS coordinates) and present the (changes in) status items of the actor via a telecommunication networks to the transaction engine. The devices, personal

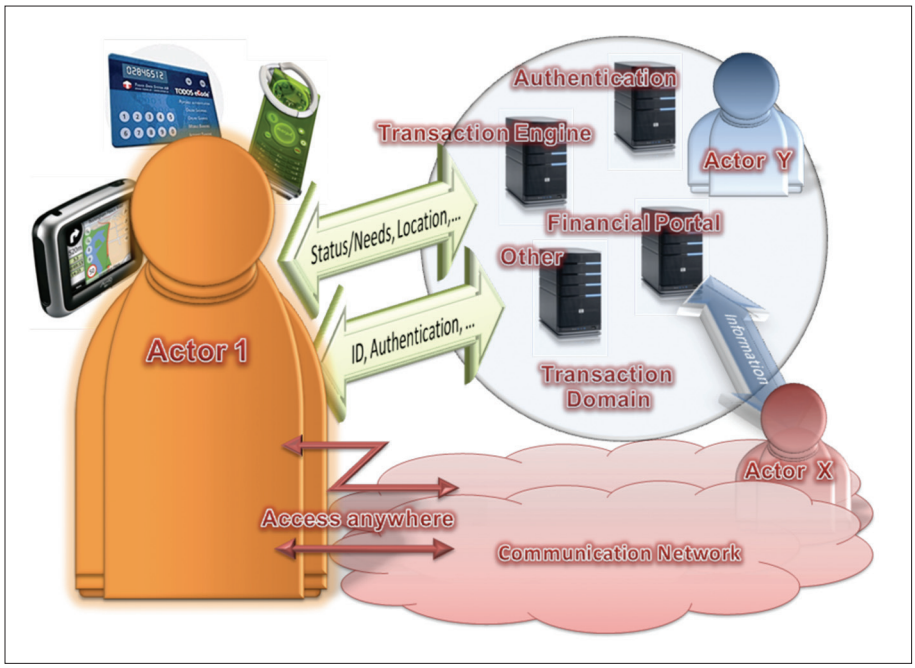

Fig. 6: Future transactions enabling infrastructure

networks and avatars must be capable to receive and inform the actor about current offerings. Sometimes the identity of an actor needs to be verified. Today, it is still unclear whether this should be a task of the communication network or the transaction engine or may be both.

Internet technology will play a dominant future role due to its global reach capabilities that unify online actors in various artificial market environments. All telecommunications networks together provide the Internets' fundaments carrying the artificial global village. Note, today approximately 1000 telecom operators and internet service providers exist worldwide. As the current physical world will find its peers in artificial environments, bridges and gateways will be required in between. These multi-domain interfaces are to be found simultaneously in the transaction domain, the financial network domain and the telecommunication network domain.

Taking the future requirements in mind, commonly known flaws and phenomena need solid solutions. Not only peer-to-peer traffic growth requires huge network resource investments and operational cost, substantial parts of the current telecom installed base needs technical replacement. Today Telecom Operators can hardly finance the necessary measures and transition to the required next stages due to fierce competition and current internet related business models.

Thus E2E Quality of Service and availability seems at stake. Responsible governments are actors too. Multi-actor agreements should be established based on new trans-sectoral business models. Thus, a sustainable status quo can be reached in which the actors responsible for our vital networks can keep on offering society premium quality services at premium tariff and best-effort quality services at best-effort tariff.

Conclusions

1. Both in physical lives, in artificial environments and in any combination, our current situation is still distant from an optimal mapping between supply and demand. Theoretically, there is no shortage of any resource at all. However, the majority of the world population lacks proper access to these resources and supporting networks and is experiencing a growing digital divide. Bridging is needed between the physical world and artificial environments
2. The importance of money will become less, and it will return to playing its original role (a common translator for value held in goods or information). Money in itself will not have value, but will represent value for those rare occasions where the needs and offers cannot be matched immediately.
3. As value is involved, a Next Generation Transaction Ecosystem requires trusted E2E devices, connections and control. Guaranteeing the necessary network robustness requires governance and world standards.
4. Consumers more and more become 'prosumers' thus P2P relations and their activity volume will grow exponentially. As artificial intelligent actors emerge as well, the borders between Business and Consumer blur even stronger resulting in (id)entity to (id)entity relations (i2i).

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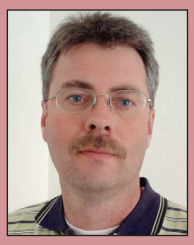
Nico Baken currently holds a part-time chair in the telecommunications department at Delft University of Technology alongside his primary position as senior consultant/chief architect within the department corporate strategy and innovation of the Royal KPN, the Dutch incumbent telecom operator in the Netherlands.

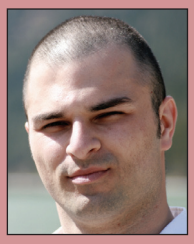
His main interest concerns broadband networks and services, dealing with a broad range of aspects such as sensor (RFID), vehicle, home and personal networks, the first mile & meter, e.g. FTTH and other access infrastructures such as xDSL, fixed-mobile convergence, operations, financial strategies e.g. the real option analysis, managerial complexity and regulations. He is responsible for co-operation with research institutes such as TNO ICT and universities. He has been asked to advise the Dutch government on the matter of Broadband in the national expert group broadband and in the Andriessen committee (former minister of Economic Affairs) to deal with the feasibility of FTTH for the city of the Hague. Recently, he introduced new concepts such as trans-sectoral innovation, City ICT architects and 'streetlight' to enhance and accelerate ICT-applications in and across sectors such as healthcare, transport and education.

Edgar van Boven studied electronics and IT at HTS Vlissingen. Though tempted to start an adventurous life as a jazz pianist, he graduated in 1987. After military service as a sergeant in a telecommunications battalion, he entered KPN. Initially telephony dominated his career from various viewpoints, starting with hardware & software engineering, via operational network planning to architecture & program management. In the late 90s he started to work on the evolution to voice over packet in the former Unisource business networks environment within KPN. In 2001, he entered the Delft University of Technology as a guest lecturer. Today Edgar is active in the area of fixed mobile convergence working at the innovation management department of KPN. In 2006 he started combining his work for KPN with a trans-sectoral innovation thesis at the Delft University of Technology.

After finishing his education in informatics, **Bert Feunekes** has worked as a (technical) consultant in the ICT branch. There he came into contact with LANs, system and network support, and evaluation of new products and releases. Through jobs at SWIFT and PTT Telecom he moved towards designing network infrastructures and OSS-environments. At Unisource Business Networks and KPN he was involved as a consultant in various internal and external projects. In organisational changes Mr. Feunekes has been responsible for the aspect 'process and IT', and he gave direction to the forming of the vision and policy of subdivisions within the organisation. Finally he has been process/IT architect in the design of an organisation for a multimedia service provider within KPN, and for putting together the requirements for the control functions that were to be carried out by the service provider. He joined Cap Gemini in 2005 as managing consultant and is working on client projects as architect/ designer.



John Hoffmans studied electronics and telematics at HTS Venlo. After his graduation he started working at the former Unisource Business Networks part of KPN. From here on he was active in the fields of consultancy, network design and architecture with a strong focus on packet switching technologies and infrastructures. John is now working at the innovation management department of KPN where his primary interests are telecommunications technologies and their applicability to support current and future carrier portfolio and services.



After graduating with a bachelor's degree of information technology from Budapest University of Technology and Economics in Hungary, **Shahin Mesgar Zadeh** was offered a scholarship by Technical University of Delft, The Netherlands, to continue his education and obtain his MSc degree. In collaboration with Cap Gemini Netherlands, with the thesis of 'Future of Transactions', Shahin has been involved in a visionary research and modelling about the changes that will happen to transactions, and the impact of them in our life. Having an entrepreneurship spirit and innovation mindset, Shahin is a co-author of the 'BizTalk' column in the local weekly newspaper of TUDelft, inspiring the students to be more proactive in the field of innovation, and promoting 'outside the box' solutions.