Your phone, my life

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Or, how did that phone land in your hand?

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Preface

The title of this book 'Your phone, my life', and the tagline 'Or, how did that phone land in your hand?' were chosen as they represent my, and many of my colleagues', journey of how we built and expanded mobile telecommunications networks all over the world in less than two decades. Traveling from country to country whenever a new project presented itself.

To be able to write 'Your phone, my life' I relied on my 'bullet point type' notebooks, on my memory, and not to forget, on the stories my colleagues and I shared, and still share, over a glass of 'something'. We can't recall that anyone in the industry actually has stood up in public to tell the history of how you ended up having that clever device with you, all day, every day. Regard this as a first attempt.

I'd like to emphasize that this is not an autobiography but rather a memoir. The stories are written from my point of view, how I did or had to do my job, how I observed my environment and certainly experienced the changes that the world went through as a result of this new kind of communication.

To protect the privacy of those who appear in this book, I have not mentioned their last names, unless they are well known, and in some cases I have taken the liberty to even change their first names. All these stories are true to me and my close colleagues, friends, who kindly gave their feedback. Sometimes I omitted parts of stories as certain things are confidential and sensitive. But these omissions have little impact on the stories themselves, or their truth, or should I say, my truth.

Background information is from articles and books I have read with the sole purpose of putting all our efforts and adventures in their historical and political context.

Chapter 1
Introduction

The first time someone suggested that I write about my adventures was when I had just arrived in Lebanon. He looked at me with sincere curiosity, puzzled too. We were seated in a large kitchen at a friend's house, having lunch. It was a beautiful yellow brick house, on top of a hill, very bright, the garden in bloom, wonderful colors and my story of poverty and gloom in Kosovo couldn't be a greater contrast. We drank lovely Lebanese white wine, ate warm flatbread with labneh, foul, sujuk, and plenty of other mezze dishes. I laughed, thanked him for the suggestion and immediately discarded the idea. I worked far too hard to even contemplate writing short stories, which was, coincidentally, something that I used to do in the past, sometimes, for family and friends.

Now, many years later, five more countries under my belt and umpteen more people who suggested, or sometimes even insisted, that I write, I have finally taken the time to reflect on that idea more seriously. Reflect on why I would write about my journey. Just to tell my story, not as an autobiography but as a personal account of the mobile adventure, in the hope that my global experience, especially the experience gained in countries that are quite unknown to most people, could be of interest or even of help. I'm used to dealing with situations one doesn't often encounter, especially not in the Western world. Needless to say, it has been a steep learning curve, a road full of potholes and often nasty political games and business tricks.

My world, the mobile telecommunications industry, is today's basis of any economy and one of the fastest growing and most capital intensive industries we know. Its impact has been and still is enormous. Just owning a simple mobile, or cell phone, has created possibilities and opportunities that previously never existed. Connecting people, supporting trade, offering more security in dangerous situa-

tions and a tool for all mobile services that are being developed and implemented all over the world. From m-banking and m-health to m-learning and much more. The phone or mobile device as the mirror of our being, with all the positives and negatives that come with it.

The industry started in the late 1980s, early 1990s. First in Japan and the Western world, but very soon the rest followed. One of the challenges was technical; limited availability of the frequencies necessary for the analogue and soon digital mobile network technology, as developed in Scandinavia, the EU, Japan and the USA. The first European standard that had limited roaming capability was the analogue Nordic standard (NMT), followed by GSM, developed by ETSI. GSM initially stood for Groupe Spécial Mobile and was soon re-baptized Global Standard for Mobile Communications, a digital standard that was adopted globally, initially with the exception only of the USA and Japan.

GSM roaming opened-up the world, but a few issues needed to be solved. In countries where the 900 or 1800 MHz frequency bands were already in use – mostly by the military – regulators and mobile operators had a big task ahead. Re-farming frequencies and making them available for the mobile telecoms industry took time and money, which resulted in some delay. But, on the whole, almost all countries had one or two mobile networks up and running by the mid-1990s. A miracle, taking into account the initial small production capacity, the enormous lack of trained personnel and limited technical and practical knowledge available. Billions spent and endless hours of hard work. By everyone involved. We were living the true hockey stick effect of exponential growth. Today, we have built and continuously expanded almost 1,000 mobile networks, serving over 5.2 billion subscribers, with 10 billion connections in place. That is person to person, person to machine and machine to machine.

I started my first mobile project in Kiev – or Kyiv – in 1991, which was still part of the USSR at the time. We were negotiating with the Minister of Telecommunications for almost a year, during which time

we saw Ukraine move from being part of the communist bloc to being an independent country. We worked in consortia. We would call colleagues at other telecom companies, mostly in Europe, and ask if they would be interested in exploring a new license opportunity together, and off we went. That is after waiting for visas for days, and traveling via detours, as most airlines wouldn't fly directly from Western Europe to the USSR. And, of course, hardly any fixed, or landline, or commercial banks yet necessary to facilitate businesses.

The industry quickly developed, and lawyers, investment bankers, consultants and contractors offered their services. The feeling of ownership of the projects and the effort of getting networks up and running within the shortest possible time span was gigantic. Engineers slept in their cars to make sure that they could start early mornings, 'war rooms' were kitted out with huge maps, project timelines, pictures and milestone markers. Contests ongoing between different teams in the specific country regions where we were building. Employing a thousand people in no time and generating work for tenfold that number; network and other suppliers, construction companies, distributors, retailers and other often highly skilled third parties.

Having worked and lived in Western and Eastern Europe, the Balkans, the Middle East, Central Asia, Central America and the Caribbean and now living and working in East Africa, I am satisfied and proud of my teams' and also my own achievements that involved very hard work, a good set of brains, endless portions of endurance but also just simply serendipity, good luck, great colleagues, friends, family and supportive parents. But also conscious of the losses that continuous change bring and sometimes the isolation and loneliness that go hand in hand with this nomadic life that I led.

Today, though, I live a relatively easy life in the Pearl of Africa, Uganda. I coach, help start-ups and tell my stories, mostly to young people working to build their businesses in this ever faster-evolving world, hoping I can help them succeed and contribute in their own ways to

make their life a good life.

This book is for those who traveled the same road but also for the adventurists, the culturally interested, the entrepreneurs, the businesswomen and men who see opportunity and follow their noses. It is a tale of the international business world where rules and practices change, where mores are different, where pride and respect are king, where I saw real hardship. And, despite all that, I am happy that we, the mobile industry, have changed the world, and mostly for the better.

But before the adventure commences, let's start with an introduction to mobile technology and a first glimpse into my world. If you want to dive into the story straightaway, you can always come back to this technical introduction to look something up as and when needed.

This book is an homage to my dear friend and colleague Luc, who taught me so much about mobile technology and the industry, but who left us far too early.

Quick overview of mobile technology

Mobile frequency licenses

First and foremost, the mobile, or cellular, operators need frequencies that are part of the radio spectrum and used to send information to devices such as TVs, radios, alarm clocks, microwave ovens and mobile phones. Frequency is gold dust, without it there would be no mobile connection. Frequencies are owned by the respective Governments that award them to mobile operators in auctions, beauty contests, or a combination thereof.

The licensing process is the prerogative of the respective countries i.e., their Ministries of Telecommunications, even though most mobile operators nowadays are big conglomerates that look at their presence in countries as if they were sitting on the moon. They want to make sure that their company colors flag up in neighboring countries as this gives them advantages like optimizing their running costs, centralizing certain critical network elements more easily and offering customers international roaming at lower prices thanks to the concept of 'roam as if you're home' (1).

Most countries award no more than three mobile frequency licenses and each time a new technology standard is introduced, the serious and lengthy game of obtaining efficient frequency blocks starts all over again. Governments, i.e. Ministries or Departments of Telecommunications, are members of ITU, the International Telecommunications Union in Geneva (2), ETSI, the European Technical Standard Institute in Paris (3) and the GSM Association in Dublin (4) that develop, award and harmonize numbering plans, develop international technical standards and coordinate new initiatives. These institutes support not only Government Ministries but also the mobile operators, playing a significant role in constantly developing the digital world we live in.

The mobile communication world is very young. When I started in 1991, there were about a million analogue mobile, or cellular, hand-

held phones on this planet. The market really took off when GSM and equivalent 2G networks became operational from 1993 onwards, further boosted by the introduction of prepaid technology in 1995. Any customer could now buy credit when needed, instead of paying a fixed monthly subscription (post-paid).

Today, almost all countries have 4G networks, 5G is introduced rapidly and 6G is on the way. If you visit the GSMA Data Intelligence website (5), you can see the counters ticking; mobile connections, including Internet of Things (IoT), stand at over 10 billion, mobile subscribers at over 5.2 billion, and average monthly revenue per customer at USD 8.45 (GSMA 2021). Investment in these networks runs into the trillions of dollars and every introduction of a new, higher standard supports our increasing need for faster communication.

Building and expanding mobile networks

When the first generation networks were built, revenues were generated by people talking on their phones. As early as 1992, however, mobile data entered our world in the form of SMS (Short Messaging Service). It was initially used by few but rapidly grew in popularity. By 2010, 3.5 billion people were texting away, on every kind of phone, even the oldest and simplest 2G phone. And this is still the case today in most countries, especially in emerging markets, where 2G technology is still omnipresent, and its maintenance and repairs are supported by a second-hand equipment market to make sure that even people in remote areas can make a phone call or send a text message. But frequencies are scarce and the industry needs to optimize their use, or in other words, when the technology becomes obsolete, frequencies are 're-farmed' to meet the ever increasing demand for capacity.

Radio waves, or electromagnetic waves using frequency, were first identified and studied by the German physicist Heinrich Hertz in 1886. The first practical radio transmitters and receivers were developed around 1895 by Marconi in Italy and radio began to be used commercially around 1900. The spectrum bands run from 30 Hertz

(Hz) to 300 Giga Hertz. (GHz). The mobile industry initially used the 450 MHz band, which had the advantage of a radius of up to 30 kilometers, provided there was an uninterrupted line of sight, when using towers as high as 50 meters. Today's 5G generally operates in the 3.3 – 4.2 GHz spectrum with much smaller cell radius depending on where the equipment is installed. Although 5G shares part of its frequency spectrum with 4G, you will need a new 5G phone if you want to enjoy the speeds of up to 10 GB p/s that make this new technology so ideal for streaming and other services with high capacity needs.

Once an operator has 'won' new frequency blocks, it starts building its network. This network consists of many network elements, the most important being the Mobile Switching Center (MSC) where traffic initiated by a customer, who has dialed a certain number, is 'switched' to another subscriber's number on the same or another network. The switch recognizes the dialed number and knows where to send the call to.

Number blocks are issued by ITU and have a clear logic. The international access code (00, 01, 09, or simply +) is followed by the country codes made up of 1 to 3 digits (e.g. +1 for the USA, +86 for China, +44 for the UK etc.) and then the subscriber number itself. The total string of digits will never be more than 15. Some countries have very few inhabitants, such as Monaco (~40,000), but even if they have only one number block, they can serve 999,999 subscribers. This is why Monaco could spare a big part of their number block after the Yugoslav war when new countries were formed. Kosovo, which had not yet been recognized as an independent country, used the Monaco country code +377 for its new mobile network Vala for a long time.

Competition

Especially in the past, mobile operators competed on coverage. The better the area and population coverage, the more potential subscribers. It was (and is), therefore, very important to carry out market-

ing surveys deciding where the best customers, in terms of potential revenue, are located. The trick is to make sure that the operator has site contracts in place with airports, shopping malls, conference centers, hotels and the like, so as to be able to build towers and rooftop reinforcements where mobile equipment can be installed, i.e. the so-called BTSs (Base Stations) or in layman terms, masts. Airports and border towns are especially interesting as this is where international roamers enter a country. Everyone gets off the plane fiddling around with their phone these days, eager to get connected to a network. As soon as a phone is switched on outside its home country, it starts to look for the strongest signal or preferred network and hooks on.

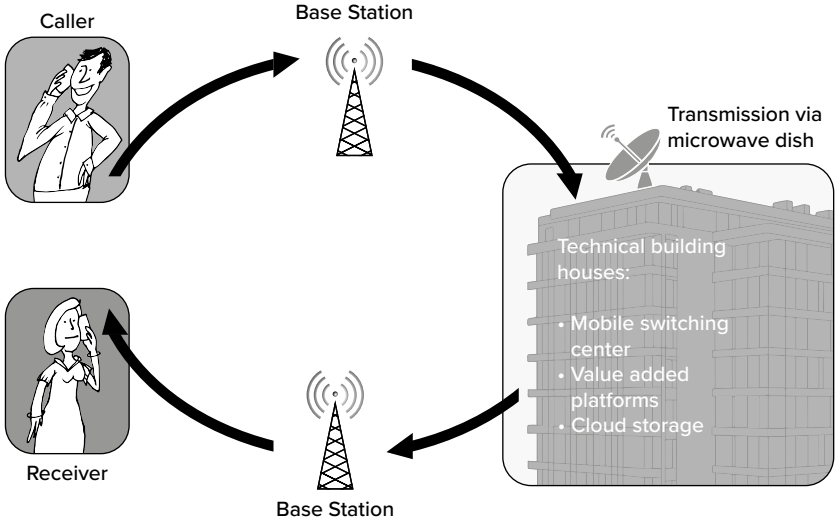
The phone sends out a data signal with its customer's details that the Visitors Location Register (VLR) platform picks up. If you have roaming enabled on your phone, you can then start making calls or sending data. The VLR communicates with your own home network where you are registered on the Home Location Register (HLR) that stores your number and 'talks to the billing system' to check if you have paid your bills. This checking process can take a minute as this mobile subscriber is alien to the receiving network. All international roaming traffic is logged in so-called TAP files and these files are sent to international clearing houses that settle the bills between MNOs (Mobile Network Operators) on a continuous basis. A little later, you will receive your invoice stating your mobile use in the country you visited. For prepaid customers, however, usage is deducted instantly as they roam.

Network topology

As the signal is picked up by a BTS receiver, the call will be transmitted to the switch via terrestrial cables or over the air, using so-called 'microwave dishes', i.e., those big round drums that you see on masts, especially in countries/areas where there is little or no fixed line network coverage or public switched telephone network (PSTN) coverage. Today, many operators make sure that they own their own fiber routes that run from the switch locations to transmission hubs where it then spreads via a finer transmission network to the BTSs.

To select sites to build BTSs and connect to the transmission network, it is extremely important that there be 'line of sight' so that the radio and transmission networks can be built in the most cost-effective way. When the marketing guys and girls decide where the operator needs coverage, a team of engineers and a lawyer start to negotiate site contracts to make sure that the BTS, or a Hub, is built in the best possible place. While seamless outdoor coverage was the name of the game when the industry started, today we expect no less than perfect indoor reception, which is accomplished by using smaller and smaller cells.

Where the radius of an analogue NMT tower was more than 30 km, 5G transmitters' reach in 2020 can be as short as 400 meters, albeit we have to bear in mind that 5G technology uses several frequency ranges and the radii are, as a result, not all the same. In other words, and looking at the huge costs involved, just like 4G, the 5G technology is being rolled out in cities first and foremost, and operators will keep using 2G, 3G and 4G for services that require lower speed and less capacity, e.g. voice and text.



Simple mobile network picture for kids

More about the technical evolution of mobile network architectures see e.g.: https://www.youtube.com/watch?v=16X34zfSxwA

Using a network other than your own

Mobile networks operators (MNOs) need to interconnect, both technically and financially, so you can make calls to another network for which you pay a little extra as your traffic is routed outside your own network. If you make a call to a foreign country, the MSC will switch your traffic to an international gateway that sends it via an international carrier who provides the connection to that country to forward it to its destination.

This connection can be fiber, microwave, sea cable or a satellite route. International traffic is a huge market where tariffs and quality of traffic are negotiated between international carriers and MNOs. While most MNOs use 'legal routes', some traffic is routed via so-called 'gray routes' in some areas of the world, bypassing official international gateways and hence the associated costs. Sometimes, we see a call coming in with a strange country code; this is a typical example of an operator using such alternative routes.

Digital

When GSM was first introduced, new players had a few unique selling points over the existing analogue systems, such as safe digital communication and international roaming. Everyone remembers how then British Prince Charles' conversations were listened in on and that could not have happened with GSM, or later generations. No radio scanner can just pick up the GSM signal and listen in, as the digital signal is encrypted and the SIMs cannot be cloned, because they are configured with the algorithm that is unique to that particular operator. Of course, a phone call can be intercepted for legal reasons, but only by a very limited number of judicial bodies and usually on very strict conditions. This has not changed. Whether you are using 2G, 3G, 4G or 5G, your calls are 99.9% safe, unless there is a legally valid reason to intercept.

The phone and the SIM card, or eSIM, have unique codes identifying you and your phone. These are the IMSI (International Mobile Subscriber Identity) the IMEI (International Mobile Equipment Identity) and the PUK (Personal Unblocking Key). These codes make that the MNO recognizes you and your phone. These codes can be used to locate you, provided you have given permission for that, because you generally have to tick a box for services that track your location. Location-based services and apps such as weather reports, find me, Uber, mobile advertising etc. etc. use the GPS technology installed in any smartphone.

Call Routing

When you make a call, send a text message, or send other data to a certain number, your phone sends a signal to the nearest tower or rooftop where a BTS is located, but once you start moving you move out of that BTS radius. The Base Station Controller (BSC) will hand over your traffic to another BTS that has free channels and is nearest. This makes that your call is seamless. Of course, there are problems sometimes, such as a call drop when the handover fails as there might be no coverage or no free channel to handle your call. But this does not happen too often as the license that the MNO has to respect stipulates strict Key Performance Indicators (KPIs) for traffic handling. If the operator violates these KPI stipulations, it risks being fined, but more importantly, it will lose customers who can pick up a competitors' SIM card for little to no cost.

Certainly with number portability or dual SIM phones, this is a constant risk. Customer churn* is expensive as the investment per subscriber is still about USD 150. Luckily, most people are happy and don't churn every day, but churn figures in countries where large numbers of the population live below the poverty line are different. When everyone can have two or more SIM cards for free, or for next to nothing, and competition is fierce, the churn rate can be as high as 25%, and winning customers back onto your network is an expensive hobby. Better to keep them happy.

In short

A mobile network consists of a radio network RAN, i.e., the BTSs managed by the BSCs, a transmission network (fiber or microwave) and the core network, which is the MSC and connected VAS (Value Added Services) platforms such as those for SMS and voicemail (or voice messaging). Each network has APIs (Application Programming Interfaces) where Internet Service Providers (ISPs) can connect to the MNO so that their services can be used on the phone.

The MSC records the usage and produces Call Data Records (CDRs) that are processed in order to be sent to the billing system that reads them and sends the customer an invoice, or deducts the charges from their credit in the case of prepaid customers. Services are usually shown as separate line items on the invoice.

Prepaid customers often install a mobile wallet where credit for particular services can be stored. These customers represent about 25% of the customer base in the Western world but up to 95% in emerging markets, where an army of street sellers, mostly youngsters, transfer mobile credit to their clientele. Sometimes as little as a few cents per day.

In many countries, phone batteries are charged via solar devices or charging stations located in villages where there might be no, or hardly any, electricity, but always needed as almost everyone on this planet has a phone.

*Customer churn rate, also known as the rate of attrition, is the rate at which customers stop doing business with an entity (Investopedia).

Important organizations

1. **EU Directive**: https://ec.europa.eu/digital-single-market/en/roaming
2. **ITU**: https://www.youtube.com/watch?v=EBPiWhp4KG4#action=share
3. **ETSI**: www.etsi.org
4. **GSMA**: www.gsma.com
5. **GSMA Data Intelligence**: https://www.gsmaintelligence.com/data/

Abbreviations in order of appearance

MNO: Mobile Network Operator, also called cellular or wireless operator
IoT: Internet of Things, machine to machine communication
MSC: Mobile Switching Center, switches traffic to requested destination
BTS: Base Stations, or nodes are part of the Radio Network (RAN)
BSC: Base Station Controller, manages traffic hand-over
PSTN: Public Switched Telephone Networks, fixed, or landline, networks
SIM: Subscriber Identification Module or SIM, moving to eSIM (no cards)
IMSI: International Mobile Subscriber Identity
IMEI: International Mobile Equipment Identity
PUK: Personal Unblocking Key
KPI: Key Performance Indicator
GPS: Global Positioning System
VAS: Value-Added Services
API: Application Programming Interface
ISP: Internet Service Provider
CDR: Call Data Record

A first glimpse of the mobile world

History

While reading an old book on the development of the mobile telecommunications industry, I found a funny picture of Mrs. Hilda and Mr. Lars Magnus Ericsson (SE) putting their phone into their brand-new convertible along with two sticks with metal hooks. When they went for a drive in the Swedish countryside in 1910, they were not only seen as a strange couple in a motorcar but also as the first ones to have invented mobile telephony as Hilda would hook her sticks onto a telephone cable and Lars Magnus would turn the dynamo handle to make a connection and, lo and behold, it worked.

Mrs. and Mr. Ericsson,
drawing by Clare Terblanche, after Anders Sunerson

It was not until the 1970s that the development of the commercial use of mobile phones started in earnest, on both sides of the Atlantic. In the USA, it was pioneered by Bell Systems, named after

Alexander G. Bell, who had invented the telephone in 1876, but better known as AT&T, and in Europe, especially Scandinavia where the Nordic Council had identified telecommunications as a strategic area for cooperation. The first report from the Nordic Mobile Telephone group (NMT) was published in 1970 and recommended that a pan-Nordic mobile system be developed, which later became known as 1G, i.e. the first generation of mobile telephony, or just NMT. This technology was based on the harmonization of frequency use and operated in the 450 MHz band. Funnily enough, the first commercial NMT network, supplied by Philips (NL) and Ericsson (SE), was launched in Saudi Arabia in September 1981, before the Nordic network itself, that was commercially operational from October 1981. Two years after the first 1G network was launched in Japan, using its own technical standard, developed by Panasonic.

From state-owned utilities to fierce competition

Until the 1980s, many countries had one local PTT (Post Telegraph and Telephone company) and the discussion started about the positioning of mobile networks in the respective companies. These incumbents understood quickly that mobile telephony had a future and that it was better the make it a separate business within the organization. When PTTs in the late eighties started to – partially - privatize, the mobile divisions turned into independent business units, at first not competing with the fixed line business, but with other, brand-new companies that quickly emerged and that won licenses to build and operate networks for periods of 15 to 20 years.

Soon, these newcomers not only captured market share from the incumbents by launching innovative tariff packages and offering a range of mobile handsets, but they also managed to get their portion of new subscribers. The managers of the initial small mobile units were promoted to Chief Executive Officers on Management teams and often with seats on Boards of Directors. Their importance grew in step with the revenues they generated, which in the mid-1990s already amounted to 20% of total revenue at the Nordic operators.

Still, the industry was in its infancy, and especially incumbents were cautious. Unfortunately, in practice, the underestimation of the markets caused enormous pressure on both the operators and the suppliers that had to deliver network elements and handsets in a space of nothing. Equipment suppliers like Ericsson and Nokia had also split their activities into network and handset production lines, with both trying to keep up as fast as they could. In some instances, mobile switches were even put in containers or BTSs were built on trucks as operators had no time to waste.

Ministries often put huge penalties on the Shareholders, and hence the CEOs heads, or even threatened them to withdraw the license altogether if they didn't launch on the stipulated dates. In general, network suppliers were always quicker to market than device manufacturers and operators would build while the phones would only be available just before going live. And this is still the case with the 5G networks that are being launched today. Unfortunately, only when device manufacturers are able to keep delivering different kinds of handsets, and do so fast, can new generation mobile technology take off properly.

Professionals

In the early nineties, we were just small Business Development teams, baptized 'license hunters', but soon the rest of the world woke up to the success of this innovative industry where billions were spent in no time. MNOs were in need of educated and trained personnel that was not available as universities couldn't educate them quickly enough. It resulted in one of the most international HR markets ever seen. If you had experience building networks in any discipline, you could find a job all over the world. And many youngsters did, often helped by agencies who would take a percentage of the contractors' fees for organizing new assignments for them, including work permits and tax issues.

Most young contractors stayed, and still stay, with this exciting international circus for quite some time, moving from country to coun-

try, often leaving family behind. Their working hours were limitless, their fees very respectable. Some conglomerates such as Hutchison Whampoa paid 28-year-old radio engineers with only a couple of years of experience more per week than they would have earned in a month in the same position in their home country. It was very attractive for them, although some were not cut out for this life, as we'll see later.

But not only the contractors were young, so were the new mobile companies' permanent staff, with the average age generally being no more than 28 or 29. Young graduates would often start out in a call center job and then move up from there. The mobile industry paid and still pays well, also its local employees. The industry not only employs the brightest minds, but also positions itself among the best employers in most countries, in terms of salary, training and support. Especially in emerging countries, the majority of employees have university degrees and a constant drive to learn.

I remember that German incumbent Deutsche Telekom spent an amount equaling 3% of their entire workforce's annual pay on training in 2005. I negotiated a 7% training budget both in Lebanon and Azerbaijan to accelerate and make sure we could deal with the huge company transformations. This intensive training schedule also led to many of them joining the international circus later, and me finding former employees in operations in other countries. Or purposely taking them with me.

Employment in the mobile ecosystem

The latest figures (2019) show that the mobile ecosystem currently provides work for 30 million people worldwide, both direct and indirect jobs. This ecosystem includes network operators (MNOs), virtual mobile network operators (MVNOs), network and device suppliers - like Ericsson, Nokia, Huawei, ZTE, Alcatel, Motorola etc. - specialist infrastructure and installation companies, distributors, retailers, training and consultancy companies etc. Normally, an operator creates up to 10 times more jobs than it employs people, and this figure can