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The coming "tech-frastructure" boom

How to profit from the hidden class of companies behind every breakthrough technology

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There is an underlying pattern that drives the world of technology forward. It goes back more than 250 years. Understand it and you can profit from grand, sweeping change in the economy in a very real way.

That's quite a claim to start this month's issue of *Frontier Tech Investor*. But today I'm going to prove to you that it is true. And I'm going to introduce you to a company that I believe is perfectly placed to benefit as a new stage of the cycle begins. It's a core technology stock that'll fit perfectly into any tech investor's portfolio.

But first – the dynamic cycle of innovation, new technology, golden ages of prosperity and the creation of incredible wealth.

Anyone looking to explore this idea in more detail should seek out Carlota Perez's seminal work *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. I highly recommend it.

The concept of the book is simple but profound. Roughly every 50 years, going back a quarter of a millennium, a new "epochal innovation" arises in the economy. This doesn't mean the next iteration of an iPhone or some evolutionary technology. It means a disruptive, *revolutionary* technology that influences the way the rest of the economy operates. It then takes around half a century for this technology to be fully deployed in the economy.

Perez argues that this process started in 1770 with the first steam-powered mill (Industrial Revolution), followed in the 1830s by the railways (Age of Steam and Railways), the 1870s by heavy manufacturing (Age of Steel and Electricity), the 1920s with the automobile (Age of Oil and Autos) and in the 1970s with the microprocessors (Age of Information and Telecommunications).

You'll have noticed that it's been roughly half a century since that

last innovation emerged, and that microprocessors are now fully and productively deployed across the economy. What comes next? More on that shortly!

That's the macro level. But dig a little deeper and understand each cycle in more detail, and another pattern emerges: each breakthrough technology required – or created the demand for – a specialised infrastructure to support it.

Let's call it the "tech-frastructure" – the key associated technologies that make the overall revolution possible.

The unloved heroes of technological revolutions

Tech infrastructure might not be sexy. But it's vital. And the companies that build it can be as profitable – if not more so – than the "flagship" firms on the cutting edge of innovation.

Think about it. The Industrial Revolution led to a major canal network being built across the UK (it's still with us). This led to a "canal mania" – an investment boom. Steam-powered trains required vast amounts of track to be laid. Heavy machinery led to the electrification of the economy and a modern power network. Automobiles were nothing without a road network. And the information revolution led to huge growth in satellite systems as well as a fibre optic network.

As Perez put it (emphasis mine):

> *Each technological revolution has led to the massive replacement of one set of technologies by another,* ***either by outright substitution or through modernisation of existing equipment in people, organisations and skills in a sort of habit breaking hurricane.*** *Each led to an explosive period in the financial markets.*

The question is what's the next tech revolution going to be, what infrastructure will it need and who is going to benefit from that?

Pinning down the exact innovation is difficult (and risky). Many of the firms we've put in the portfolio so far could be at the forefront of it – things like solar, artificial intelligence (AI), gene editing, new medicines and quantum computing. But what about the infrastructure?

The question is, what's the next tech revolution going to be?

Well, to me it will come down to something very simple: **connectivity.**

Build it and they will come

Let's fast forward to 2025. It might sound far away, but we're only talking about eight years from now. Believe it or not, the iPhone turns ten in June so don't underestimate what can happen in such a short period of time. The future is going to be about connectivity on a level we cannot imagine today. We think we are connected 24/7 now, but that is because we choose to be and our attention is captured by games and social media. What I'm talking about is a future where our entire world is connected in the background of our lives.

Every piece of machinery we come into contact with is already approaching internet connectivity, and the number of devices connected to the internet in our homes is growing at an impressive rate. The future will be about maximising the potential for data collection in every facet of our lives. Every machine, no matter how small, will have an IP address, the capacity for deep analytics, and be limited only by data and computing power.

It's not just in the home (or on our person) that devices are becoming more connected. Autonomous vehicles are already collecting data, but that is only going to multiply with each additional car or truck that hits the road. The range of services that can be offered online continues to expand. There's no logical limit in sight. And the range of business activities both internally and outward facing that are being conducted online is growing at an even faster pace. That is before we

talk about the potential for media, entertainment, education and banking to continue to grow.

It's all going to need a lot of bandwidth, and the infrastructure we have right now is just not up to the task of handling it. This month I want to talk to you about the company in the lead position to deliver the hardware and networks we need to achieve the exciting future we can glimpse on the horizon: Cisco Systems.

A short history of tech-frastructure

Do you remember the tech bubble of the 1990s? It was a go-go time for markets amid what was an exciting time for just about everyone, with the invention of the internet and the disintermediation that has since transformed the global economy. To use our earlier schema, the internet was simply an outcome of the microprocessing revolution – the last 20 years have seen its deployment and maturation.

The change persisted and is still an important influence today, but the stockmarket crashed and a whole generation of investors were burned. Today, everyone knows about Google, Amazon and Facebook, but it's worth remembering that Amazon is the only one of the three that had an active listing back in the 1990s. Microsoft is another success story from that time. But what about all the other big companies that prospered during the evolution of the internet but not from its maturity?

Some of the biggest success stories of the 1990s were the companies that built the infrastructure for the internet. That's often why it was referred to as the TMT bull market – ie, telecoms, media and technology. It wasn't just about the software companies that would eventually benefit from the ability to do business online. Some of the biggest beneficiaries were the companies laying down the cables, controlling the networks, building mobile phones, designing routers, switches, connectors, transmitters etc. In other words: hardware manufacturers.

The reason this sector has been all but forgotten since the crash in 1999/2000 is because investment in infrastructure evaporated almost overnight and these kinds of companies went through a painful process of rationalisation and consolidation. Massive companies like WorldCom and Nortel Networks went bust. Others were confined to very lengthy ranges that have persisted for more than a decade.

From past issues you will be familiar with our belief that the Internet of Things, autonomous vehicles, superfast internet and mobile connectivity at rates way beyond anything currently available are in the pipeline and are going to transform the economy in even more surprising ways than the original growth of the internet did. To achieve these lofty but realistic goals is going to require a great deal of investment in new infrastructure. The companies which were banished to the hinterland of investor attention for the last decade are now poised to make a comeback as companies compete to get a competitive edge by trying to be the first to build new networks.

From my research, I can see three main themes that are going to fuel spending on infrastructure. These are:

- Hybrid cloud services & AAA (analytics, artificial intelligence and automation)
- Terabyte (1,000 gigabyte) optical
- 5G mobile connectivity and the Internet of Things.

Let's take each in turn. I'll explain a little about what it means and why it's important. Then I'll show you why Cisco is the perfect company to own to benefit from them.

All tech booms need new infrastructure

Hybrid cloud services & AAA (analytics, artificial intelligence and automation)

AAA is a combined approach major corporations are employing to building their own internal cloud services. Let's think for a moment that a cloud is essentially

a sophisticated network that can be accessed remotely. Major corporations have multiple locations across cities, states, countries and continents. As the complexity of the global economy increases, keeping touch with every area of the business and sustaining company culture across borders is more important than ever.

As a result, serious investment is flowing into the development of clouds that maximise a company's ability to leverage the data they have. That's where the analytics portion of the theme comes in.

Artificial intelligence is increasingly being implemented to drive the evolution of knowledge and nonlinear conclusions which can be drawn from this data, while the process of automation is such that once set up the process can run in the background.

A $29 billion market growing at 10% per year

When we consider the potential for growth in cloud, we cannot begin to think about the opportunities without thinking about some of the risks. The sophistication of hackers is improving all the time, and they are particularly adept at exploiting the weakness of legacy architecture. After all, they have had years to play with it, and technology and competing power have improved substantially in the last 20 years and have little resistance to the attacks which are growing in frequency all the time. New hybrid cloud hardware and software represses a significant growth business – not least because the cost of dealing with cyber-attacks continues to grow. These companies keep sensitive data internally but also have facilitated access to public clouds.

To put some numbers on the kind of opportunity this represents, Deutsche Bank estimates Data centre switching represents a $10 billion market in 2017 and should grow in the high single digits between 2018 and 2020. Cloud security (DDoS, web apps, etc) is a $4 billion market in 2017 and should grow at 40% between 2018 and 2020. Analytics, artificial intelligence and automation is a $15 billion market growing in the high single digits multiples. Adding that together, we are talking about a $29 billion market growing at almost 10% a year over the next four years.

Terabyte (1,000 gigabyte) optical

I conduct all my research, writing and trading at home and rely on the internet for the bulk of our family's entertainment with a 100MB internet connection. It is sufficient most of the time. However, when the kids are streaming Netflix on up to three devices and my wife is FaceTiming China while I'm working, the Wi-Fi signal can get a bit congested.

Right now Google Fiber is offering optical to the door of companies at speeds up to 1GB for around $5,500 a month. If you're a good-sized business that cost is probably justifiable, but for the rest of us it's extortion. Yet that is as fast as it gets right now.

Superfast connections are being pioneered within data centres. They need the speed to cater to the quantity of data porting through their operations as more and more businesses rely on the internet for sales and communication. Amazon remains the global leader in supplying data centre solutions. Just how pervasive it is was highlighted in the recent Snap Inc. IPO, when it was revealed it uses Amazon for just about all its backend applications.

Deutsche Bank estimates that data centres will account for $4 billion in terabit optical this year, metro installations another $5 billion, while long haul and subsea will likely account for $5 billion and $3 billion respectively. Meanwhile, the data centre spend over the next three years is expected to grow at a 50% rate annually.

Telecoms and cable companies are expanding their networks in the US right now with the aim of supplying 100MB speed connections to more people. AT&T, for example, is rolling out fiber to the building and has plans to trial 200,000 businesses this year. In the fourth quarter earnings call, the company reiterated the focus

on growth and said it is ahead of schedule on fiber to the home with four million signed up and ramping up to 12.5 million over the next few years.

The big unmistakeable point with this theme is that the demand for faster and more connectivity is undeniable. It really is a story of build it and they will come.

5G mobile connectivity and the Internet of Things

Major companies like Walmart, Boeing and Honeywell – in other words, some of the largest consumers of technology – have made the Internet of Things (IoT) a top priority. There is a simple reason for that. They are constantly pressured to control prices, and increasingly the only way to do that is to maximise data collection and analysis. Having 20 billion IoT devices at major corporations over the next couple of years, all of which will need to be connected to each corporation's individual cloud, is no small task and represents a significant IT spend.

In addition to the IoT, we are going to need major network development to enable some of the hottest themes we have been talking about for the last year. I'm thinking smart cities, smart homes, high definition video via mobile devices, virtual reality on demand, self-driving cars and industrial automation. 5G is critical to enabling these themes become reality.

5G research is already well underway in the US with Verizon launching next-generation fibre in Boston and it is launching ten pre-commercial 5G pilots ahead of commercial rollout. It's still early days, and it will take time to test the technology and proof it up for wide-scale adoption. Therefore we can probably expect to have it in our hands within the next five years, but 5G will be at least ten times faster than 4G from a mobile user's perspective.

In meantime, keep an eye out for news about 5G fixed wireless access (FWA). It represents a stepping stone to true 5G, which is now being tested by both AT&T and Verizon. It allows them to test new spectrum radio bands, radio form factors and antenna systems, but the result is fibre-like speeds over the air. The nice thing about 5G FWA is that there is no need for the expense and time delay of laying fibre optic cable, so we can expect it to represent a particular focus for companies seeking to build-out this sector.

Buy Cisco Systems

It's exciting stuff isn't it? The reason I am recommending you buy Cisco Systems is because being a leader in developing the tools for delivering networks is what it does. It is playing a pivotal role in exploiting the nexus of innovation represented by the hybrid cloud services & AAA, terabyte (1,000 gigabyte) optical, 5G mobile connectivity and the Internet of Things. There are other companies out there which have expertise in one or more of these themes, but Cisco is one of the very few with a toe in all three and the scale to bid for major projects.

Our pick could be vital to the growth of the tech sector

Cisco's edge cloud computing solution focuses on linking IoT devices through hardware and software to the host network. Its network connectivity represents a broad portfolio of routing, switches and wireless products with a range of software solutions that can all be twinned with other companies' software. This is all backed up by cutting-edge cybersecurity, not least the IoT network as a sensor and IoT physical security. Twinned with the company's data analytics, this allows customers to perform analysis between the smallest sensor and the edge of the company's cloud where it interfaces with users. This really just scratches the surface of everything the company has to offer.

Some examples include when General Electric (GE) improved manufacturing productivity by enable GE's "Brilliant Manufacturing Suite" using Cisco networks. General Motors was able to achieve a Zero Downtime application, which it is rolling out

across its factories by using Cisco. Stanley Black & Decker uses Cisco's Wi-Fi and Ethernet solutions to improve visibility and productivity across its manufacturing operations.

In the smart city sector, Cisco collaborated with New York City to launch an interactive platform delivering local information and services. Kansas City is rolling out internet connected kiosks, video sensors and smart lighting using Cisco's Smart+Connected Communities solutions. Amsterdam has been working with Cisco and Philips on network-enabled LED street lighting.

The company makes about 75% of its money from products and the rest from service. It is internationally diversified with 59.7% of revenue from the Americas; 24.9% from Europe, the Middle East and Africa; and 15.3% from APEC. Cisco introduced a dividend in 2011 and has been growing at a five-year average of 31.95%. Its current dividend yield is 3.43%, which is competitive by any measure and means potential investors get the yield of a conservative company from a growth stock.

The share collapsed in 2000 and spent over 16 years ranging below $30. It is now in the process of completing that long "sleeper" base, and I recommend buying Cisco Systems up to $40. My 12-month target is $45 while I believe $70 is conservative over the next three years.

The risks are that companies scale back their ambitions regarding the IoT or that other lower-cost competitors try to outbid Cisco on some of the larger projects. The dividend is a positive of course but if for any reason the company cannot sustain the payout, the price would suffer.

All in all, given the trends we're seeing in the economy, and given that 250 years of history tell us new technologies always need new infrastructure, I think those risks are worth taking. **Cisco is a BUY in the technology portion of our portfolio.**

Name:	**Cisco Systems Inc.**
Ticker:	**CSCO: US**
Current Price (03/04/2017):	**$33.80 USD**
Market Cap:	**$169.3 B (USD)**
52 week high/low:	**$34.53 / $25.81 USD**
Buy up to:	**$40**
1 year forecast:	**$45**
3 year forecast:	**$70**

Data as of 03.04.17

5 year performance data: 2012 +6.55%| 2013 +14.58% |2014 +35.23% | 2015 +6.40%| 2016 +37.09%

Struggling to buy TerraTech but want exposure to legalised cannabis? Here's what to do

It has come to our attention that a number of subscribers are having difficulty buying TerraTech shares because a number of UK brokers have ethical qualms about dealing in cannabis-related shares and refuse to deal. I won't go into why I believe this is a flawed policy, not least since the UK government now admits the plant has medicinal properties, but I would rather offer you an alternative which I believe is an equally good investment.

Note, this doesn't replace TerraTech in the portfolio. It's a secondary position. I'll continue to cover TerraTech until I think it's time to sell. So if you own it, don't be alarmed. It's simply that I know many of you want in, but can't due to broker restrictions. If that's the case, Zynerba Pharmaceuticals is my recommendation. I'm adding it to the portfolio today and will cover it alongside TerraTech.

Humans have been using opium as a source of pleasure and pain medication for at least 6,000 years. In all that time, our ability to manage pain has hardly improved at all. That is quite scary when you think about the progress made in many other parts of our lives. Cannabis has also been used for pain relief and is most particularly used for the treatment of chronic pain. However, the use of cannabis for medical use is heavily regulated. In fact it is much more strictly regulated than opium despite the very real dependency issues that the drug can create.

Zynerba develops cannabinoid imbued drugs. The company announced in January that it was beginning its stage two trial for a topical cannabis-based cream, which is a first for the sector and

is aimed at treating acute pain for people suffering from epilepsy, osteoarthritis, Fragile X syndrome (which is a genetic condition causing intellectual disability and anxiety disorders), fibromyalgia and peripheral neuropathic pain. These are all ailments that opiates are ill-suited to treat.

The share has been trending steadily higher since June of last year and has pulled back over the last month to test the progression of higher reaction lows. I believe this is a favourable entry point and recommend the share as a buy up to $25.

The risk of course is that the drugs it is developing are not deemed novel enough to gain approval. I rate this as a low risk since so little research has been done into cannabis, but it is a risk nonetheless. As a relatively illiquid share with a market cap of $265 million it might also be easier to buy than sell. For more information – and the general investment case for legalised cannabis – read our special report on the subject (accessible via the subscribers' area).

An update on our CRISPR position

CRISPR update – as veteran subscribers will know, we are about as excited about the potential for genetics here at *Frontier Tech Investor* as it is possible to be. That is because CRISPR-Cas9 represents such a ground-breaking development by improving the cost, speed and scope of innovation. In no uncertain terms, it represents one of the most influential discoveries in decades and someone is going to get a Nobel prize for it.

The often tawdry tale of exactly which company owns the majority of intellectual property relating to the method took another turn this month. The US Patent and Trademark Office decided in December to award the majority of the patents to MIT and Harvard, which benefitted Editas (the company with the exclusive rights to commercialise and licence their claims). This month the European Patent Office and the UK's Intellectual Property Office awarded CRISPR Therapeutics similar strong support for its claim to ownership of the core intellectual property.

CRISPR Therapeutics will no doubt use this decision as fuel to pursue its claim in other jurisdictions. But even if successful, it will have difficulty trying to roll back the decision already taken by the US Patent Office in favour of Editas. It is also open to question whether it will be successful in its efforts.

The US market is the big prize internationally because it represents the largest market for healthcare by orders of magnitude. Editas has a privileged position because it has control of the US patent ownership and therefore dictates what can and cannot be sold in that market.

That means even if a firm purchases a licence to develop a drug with CRISPR from Intellia Therapeutics in Europe, it will not be able to sell the drug in the US without paying Editas as well. The net result of the decision is that both Editas and CRISPR Therapeutics now have the potential to benefit.

The benefits of CRISPR could be enormous

Name:	**Zynerba Pharmaceuticals Inc.**
Ticker:	**ZYNE: US**
Current Price (03/04/2017):	**$20.10**
Market Cap:	**$265.62 M**
52 week high/low:	**$23.75/ $6.02**
Buy up to:	**$25**

Data as of 03.04.17

5 year performance data: 2016 +54.82%

Please note five-year performance data is not available as company was listed in August 2015.

Energy

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Orocobre Ltd	ORE. AX	07/04/16	A$ 2.92	A$ 2.80	-4.11

Technology

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Cyberdyne	7779	30/05/16	JPY 2,353	JPY 1556	-33.45
IBM	IBM LN	07/06/16	$153.33	$174.50	13.18
SAIC	SAIC US	05/07/16	$58.17	$73.04	25.50
Garmin	GRMN US	02/08/16	$55.75	$50.24	-9.88
2U INC	TWOU: US	06/02/17	$33.25	$40.11	20.63
Cisco Systems Inc.	CSCO: US	03/04/17	$33.80	$33.80	0

Medical

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
Intuitive Surgical	ISRG	07/04/16	$ 626.12	$ 764.71	22.13
Terra Tech Corp	TRTC	11/11/16	$0.41	$0.29	-29.37
Autodesk	ADSK	01/11/16	$70.10	$85.39	21.81
Abcam	ABC	07/03/17	913p	826p	-8.98
Zynerba Pharmaceuticals Inc	ZYNE: US	03/04/17	$20.10	$20.10	0

Moonshot

Company	Ticker	Rec Date	Price Then	Price Now	Gain/ loss %
SolarWindow	WNDW	07/04/16	$3.96	$2.99	-24.49
Alkane Resources Ltd	ALK: AU	05/09/16	AU$ 0.31	AU$ 0.29	-6.56
Editas	EDIT: US	07/03/17	$21.02	$22.25	4.56

For the full portfolio including live prices, please visit the *Frontier Tech Investor* subscriber area. **You can view that by following this link.**