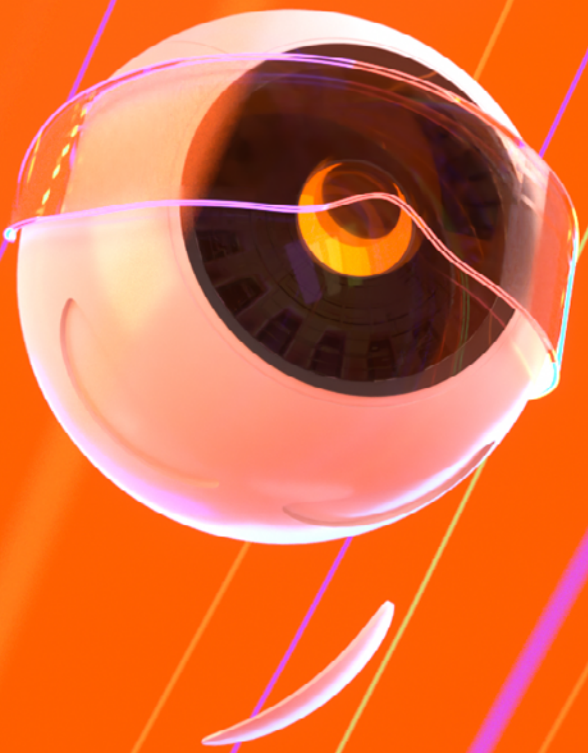
Investment Recipes

by AtonRā Partners



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On the Menu

SUN SHINES ABOVE THE MULTI-CLOUDS

The Next Step In The Cloud Revolution

Companies are adopting multi-cloud

A multi-cloud strategy means leveraging the best of multiple providers to achieve greater operational efficiency and productivity for the business as a whole.

- 95% of companies have concerns about vendor lock-in (being dependent on a single provider for core assets and a growing part of operational costs).
- Choosing a single provider often means settling for a sub-optimal solution.

Multi-cloud migration requires adequate skills and tools

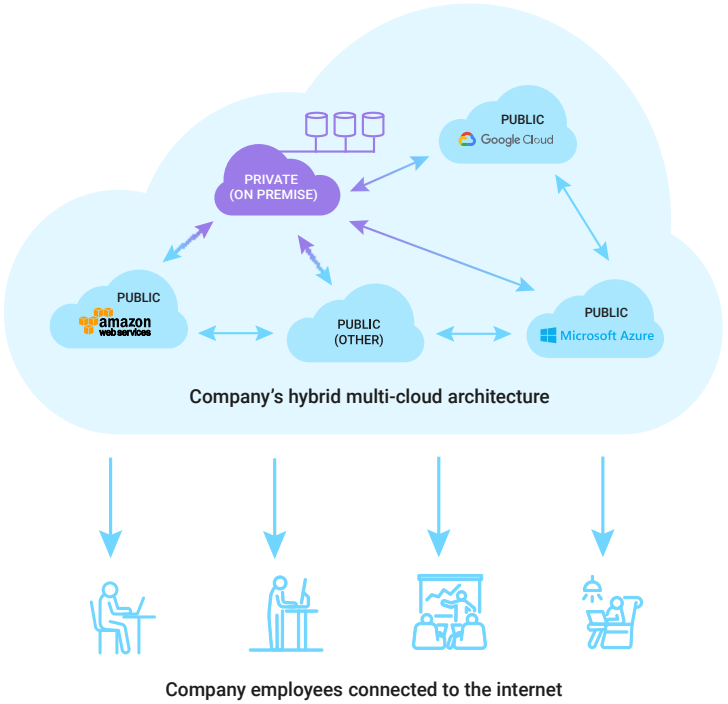
Multi-cloud is the preferred destination for migrating operations to the cloud, but its architecture is complex and requires adequate skills and tools to be deployed efficiently.

- Artificial Intelligence (AI) and the Internet-of-Things (IoT) consume data in different forms, with multiple storages, security, and computation needs.
- ~40% of the companies use multi-cloud to integrate data, and more than 33% use workload mobility and intelligent workload placement.

A significant opportunity for value-adding solution providers

2021 is expected to be the year of multi-cloud as COVID-19 reaffirms the critical need for business agility and the migration towards efficient cloud architectures.

- 93% of enterprises have a multi-cloud strategy, yet only 33% use multi-cloud management or security tools, creating opportunities for software vendors.
- The multi-cloud management market should grow at a 5Y CAGR of ~30% reaching $12bn by 2025.



SOURCE:
Gartner, Flexera, Markets and markets, Verified Market Research, IDC

Hybrid Multi-cloud Is The Way Forward

Cloud computing is every business cornerstone

Cloud drives the latest computing innovations in a model, granting users with a pool of configurable computational resources that they can provision and scale.

- The total cloud market is expected to reach approx. $500bn by 2025, growing at a CAGR of 18%, and virtually all organizations use cloud services (>98%).
- Organizations are over budget for cloud spending by an average of 23% (a third being up to 40%) and expect it to increase by 47% next year.

Sticking to the hybrid

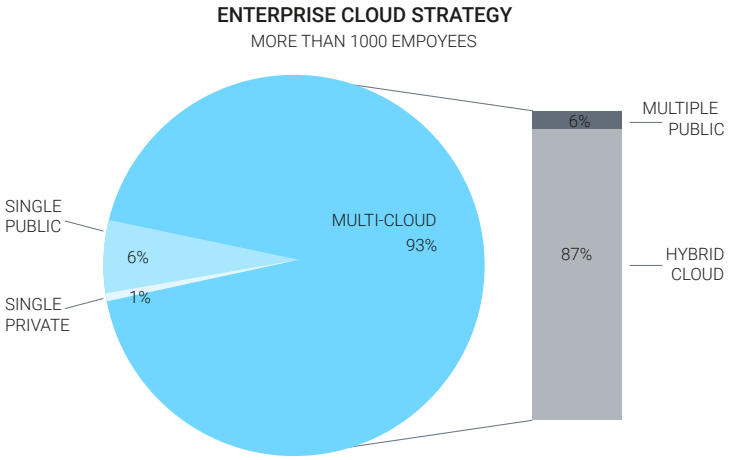
As companies plan to migrate a larger share of their workloads to the cloud, they aren't abandoning on-premise computing. Instead, they are developing hybrid IT models in which applications and resources are shared between public clouds and their own internal data-centers.

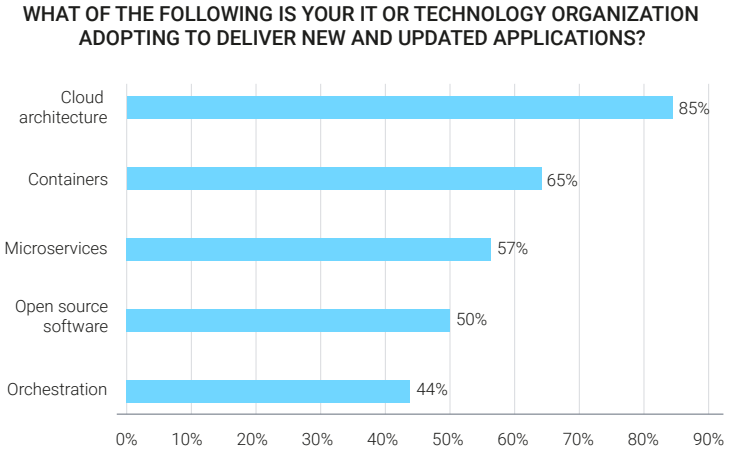
- 62% of public cloud adopters use multiple platforms, with the average number of private and public clouds used by companies being ~5.
- 93% of enterprises describe their strategy as hybrid/multi-cloud today.

Leveraging cloud's full potential

As cloud computing options have proliferated, companies using a multi-cloud strategy can take advantage of the strengths of the various options available and help CIOs explore new ways of bringing together data from multiple sources, stored in multiple locations, for different uses. But cost-control becomes a priority.

- In the Flexera 2020 State of the Cloud report, 73% of companies indicated having initiatives aiming at optimizing the use of the cloud (cost savings).





SOURCE:
Multi-Cloud, Hybrid Cloud, and Cloud Spend — Statistics on Cloud Computing

Cloud Migration Requires Proper Skills

Exploiting the opportunity

The real advantage of implementing a multi-cloud strategy boils down to greater flexibility and agility to adapt, leveraging the powerful potential of the cloud.

- By making core IT functions less time-consuming, IT teams can shift their focus from maintenance to innovation.
- Avoiding being locked-in with a single vendor also offers better bargaining power with public cloud providers.

Complexity on the rise

Adopting a multi-cloud approach and relying on multiple public cloud vendors increases the overall complexity of the cloud environment, bringing challenges about re-platforming and re-provisioning infrastructure, ensuring consistent security, and navigating complex network integrations.

- Each of the public clouds on offer today is different in terms of architecture, pricing, technical specs, available features, and many more aspects.

Being able to manage the issues is key

Complexity translates mainly into cloud management issues. Optimizing resource allocation is driven by multiple factors, including costs, speed, capacity, and available features. CIOs need to ensure compliance across the board and that tools are deployed timely and correctly across the board while reducing waste.

- Different public cloud vendors have different strengths and offer different tools.
- Estimates of waste go as high as being 35% of a company's cloud spending.

SOURCE:
Flexera

Multiple Challenges And Opportunities

A drastic change to the data model

Moving to a cloud-based data model requires transitioning from a relatively static pool of homogeneous infrastructure, located in dedicated data-centers and protected by a strong network perimeter, to a widely distributed fleet of dynamic infrastructure that is provisioned as-needed and with no notion of a physical host.

- On the cloud, it is practically impossible to know which physical machine is concerned by a process or application and know where the data resides.

Cost control, waste, and adequate skill sets

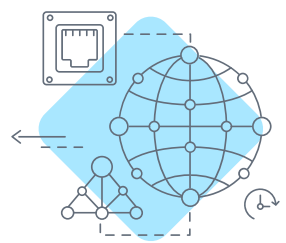
Multiplying the cloud environments on which services run increases costs due to duplication of allocated resources and the specific skill sets needed to manage differing environments.

- The skill sets required to manage Azure do not apply easily to AWS or GCP.
- Duplicating environments across different cloud providers leads to duplicating the “security buffers” (and the level of waste) within resource allocation.

Security is both better and worse

Cloud vendors provide enhanced and better-managed security layers, but hybrid architectures based on dynamic infrastructure cannot rely on old-school security mechanisms. Any server is now facing the internet, and the notion of “ring-fencing” a company’s network is not applicable anymore. Identity validation is taking over.

- Old systems based on IP addresses and firewalls become inefficient when applied to a fluid tech stack, where a virtual machine can be run anywhere.
- In a low-trust environment, identity validation becomes the easiest solution to deploy, given models are well established across organizations.



GLOBAL NETWORK

CLOUDS

DASHBOARD

DATA BASE

New Solutions Are Getting Traction

Cloud service providers will get commoditized

As companies move to the multi-cloud model, they will pick and choose providers according to their needs and optimizing the mix of services across providers. But ever more sophisticated tools will be required to ensure proper resource allocation and fine-tuning across the board.

- Tools natively designed to work across cloud environments (like Snowflake) will beat cloud-specific equivalents (such as Azure SQL, or AWS Redshift).

Intelligent monitoring becomes unavoidable

With applications running across a varied tech stack that spans multiple clouds, it will be critical to identify where precisely an issue is occurring to solve it quickly. With a complex and fluid architecture, monitoring tools need to be AI-enabled and offer native multi-cloud capabilities.

- State of the art monitoring tools (such as Dynatrace) differentiate themselves thanks to their ability to perform cross-checks across the full tech stack.

A novel security approach

With the move to a cloud-centric architecture, old “ring-fenced” security, based on firewalls and gateways around the whole network, is not effective anymore. Hybrid, multi-cloud deployment means the vulnerabilities and mitigations will need to be managed in a novel, coordinated, and coherent-across-environments way.

- Novel tools (like Crowdstrike and Zscaler) bring an individual layer of protection to each connected device in a company’s network.

Catalysts

- **Larger migration solutions.** Companies are striving for flexible options to scale their business. Many are significantly overbudget regarding cloud spending and look for optimizing and migrating their infrastructure.
- **Easier orchestration.** Multi-cloud orchestrations allow for the most performing storage and computing. In a digital world, there is no option ignoring the opportunity of such natural upgrade of capabilities.
- **Better deployment monitoring.** Optimizing deployment across different clouds allows for cost savings and reduction in redundancies. This requires adequate software solutions to properly manage and monitor the multi-cloud deployment of a company's tech stacks.

Risks

- **Competition.** Leading cloud providers have multiple options to thwart initiatives that would jeopardize their business leveraging their own infrastructure, starting by growing their own multi-cloud solutions.
- **Complexity.** The promise of multi-cloud requires fine orchestration of resources and customer engagement. Despite most companies indicating their will to implement such strategies, practical deployment requires a profound restructuring of the complete tech-stack.
- **Security.** The most controversial point in the multi-cloud strategy is ensuring security. The dynamic nature of underlying system architecture continuously provides new surface to potential attacks making it challenging for companies to ensure full security.

Bottom Line

- Multi-cloud is the next natural step for cloud computing, as companies reap the benefits of competition between cloud service providers. Every cloud has its own advantages and accessing them all allows users to leverage maximum potential. The flip-side of the coin is increased complexity in managing, monitoring and securing the whole tech stack as a single entity, providing opportunities for software providers capable of bridging the gap.
- In our AI & Robotics portfolios we have built a comprehensive exposure to the cloud segment but are shifting away from the big cloud service providers and towards value-adding multi-cloud enablers while continuing to monitor the space for new technologies and approaches.

Companies mentioned in this article:

AWS – Amazon (AMZN US), Azure – Micorosoft (MSFT US), Crowdstrike (CRWD US), Dynatrace (DT US), GCP – Google (GOOG US), Snowflake (SNOW US), Zscaler (ZS US)

WHEN AI DO DRUGS…

Revolutionizing Drug Discovery

Artificial intelligence (AI) is transforming biochemical research

AI-powered drug discovery builds upon AI advances such as Natural Language Processing (NLP) and exponential cloud computing power to enable faster screening of drugs and the simulation of biomolecular dynamics.

- AI drives a revolution in drug discovery, enabling orders of magnitude improvements in productivity (5x to 10x) and out-of-the-box ideas.
- The market for AI in biopharma should reach $3.9bn by 2025 (53% 5Y CAGR).

Accelerated drug discovery and clinical trials

Drug discovery is a competitive environment. Staying behind is not an option, and 2020 marks an inflection point in AI deployment across the industry.

- AI-powered biotechs, like Moderna and BioNTech (in our portfolios), beat Big Pharma to the punch, bringing COVID-19 vaccines to the market first.
- The industry is organizing to capitalize on the opportunity.

Supercharging the innovation engine of the industry

Deploying AI in the drug discovery pipeline is bringing attractive returns on investments and promoting the creation of fertile ecosystems.

- All major pharma companies are partnering with AI companies, boosting R&D.
- AI-powered biotechnology companies deliver game-changing productivity, supercharging the economics of drugs and treatments and offering massive growth opportunities.

SOURCE:
Deloitte, "2020 global life science outlook", Nvidia, Schrödinger

New Superpowers For Drug Discovery

Natural Language Processing (NLP)

Biomedical NLP leverages public biomedical databases, scientific literature, and proprietary structured data to anticipate outcomes without being given a priori rule.

- The exponential growth (2x every 18mo) of Medline and GenBank (the leading biomedical databases) is rapidly transforming bio-NLP into a practical necessity.
- Transformer language models (e.g., Google's Alphafold), are transforming research and applications by accelerating the prediction of molecule properties.

Computational Microscope

AI and data-centers open a new chapter in medical research, enabling atomic molecular simulations of biological macromolecules, revealing mechanisms that are difficult to observe experimentally.

- AI-assisted simulation of molecular dynamics was rewarded with the 2020 Gordon Bell Prize (achieving the simulation of up to 100mn atoms).
- Computational simulations and AI are used to augment and extend experimental datasets with molecular dynamics information (e.g., Relay Therapeutics).

Robotic laboratories

Robotic automation enables the screening of massive datasets with both in-vivo imaging and in-silico models, accelerating pre-clinical and clinical trials.

- Recursion Pharma's platform pioneers an iterative loop of "biology and bits", merging computational chemistry and several millions of experimental images.
- Most of the human genome remains undrugged (96% of all human gene targets). Artificial intelligence (in-silico) is the tool of choice for de novo drug discovery.

SOURCE:
Nvidia, Nucleic Acids Research, RecurSion Pharma

AI Revisits Biochemistry

More drug compounds than there are atoms in the universe

Computing power is now easily available and relies on accelerators which make physics calculations feasible and economically viable.

- AI-driven GPU computing is expected to achieve a 1'000x acceleration vs. traditional microprocessors in 2025.
- Such computing power enables the screening of billions of candidates and physics-based simulations to design the most promising drug candidates.

AI reconstruction opens a new era of microscopy

Cryo-electron microscopy revolutionized biochemistry in the early '80s by enabling the imaging of biomolecules inside thinly sliced cells.

- This breakthrough was rewarded by the 2017 Nobel Prize – J. Dubochet (University of Lausanne) and J. Franck (Columbia University).
- The use of AI (demonstrated by teams of the MIT and UCSF) enables the 3-dimensional reconstruction of the molecules and their motion.

AI goes where no man has gone before

Generative AI and adversarial networks have been successfully demonstrated for guessing new molecules that were not envisioned by human chemists.

- In the last 5 years, more than 20 GAN platforms (Generative Adversarial Networks) have been presented, and some are entering pre-clinical trials.
- The technology is now being applied by ApriNoia and InSilico to fields where the classical approach has failed, such as Alzheimer's Disease (AD) and other neurodegenerative diseases we discussed here.

SOURCE:
Nvidia, Insilico Medicine: a brief history of deep generative models for de-novo molecular design "Science "A molecular pore spans the double membrane of the coronavirus replication organelle", SEP 2020 Nature Methods "CryoDRGN: reconstruction of heterogeneous cryo-EM structures using neural networks" FEB 2021

Pipeline Speed From Years To Months

Identify disease targets

AI accelerates the process of compiling genome sequence data and learning from it, enabling better disease targeting and thus personalized treatment of an individual.

- AI identifies genetic markers from a sequenced genome, identifies variants (i.e., where genomes differ), and computes structural implications (molecule shape).
- 4'000 genes have experimental evidence linking them to human disease yet have insufficient structural data for traditional drug design – a potential for a 4x increase in FDA-approved drugs existing today.

Design novel molecules

Drug discovery begins with screening billions of compounds; AI optimizes the search and helps to crack the molecular structure. GANs then allow AI to experiment on compounds that may never have been researched.

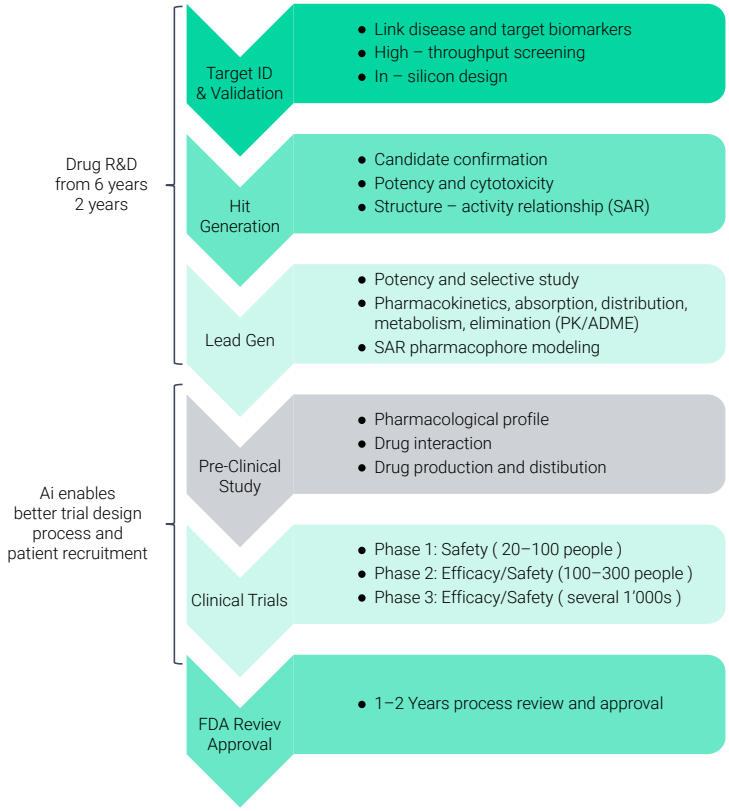
- Oak Ridge National Laboratory's supercomputer was able to screen 2bn compounds in 1 day, which would have previously required 3 months.
- Merging lots of images with X-ray crystallography, AI programs have built the COVID-19 virus' structure, enabling molecular docking experiments.

Select higher-quality candidates

Simulations of how the screened candidates interact with their target allow the selection of molecules with superior properties and better clinical outcomes.

- With traditional methods, if the molecule does not check all boxes in the lab tests, we start again, throwing away the synthesized molecule.
- Thanks to AI platforms (e.g., Schrödinger), molecules can be optimized before synthesis. This allows developers to explore many more potential candidates, avoid wasted time/money and ultimately deliver a better-quality drug.

AI IS EMPOWERING THE DRUG DISCOVERY PIPELINE AT EVERY STEP



SOURCE:
Source: Nvidia, "Entering the AI Healthcare ERA, JP MORGAN 2021"; Schrödinger annual report, ATomwise

Optimizing Clinical Trial Design

Finding the right design before entering clinical trials

Genetic variability in patients and diseases makes it difficult to optimize the patient's group composition in future clinical trials. A poor trial design could lead to statistically non-significant endpoints.

- AI can predict patients' responses based on their genetic profile and help stratify patients into the responder and non-responder group before entering clinical trials.
- NLP approaches correlate diverse databases from sequencing data to medical literature and real-world data.

Exploring the molecular data jungle

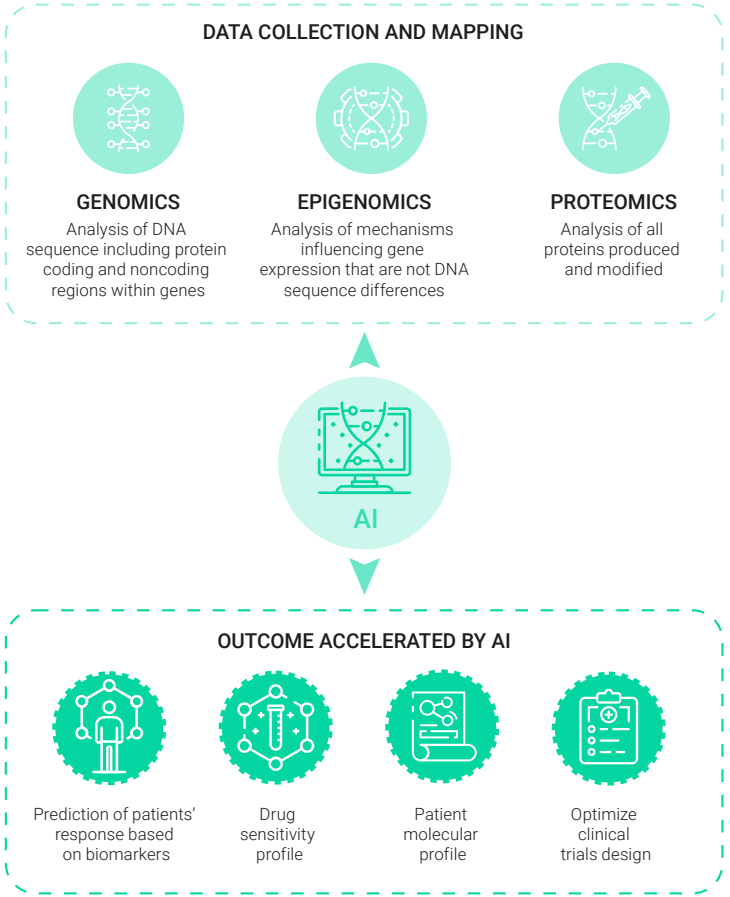
The aim is to select patients' molecular profiles that could best respond to drugs candidates by studying all available data (epigenomic, genomic, and proteomic data – see chart).

- Lantern Pharma's AI platform uses machine learning to build a map of more than 500mn data points, with a target of 1bn data points by 2021.
- From this map, they will select the top 500 genes that contribute to drug response. The prediction modules will then generate a set of predictive biomarkers, less than 50, from the 500 filtered genes.

The power of Real-World Data (RWD)

RWD will provide richer insights, as they come from a variety of sources, other than traditional trials. Using AI will leverage those data to generate real-world evidence.

- The NLP method allows efficient data extraction from unstructured sources that are often difficult to exploit (clinician notes, patient entries, social media data, etc.). The retrieved data will then be used as input into ML algorithms to make predictions.
- AI powered by real-world data is two and a half times better than a simple epidemiological study for the detection of a rare disease.



SOURCE:
Lantern white paper, IQVIA RWE

Fueling The Innovation Engine

Accelerating drug discovery

AI drug discovery was under the spotlight in 2020, helping cutting vaccine development timelines from 10 years to 10 months.

- A 2019 survey by the Pistoia Alliance found that 70% of life science researchers use AI – or machine learning – and that adoption is rapidly increasing.
- The market for AI in drug discovery alone is estimated at $2.9bn (vs. $343mn in 2020).

A massive return on investment

Currently, the cost of developing a drug is in the range of $2bn, 12 years of R&D, and a 90% failure rate. This results in low-single digit returns on investment from drug development, despite the acceleration of drug approvals.

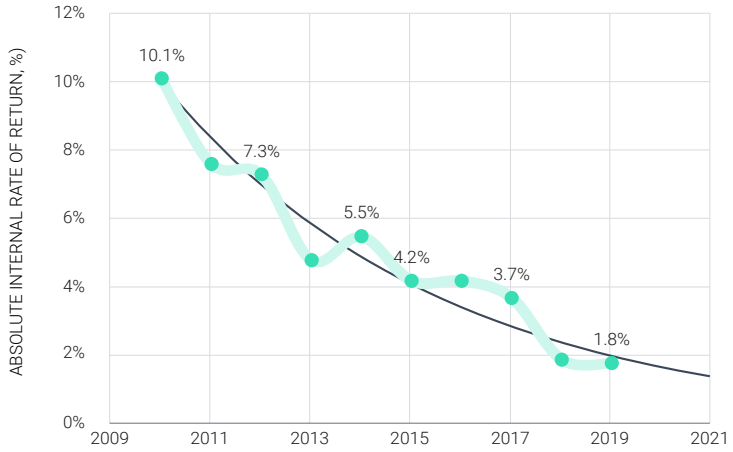
- AI can speed up drug discovery and preclinical stages by a factor of 15.
- InSilico Medicine's AI for de novo small-molecule design demonstrated a leading drug candidate in 21 days at a cost of only $150'000.

A buoyant AI ecosystem serving biotechnology

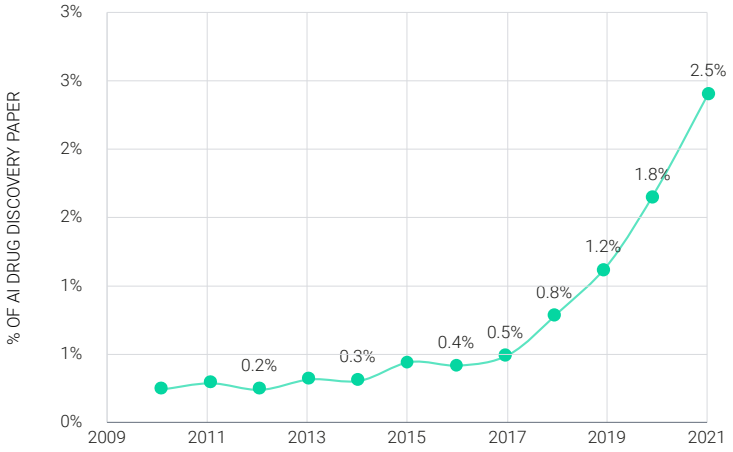
Biology is experiencing an AI moment with publications increasing >50% YoY since 2017, and this research translates into a myriad of products and applications.

- Funding for healthcare AI startups hit the $2bn mark for the first time in 3Q 2020, and two of them did IPO this year: Schrödinger and Lantern Pharma.
- Most big pharma companies are using AI for drug discovery, partnering with startups and leading cloud companies. Nvidia has grown its inception program 5x in the last 3 years, adding its 1'000th healthcare company in 4Q 2020.

UNSUSTAINABLE DRUG DEVELOPMENT RETURN ON INVESTMENT…



… CALL FOR NEW APPROACHES DRIVEN BY AI.



SOURCE:
Deloitte, "2020 global life science outlook", Nvidia, "Entering the AI Healthcare ERA, JP MORGAN 2021"CB Insights, "The state of healthcare report q3'20", PubMed.gov, InSilico

Big Pharma Partnering With AI Companies

Roche	GNS HEALTHCARE	Exscientia		
Johnson & Johnson	BenevolentAI	GENOME BIOLOGICS Accelerated Drug Development		
NOVARTIS	IBM Watson	retinai	BenevolentAI	intel
Pfizer	IBM Watson	Insilico Medicine	XtalPi	
MERCK	Atomwise	PathAI	Insilico Medicine	Numerate
SANOFI	SCHRÖDINGER	BERG	Exscientia	
AstraZeneca	SCHRÖDINGER	BenevolentAI	BERG	
GlaxoSmithKline	BERG	Exscientia		
abbvie	Atomwise	AiCure		
Bristol-Myers Squibb	PathAI	Exscientia		
BAYER	SCHRÖDINGER	Exscientia	RECURSION	

Catalysts

- **Data and processing power.** We produce more biomedical data in three months than the entire 300-year history of healthcare. New NLP models and AI-accelerated simulations are transforming how such data can be leveraged.
- **Biotechnologies under the spotlight.** COVID-19 has demonstrated the benefit of AI & Robotics applied to treatment discovery. The ecosystem is now turning to opportunities beyond vaccines.
- **Targets' validation through all phases.** The compounds selected during the discovery phases are entering clinical phases. Exscientia's first AI-created drug entered trials in late 2020 and Schrödinger's drugs will enter the clinical phase in 2021.

Risks

- **Hope or Hype.** AI is a new hope to revive the struggling small molecule business discovery model. Promises have yet to be fulfilled on a larger scale and emerging approaches are rigorously validated.
- **Regulations.** FDA and other regulatory bodies tend to lag technology innovations and the drug rigid framework might delay scaling of AI-powered processes.
- **AI implementation in complex diseases.** AI models still rarely consider biological complexity, and compound–target–effect links are still not well understood. In-silico design and simulations have yet to be confirmed by field and clinical trials.

Bottom Line

- COVID-19 demonstrated the competitive advantage offered by in-silico drug development. As the technology massively improves the R&D return-on-investment, biomedical companies are rapidly adopting AI, driving a new market of ~$4bn in 2025 (>50% CAGR) where leaders are just emerging.
- AI approaches accelerate drug discovery pipelines, from new molecular compounds down to optimizing clinical trials. Such technologies have the potential to enable a manyfold increase in FDA-approved drugs by addressing currently untapped diseases and drive the global biopharma industry.

Companies mentioned in this article:

Aprinoia Therapeutics (Not Listed), BioNTech (BNTX US), Exscientia (Not Listed), Google (GOOGL US), Insilico Medecine (Not Listed), Lantern Pharma (LTRN US), Moderna (MRNA US), Nvidia (NVDA US), Recursion (Not Listed), Relay Therapeutics (Not Listed), Schrödinger (SDGR US)

LEO CONSTELLATIONS ABOUT TO ROAR

Get Ready For An Actual World Wide Web

An actual revolution based on a technology virtuous circle

Satellite constellations promise global high-speed broadband coverage in line with modern needs. Traditional geostationary players will be disrupted by this revolution based on self-sustained technological progress.

- Unlike in the 1990s, constellations are enabled by lower launch costs and the Internet expansion, which occupies a central place in western societies.
- Their low orbit offers a significant performance gap vs. current satellite services.

No lack of contenders despite major challenges

Despite lacking a proven business model and the high barriers to entry, the segment appears to be in a gold rush with major projects by SpaceX, OneWeb, Telesat, and Amazon. But it is not said that all of them will cross the finishing line.

- Capex required is in the $5–10bn ballpark. Being integrated provides a significant competitive advantage.
- The massive number of satellites in these constellations generates great concern about the risk of space debris.

Life beyond broadband

Although broadband is under the spotlight, constellations are (and will increasingly be) used for other connectivity types, such as IoT, 5G, military, and for Earth observation.

- Start-ups Kepler and Swarm already launched several dozens of spacecraft to enable global low-latency IoT connectivity.
- Earth observation is a natural fit due to the orbit's proximity.

A Revolution In The Making

Internet: a quasi-utility

The Internet has progressively become essential to many aspects of everyday life, reaching the status of a quasi utility. Yet a vast number of people on Earth are either left in the dark or without a connection "speed" sufficient for modern usage.

- 3.6bn people in the world do not have internet access.
- 162m people in the U.S. (49% of the total population) lack broadband internet.

Constellations are part of the solution

Thanks to decreasing launch and manufacturing costs, Low Earth Orbit (LEO, i.e., < 2000km) constellations have the potential to provide global coverage with much higher chances of success compared to the ill-fated 1990s ventures (e.g., Teledesic).

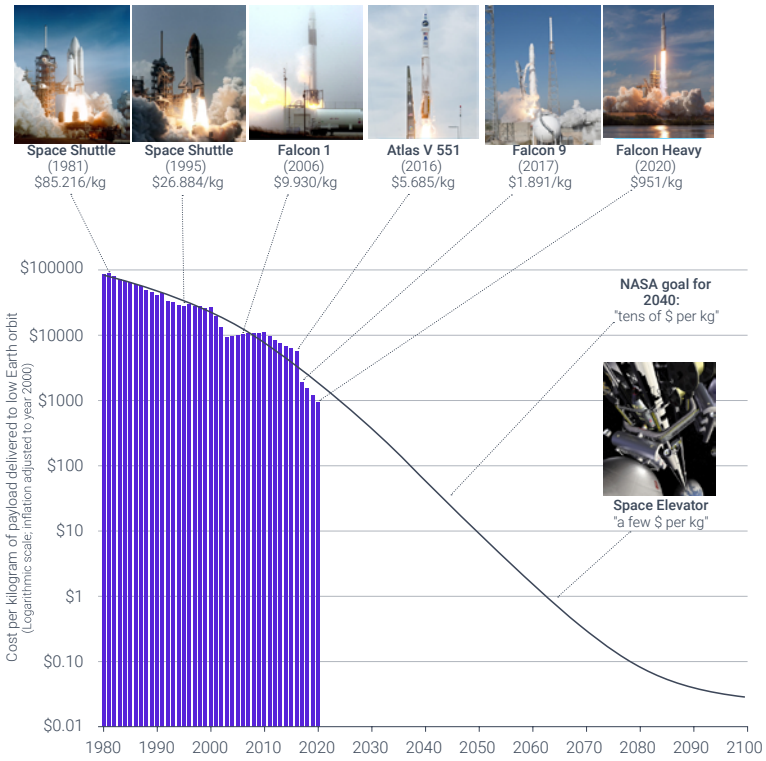
- Constellations are a network of satellites coordinated (sort of space-based telecom pylons) to provide a service, e.g., internet access, positioning, etc.
- In the case of broadband, constellations can reach several hundred satellites.

Major advantages over current satellite offering

Players such as Viasat already provide broadband services via geostationary (GEO) satellites. However, LEO constellations have the inherent advantage of lower latency and higher capacity.

- GEO satellites have an incompressible physical delay of 240ms due to the orbit height, thus excluding many applications (e.g., video conferencing, gaming).
- LEO orbit provides a theoretical structural latency inferior to 15ms.
- The higher number of satellites in a constellation also provides higher capacity.

LAUNCH COSTS TO LOW EARTH ORBIT, 1980–2100



SOURCE:
The number of Americans without reliable internet access may be way higher than the government's estimate — and that could cause major problems in 2020, Launch costs to low Earth orbit, 1980-2100, Coronavirus has exposed the digital divide like never before

The Virtuous Circle Of Technology

Same problem, different solutions

Constellations are based on small satellites, cheaper to manufacture and to launch. Higher production volumes allow to benefit from scale effect. LEO also means higher atmospheric drag and faster decay, hence regular replacement. This also leads to regular technology upgrades to cope with the latest innovation.

- Small satellites weigh less than 500kg, vs. several tons for a GEO one.
- LEO satellites' lifespan averages 5–7 years vs. 15 years for GEO.

Lasers to improve first-gen architectures

First generations adopt a "bend-pipe" architecture based on relay ground-stations. The following ones are set to use laser links, which will provide higher bandwidth, direct routing, and total autonomy concerning ground infrastructure.

- Lasers go 50% faster in space vs. fiber, thanks to vacuum.
- They can also take a much more direct route compared to ground networks.
- Constellations may therefore be able to best current fastest networks.

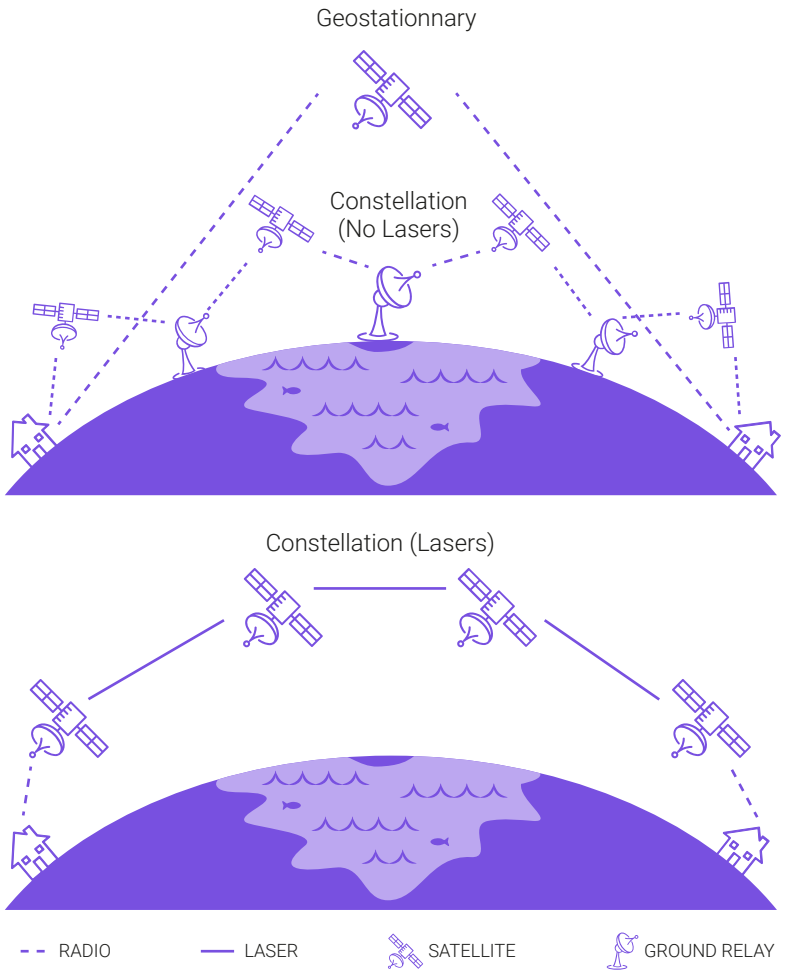
Antennas: the crux of the matter

A low orbit means high velocity for an Earth observer (orbit in ~90 minutes), hence the need to regularly switch connection from one satellite to another. As traditional mechanical antenna dishes would hardly allow it, this prompted the development of phased-array antennas derived from military radar technology.

- Antennas do not move but electronically switch between satellites.
- SpaceX's Starlink satellites cross the visible sky in ~5 minutes.
- Initial Starlink antennas were manufactured by STMicroelectronics and rumored to cost ~$2'500 a piece, with costs expected to decrease with higher volumes.

SOURCE:
SpaceX may shell out billions to outsource Starlink satellite-dish production, an industry insider says — and lose up to $2,000 on each one it sells

Evolution Of Constellations



Geostationary satellites may establish a direct connection, but with huge latency (picture not to scale).

As satellites from first-gen constellations cannot communicate with each other, they rely on ground stations (including some located on boats and islands to cross oceans) to transmit data from Alice to Bob.

Next-gen constellations with laser interlinks are independent of ground relays: all the infrastructure is located in space, guaranteeing optimal speed and latency to Alice and Bob. Radio remains in use to establish a link between the user and the satellite.

The Race Has Already Started

SpaceX: several laps ahead

SpaceX is the undisputed leader in this race. It has the biggest project, a major structural advantage by operating its manufacturing and launch infrastructure, and will be the first to propose commercial service (expected in 2021) with targeted revenues of over $30bn.

- The Starlink constellation may reach up to 42'000 satellites, of which more than 1'000 have already been launched.
- The beta already delivers latency of ~40ms vs. 640ms for Viasat, and speeds of ~80mbps vs. 25mbps.

OneWeb: back on track after an unscheduled pitstop

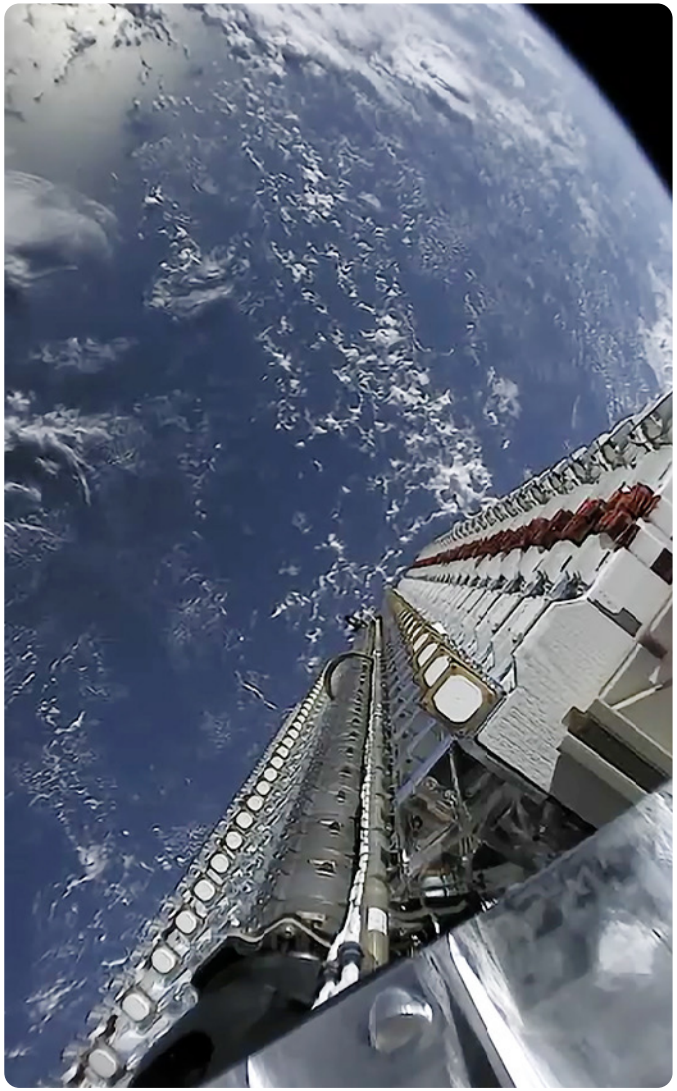
OneWeb is the challenger, although it went bankrupt and was saved by a consortium led by the U.K. government. Satellites are manufactured through a JV with Airbus and launched by Arianespace, targeting a service start in 2022.

- OneWeb's initial constellation is set to reach 648 satellites and then 6'372.
- Launches resumed in December 2020, taking the total in orbit to 110.

Telesat and Amazon: still in the garage

Telesat and Amazon have also announced projects but have yet to launch hardware. Telesat seems to be at a more advanced development stage, and a 2021 listing is planned. Still, Amazon benefits from substantial financial power and higher integration, although it will not become operational before several years.

- Telesat's "Lightspeed" constellation will initially comprise 298 satellites.
- Amazon's Kuiper project is set to reach 3'236 satellites, possibly launched on Amazon's Blue Origin rockets.



SOURCE:
PCMag Study: Starlink speed and latency top satellite Internet from Hughes and Viasat's Exede

Uncharted Territory

High deployment costs

Although the capex required to launch a constellation is much lower than in the 1990s, thanks to rocket reuse, it remains high and requires solid funding. This financial challenge already sunk or negatively impacted projects and highlights the advantage of being integrated.

- Initial cost estimates range from $5bn (Telesat) to >$10bn (SpaceX).
- LeoSat shut down due to funding problems. OneWeb went bankrupt after two launches before being rescued by the U.K. government and Bharti Global.

A business model to prove

Business models are based on subscription projections that could be proven wrong, although the initial response to Starlink seems enthusiastic. Besides, a rapid ramp-up is needed to generate the required scale effects.

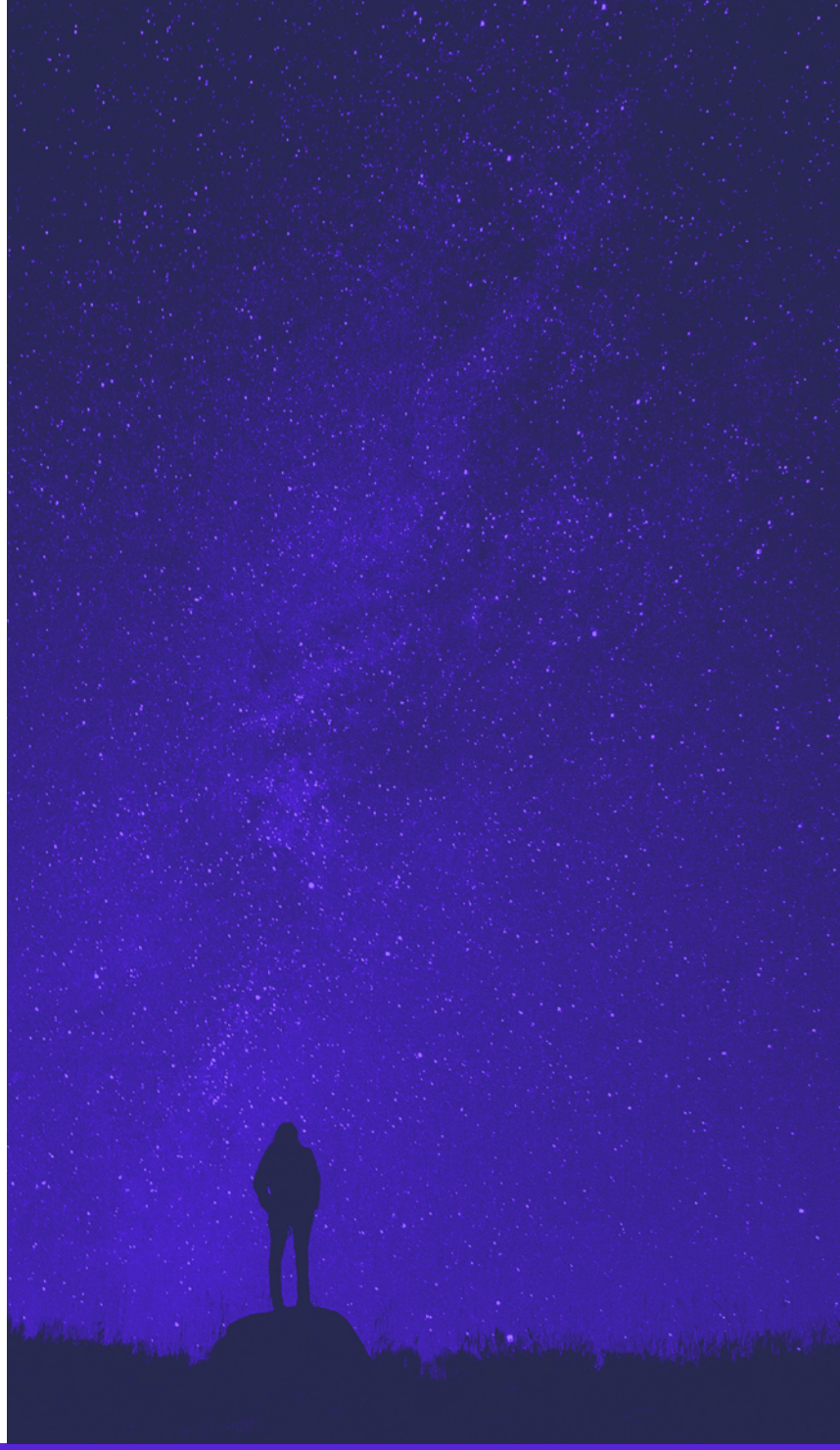
- SpaceX lost ~$2'000 per antenna dish on their beta offering, which would be unsustainable when full-scale commercial deployment starts.
- Other ventures did not communicate on any pricing yet.

The existential risk of debris

Constellations bring a steep increase in the number of orbiting satellites, therefore raising the probability of a collision and debris generation, especially as tracking so many objects is difficult and as there is no clear regulation.

- Collision could trigger chain reactions and condemn some orbits.
- ESA had to move one satellite in September 2019 to avoid a Starlink satellite.
- However, the lower orbit provides rapid natural decay: SpaceX targets below 5 years for its satellites in case of an onboard failure preventing manual deorbit.

SOURCE:
Telesat to build a $5 billion global satellite network to bring fiber-like internet to businesses,
SpaceX prices Starlink satellite internet service at $99 per month, according to e-mail



Life Beyond Broadband

Non-broadband communication

Constellations projects are not only targeting broadband communication, but also Internet of Things and 5G. Such projects may bring major developments to current industries thanks to their lower costs compared to current solutions.

- Iridium already provides IoT connectivity and global tracking.
- Constellations could dramatically increase network capacity and lower costs.
- Projects by Kepler or Swarm already launched several dozens of satellites.

Military already onboard

The military showed great interest in high-speed global connectivity projects, either for data transmission or to enhance battle situation awareness. Several projects have already been announced, with both civilian and dedicated infrastructure.

- The U.S. Army has signed a 3-year partnership with Starlink to test the system.
- The U.S. Space Development Agency has initiated a constellation project to track hypersonic weapons launch on a global scale.

Earth observation, a natural fit

Earth observation is a natural field for constellations. The lower orbit enables more detailed pictures or lower optics size at iso-details, as well as several passages per day over a given point to provide extensive coverage.

- Players such as Planet Labs, Spire Global, or Iceye have already launched several hundred satellites.
- They provide not only visible imaging but also radar and thermal one.

SOURCE:
SpaceX and US Army sign deal to test Starlink broadband for military use

Catalysts

- **Post-covid world.** COVID-19 is likely to have a lasting impact on remote work. This may lead to population moving towards less populated areas, currently underserved in terms of broadband, fuelling demand for constellations.
- **Technological progress.** The improvements in key technologies, such as flat-panel antennas, will lower the infrastructure rollout costs and increase the attractivity of the constellations offering.
- **Lower launch costs.** Launch costs account for most of the rollout costs and have been decreasing steadily, especially since the rise of SpaceX. The arrival of new launchers, either from SpaceX (Starship) or other players (Amazon's New Glenn), could further compress costs.

Risks

- **Investment cliff.** Capex required to launch the infrastructure are in the $5–10bn ballpark, which forces constellation players to rely on external funding. If funding were not to be secured due to an economic downturn, bankruptcy would be immediate (e.g., OneWeb).
- **Market size.** Constellation ventures do not have a proven business model yet. The market could ultimately be smaller than expected, either on a structural basis or due to non-competitive pricing.
- **Regulation.** Constellations benefit from a relative lack of regulation, especially when it comes to collision management and end-of-life servicing. This would change in the event of a collision, which would certainly accelerate an increase in regulation and public scrutiny.

Bottom Line

- LEO constellations are giving a new life to the space race. Current projects now benefit from lower launching costs and better technology compared to their predecessors, as well as from the central place internet has taken in people's lives. Although business models have yet to be proven, and project failures have already taken place, the public response to initial service betas has been massively positive. This suggests strong market demand and announces a new era of global broadband connectivity.
- LEO constellations have the potential to be a game-changer for many industries (e.g., the $1.75tn telecom industry), as well as pave the way for uses beyond broadband. We have been building exposure in our portfolios to this attractive segment of Space and are looking for expanding it across the value chain.

Companies mentioned in this article:

Airbus (AIR FP), Amazon (AMZN US), Bharti Global (not listed), Iceye (not listed), Iridium (IRDM US), Kepler (not listed), OneWeb (not listed), Planet Labs (not listed), SpaceX (not listed), Spire Global (not listed), STMicroelectronics (STM FP), Swarm (not listed), Telesat (not listed), Viasat (VSAT US)

CHARTS FOR THOUGHTS

A Wave Of Liquidity

U.S. Treasury to release a great wave of liquidity

The U.S. Treasury operating balance is used to ensures enough liquidity is available to cover urgent needs if refinancing markets should come to a sudden stop. After a rapid expansion due to COVID-19-related measures, Treasury is now targeting a reduction in its total operating balance, from the current $1.6tn to $800bn by the end of March and $500bn by the end of June.

- Practically releasing more than $1tn in cash over the next few months.

Compounding or diluting the next stimulus plan?

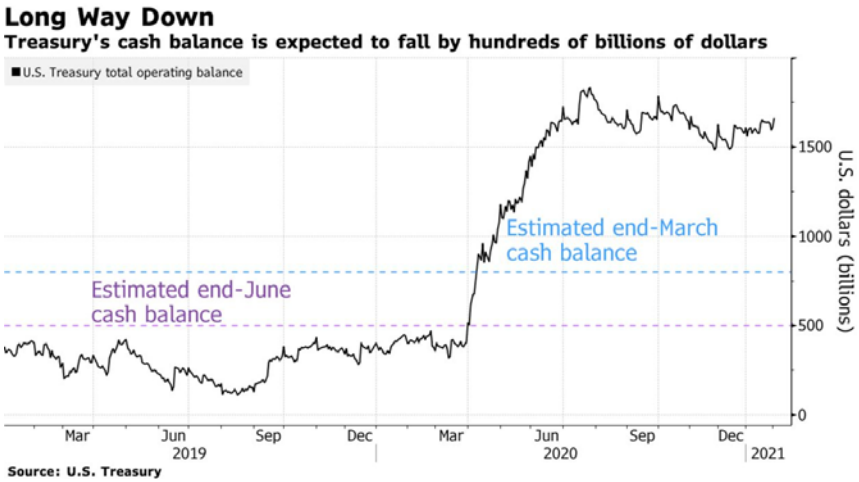
Biden is proposing a $1.9tn stimulus plan. If the stimulus plan gets fully approved, the spending will actually « help » the treasury reduce its operating balance. But using the available operating balance to execute the expenditure of the stimulus plan may reduce its financial impact.

- Reduced money creation, as it will only be a transfer of existing funds.
- The transfer will be mainly towards economic operators (taxpayers) who will have limited access to leverage for these funds.

A supply squeeze in T-bills?

If the stimulus plan will not be fully approved, the U.S. Treasury is likely to reduce the issuance of short-term bills (0–3 months), reversing last few months' extra-issuance. The resulting supply squeeze may impact the short side of the yield curve, pushing interest rates even lower.

- T-bills usually represent ~20% of overall debt but currently are at 24%.



SOURCE:
U.S. Treasury, U.S. Plans Record Debt Sale; No Big Changes Before New Stimulus

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