Borders

From Cyberspace to Outer Space

International Politics in Seemingly Boundless Spaces

Frank Sauer

The earth has not been a suitable projection screen for the idea of boundlessness for some time. In humanity's search for spaces without boundaries, our eyes turn to the stars on the one hand and to the virtual world on the other. But to what extent are these spheres really free of boundaries?

Introduction

"Space: the final frontier. These are the voyages of the starship Enterprise. Its five-year mission: to explore strange new worlds, to seek out new life and new civilizations, to boldly go where no man has gone before." These are the words at the start of the opening credits of the 1960s TV series Star Trek. Broadcast in an era when Western-themed shows attracted the largest viewing audiences, Star Trek confounded people's low expectations by not only successfully transferring the settler motif of the adventurous covered wagon train, which is part of the U.S. foundation myth, into space, i.e. pushing the boundaries not towards the terrestrial west but towards the stars. The TV fiction also succeeded in overcoming political and social boundaries – from the first TV kiss between a white man and an African-American woman to the peaceful collaboration between Russians and Americans aboard the Enterprise. Space as a domain free of conventional earthly restrictions and boundaries – this vision if nothing else, is what made Star Trek so popular.

But outer space is not the only projection screen for the idea of limitlessness. Cyberspace is one as well. The term cyberspace, coined by science fiction writer William Gibson and still somewhat obscure in the 1980s, has experienced a meteoric rise in usage since the 1990s and in parallel with the proliferation of the Internet infrastructure. Today, "cyber" is not only a common term, it almost seems as if life would be impossible without the virtual information space established by networked computers and software that envelops practically every area of people's lives in the OECD world and is being used by almost half the global population. Does this mean that there is now a second boundless space besides outer space, created by humankind itself?

Reality is more mundane and significantly more complex, as this essay will demonstrate. The author will attempt to illustrate some illuminating parallels, in broad brush strokes and with no claim to completeness. As will become apparent, the main conclusion is that both spaces are less boundless than it first appears – or than had been hoped. In both spaces, boundaries have been and still are being fought over continuously and by rigorous means, either to set them or to eliminate them. Boundaries are being shifted, new boundaries are being set, and old ones are being blurred.

Shifting Boundaries

… *in Cyberspace*

Cyberspace is expanding. For instance through the World Wide Web, which has developed as an additional usage layer atop the Internet infrastructure. Today, the WWW provides access not only to websites as in the beginning of the Internet era, but also to many more – and novel – web-based services that, for example, enable and facilitate communication and consumption in the online world in all manner of ways. Then there are of course email and the innumerable other services available via computers and smartphones, which all rely on packet-based data transmission via the Internet.

Another factor boosting the expansion of cyberspace is the soaring number of connected devices. These have become so numerous that the address range made available with Internet

Protocol v4 (IPv4) – a fundamental technical pillar of the Internet – has become too small. Almost all of the some four billion possible IPv4 addresses have already been allocated. So in order to be able to connect and network more phones, vehicles, traffic lights, TV sets, refrigerators, washing machines, door bells and the like, i.e. make them "smart" and go "online", changeover to IPv6 is currently taking place, which should provide the coming Internet of Things (IoT) with around 340 sextillion addresses – thereby offering sufficient scope for cyberspace to keep expanding its external boundaries for the foreseeable future. The Internet of Things will open up many new opportunities to make life more comfortable, but also create new vulnerabilities – a subject to which we will return later.

Self-driving means of transport and autonomous weapons systems have made the transition from science fiction to reality long since.

The importance of cyberspace will also continue to increase, becoming embedded ever more deeply in people's lives and everyday experiences. Current developments in the fields of machine learning and artificial intelligence as well as robotics make it likely that the link between networked infrastructures, learning algorithms and the use of Big Data will have effects in many social spheres that will be both fundamental and ambivalent: Self-driving, networked means of transport, which can transport goods and people more efficiently and promise to dramatically reduce the number of accidents, but at the same time destroy the jobs of millions of people who currently earn a living by driving vehicles; personal care robots, which close supply gaps, but lack a human touch and cannot give affection; autonomous weapons systems run by algorithms that make life and death decisions on the battlefield, possibly more accurately than humans could but at the price of the total loss of meaningful human control. There are plenty of other examples that could be cited.

As cyberspace grows and increases in significance, the way people perceive and experience it will change as well. Virtual reality headsets, that can now be bought by anyone for a few hundred

Kiss in space: The television series Star Trek overcame societal boundaries in the 1960s.
Source: © PictureLux, picture alliance.

euros as a peripheral for a PC or a games console, were still in the realm of science fiction in the 1980s. The outer boundary of cyberspace has thus not only drawn nearer within the horizon of our experience, it is now also more permeable so that becoming immersed in it has not only turned into an ever simpler and more mundane but also – with the aid of virtual reality – more intense experience.

… *in Outer Space*

The boundaries of outer space are not static either. According to the currently accepted theory of the Big Bang as the origin of the universe as well as the analysis of light from very distant cosmic objects, which match the prevailing interpretations of the cosmic background radiation, one must assume that the universe

is not only expanding, but that this expansion is continuously accelerating. What we can still only speculate about is what the universe and space-time as we know it is expanding into: literally nothing or some kind of hyperspace as a medium that itself hosts other universes?

An easier idea to grasp is that the human horizon of understanding in this our known universe has undergone a breathtakingly rapid expansion within an astonishingly short period of time considering the length of human evolution. There were only a few centuries between the Copernican Revolution and the development of the Hubble Space Telescope, which is taking us closer to objects over 13 billion light years away and thereby allowing us to look far back in time, into the very early universe. Very much in the spirit of the Enterprise, we have thus extended our curiosity and visual capability far into the depth of space and are seeing things that no human has seen before.

On a cosmologically far smaller scale, namely within our own solar system, humanity is once again keen to expand its sphere of action. New missions to the moon, but above all further unmanned and manned trips to Mars have gone

Ambivalent progress: Technological developments, such as in the field of robotics, are often thought to be both a blessing and a curse. Source: © Michael Buholzer, Reuters.

back on the agenda since private actors, particularly from the USA, have injected fresh momentum into manned space travel – #gyatm (get your ass to Mars) is one hashtag in this vein, popularised by Buzz Aldrin on Twitter. The entrepreneur Elon Musk with his company SpaceX has even more ambitious plans; he wants to use the window of opportunity that is currently opening up in human history to establish a permanent human presence on Mars, making humanity a multi-planetary species – before a natural or manmade catastrophe may cause humanity to drop back to a lower level of technology.

Particularly in the USA, private actors are injecting fresh momentum into manned space travel.

The limits of what is technically possible in space are also shifting. Just to mention the most recent example, there have been increasing indications of the technical feasibility of electromagnetic drives lately, which would need no chemical propellant but only a power source such as solar cells, thus opening up entirely new space travel opportunities due to a lack of fuel no longer being an issue. Finally, it has become easier than ever before to overcome the most immediate limiting factor for space travel, namely the earth's gravitational pull, and enter earth orbit. Microsatellites are allowing teams of students from numerous European universities to take part in project Space Travel with projects of their own. But the themes of overcoming and shifting are not the only ones we encounter with respect to the limits and boundaries in outer space and cyberspace.

Setting Boundaries

... in Cyberspace

In the beginning, packet-based data transmission via the Internet was purely a research project, and all the scientists involved knew each other personally. Even a few years later, all the people connected to the Internet could still be listed in a type of telephone directory and identified. In this young ecosystem, security was consequently not an issue; the infrastructure on which the Internet is built was never designed for all the sensitive types of information that are routinely exchanged online these days. The Internet therefore needed to have several layers added to it, for instance for the encryption of connections. The fact that laborious and costly "security by design" played no role when the Internet was first set up made for rapid popularisation and democratisation, but it also had some negative consequences manifesting in its commercialisation and militarisation. Today's cyberspace is therefore characterised by extreme ambivalence.

Technically, the Internet would have made it possible to offer any artistic product to the general public online, but that would have required new, alternative remuneration models to be set up. Instead, the (payment) boundaries have been drawn in a considerably more conventional manner; users are finding themselves in a disjointed landscape of incompatible streaming services and subscription models, including concepts such as geo-blocking, with which Internet companies seek to limit the availability of their content to certain regions, totally against the original concept of an open Internet. Today, anyone looking at the Internet from a commercial perspective sees anything but a space without boundaries where content is freely available to all; instead we see walls, namely the paywalls of the major content providers.

Conversely, the fact that sensible payment models were lacking for too long and users quickly became used to having access to online media for free has led to an underfunding of quality journalism, whose considered and well-balanced output based on solidly researched fact we now miss so badly among the cacophony of the social networks, twitter bots and fake news generators in the democratic public sphere. And it is the majority of these users in particular who not only relinquish their privacy to social

network platform providers, but also set the boundaries of their filter bubbles so narrowly that they effectively enter an echo chamber of opinions and never leave their comfort zone. This is in contrast to the originally envisaged scenario where people were expected to open up the online newspapers of this world in the morning with an unprejudiced mind, seeking to participate in a global debate that was conducted openly and widely among the citizens of the world. There is no doubt that the advent of cyberspace has accelerated business, the flow of information and communication and opened up innumerable new possibilities. But after an initial Wild West phase, many of the familiar boundaries from the offline world are now re-emerging in cyberspace.

Cyberspace presents an extremely ambivalent picture where security and commerce are concerned.

Cyberspace presents an extremely ambivalent picture not only from the commercial but also from the security perspective. On the one hand, citizens have a legitimate interest in government protection from the dangers emanating from cyberspace – one case in point is the protection of critical infrastructures that are indispensable for the functioning of modern societies, such as the power grid. Thus there is an understandable interest in boundaries being set up and protected – they are more akin to protective barriers in this case. On the other hand, excessive state monitoring in cyberspace jeopardises fundamental civil rights and has a chilling effect on the free expression of opinion. Silenced dissidents in Russia or Facebook's kowtow to the Chinese Internet censorship apparatus bear witness to the fact that cyberspace is no longer a sphere of limitless freedom of opinion, if it ever was. And online communication did not only help to spur on the Arab Spring in countries like Egypt, but also made it easier for state organisations to identify and crack down on demonstrators. In fact, it is oftentimes – and ironically – the power of the nation state, which many had prematurely declared obsolete, that is setting and enforcing boundaries in "boundless" cyberspace after all.

... in Outer Space

National governments are also eying up space once again with greater determination; not only out of scientific enthusiasm, but also because there are solid commercial interests at stake, as illustrated by recent news headlines from the USA. The 2015 U.S. Commercial

Cyber warriors? Devastating attacks, for instance on an adversary's critical infrastructure, are now theoretically possible from a single laptop. Source: © David Gray, Reuters.

Space Launch Competitiveness Act gives private actors the right to prospect in space. There are already some U.S. commercial enterprises such as Moon Express and Planetary Resources that are hoping to mine for water and other raw materials on the moon or on other celestial bodies such as asteroids. Whether such national legislation can be reconciled with the international Outer Space Treaty that came into force in 1967 is a highly controversial question. Put simply, that treaty declares outer space a commons. States cannot claim ownership of or in celestial bodies. But the treaty does envisage their use for peaceful purposes, potentially also by private actors. One thing that has not been conclusively determined is whether the new U.S. law can grant private companies the right to act in space in analogy with what applies to fishing in international waters on earth. According to the U.S. government's legal viewpoint, it is entitled to unilaterally assign commercial ownership in resources extracted from celestial bodies, if not ownership in the bodies themselves. But this interpretation of current international law is not shared outside the USA; and with the curious exception of Luxembourg, no other state is following a similar course.

Future battlespace? In order to balance the U.S.'s dominant position in space, China has now also positioned itself militarily. Source: © NASA Visible Earth, NASA/JSC.

The simultaneous development of very different, partly opposing trends in cyberspace – for instance online censorship and mass surveillance on the one hand, abuse of the freedom of speech in the form of fake news and hate speech on the other – is indicative of the lack of direction in humanity's search for the right course. And the attempt to stake claims in outer space is also a development whose outcome remains to be seen. One danger affecting both spaces, however, is already clearly written on the wall: the erosion of certain boundaries that are currently still in place, whose disappearance – or even just blurring – will entail considerable security risks.

Blurring Boundaries

... in Cyberspace

As the Pentagon had done back in 2011, the German Federal Ministry of Defence has recently declared cyberspace a separate domain of warfare, meaning that it is treated on a par with land, sea, air and space. For the Bundeswehr, this entails extra investments of a billion euros and setting up a new cyber force comprising 13,500 soldiers and civilians beside the Army, Navy, Air Force, Medical Service and the Joint Support Service responsible for logistics.

This build-up of capabilities is described as a defensive measure. However, policy guideline documents indicate that the Bundeswehr does maintain some offensive capabilities as well. There have been reports of the Bundeswehr having gained unauthorised access to the network of an Afghan telecommunications provider on one occasion already, which some observers criticised as illegitimate, offensive conduct. Developing protective and defensive capabilities clearly represents an urgent duty for state institutions. But where the future approach to the potential military use of "effectors" in cyberspace is concerned, particularly those that can have a physical (or "kinetic") impact, German security and defence policy is still in flux. While the new White Paper treats cyberspace as a key area to focus on, relevant practices, rules and limitations are yet to be established and exercised.

Against this backdrop, one needs to bear in mind one specific pitfall, which could result in no-holds-barred confrontations in cyberspace, potentially undermining international stability and jeopardising the safety and wellbeing of the civilian population in particular, namely the impending blurring of the boundary between the civilian and military spheres. Dropping graphite bombs on a substation to interrupt the electricity supply could serve a military purpose, but would have a disproportionate impact on the civilian population – which would then at the very least prompt open criticism and a political backlash. The same effect could now, in fact, be achieved from cyberspace – anonymously and without any risk to one's own armed forces. Anonymously because the so-called attribution problem means that the origin of activities in cyberspace can almost never be pinpointed with certainty.

The implications of the attribution problem are threefold. Deterrence is mostly ineffectual in cyberspace because it is unclear to whom the threat of retribution should be addressed. Self-defence becomes more difficult because, under international law, this needs to take place directly after the attack to be able to distinguish it from illegal retribution. And finally, and most importantly, anonymity and deniability of responsibility may well increase the temptation to embark on the proverbial slippery slope and include critical infrastructure, such as power grid components, as targets of military strikes, with corresponding negative consequences for the civilian population.

Indications of a threatening militarisation of space are proliferating.

In line with a responsible policy compliant with international law, the only possible response for now is for each country to focus on the resilience of its own networked systems and to act with prudence and restraint towards other countries. In light of this challenge, the principle of distinguishing between the civilian and the military spheres and the proportionality of military means enshrined in international law will need to be confirmed and strengthened to fend against military operations potentially crossing the line and to reinforce the rules of the modern laws of war, which are generally held to apply in cyberspace as well.

... in Outer Space

Humankind is one step ahead where space is concerned, at least in terms of the legal situation. The parties to the Partial Test Ban Treaty of 1963 agreed not to conduct any nuclear weapons testing in space. As early as 1959, the Committee on the Peaceful Uses of Outer Space had been founded at the United Nations level. Its work produced the above-mentioned Outer Space Treaty in 1967, which bans all weapons of mass destruction in space and generally condones only peaceful use of space. Nevertheless, indications of a threatening militarisation of space are proliferating.

The USSR and the USA already experimented with space weapons, i.e. weapons whose reach

extends into earth orbit or could be aimed at terrestrial targets from there, back in the days of the Cold War. In 2007, China shot down one of its own satellites with a missile almost 900 kilometers above the earth. This gave a clear political signal: the "People's Liberation Army" considers space weapons a balancer to the USA's superiority in space and a means to safeguard China's regional and global ambitions and its One China policy. Statements by high-ranking U.S. military representatives confirm that without support from its satellite network the U.S. military would, in fact, be virtually disabled. Concerns about a potential loss of the U.S. military space capabilities run so deep that U.S. Navy cadets have recently had to start practicing using a sextant for navigation again – in preparation for a potential failure of the GPS system. The USA responded fairly swiftly to the Chinese shooting down their satellite by "removing" a U.S. spy satellite that had veered out of control with a U.S. Navy missile in 2008. Due to the lower orbit of that satellite, the space junk produced by the strike burnt up more quickly than that from the Chinese strike, but it once again brought home the problem of space debris in earth orbit resulting from military activities as one of the main dangers of space militarisation.

Debris is a dangerous threat to space travel. Due to their enormous velocity, even the smallest particles can penetrate satellites or other man-made objects in orbit. Particles larger than one centimeter can cause critical damage, and those measuring ten centimeters or more would totally destroy a spacecraft such as the Space Shuttle. The only possible course of action to overcome the problem besides shielding and hardening is the accurate locating and tracking of the pieces of space debris and taking evasive action to get out of the way of objects on a dangerous trajectory. There have been a number of occasions when the International Space Station has had to make these kinds of evasive manoeuvres in the past. Space debris, such as that produced by the Chinese and U.S. missile strikes on the satellites, remains in space for 25 years or more and will therefore represent a danger to the use of space for the foreseeable future. But life without the peaceful use of space is virtually unimaginable in the modern age: communication, transportation, trade, navigation – not only the U.S. military but large parts of civilian life on earth would grind to a halt were the satellite systems to fail.

Against this backdrop, experts have been warning for years against a discourse that portrays the militarisation of space as a virtually unavoidable extension of the terrestrial security dilemma. After all, judging from the current state of technology, such a stance is not justified. Instead, there is still sufficient time for preventive arms control measures; taking such measures would be a sensible course of action and very much in the interest of particularly those nations engaged in space exploration.

Concluding Thoughts

There is no absence of boundaries either in cyberspace or in outer space. Boundaries are a permanent human legacy. But deciding how these are to be established in the two spaces in concrete terms, which new boundaries are to be drawn and which existing ones may disappear will require a continuous process of political negotiation. Would the total absence of boundaries actually be desirable? This essay has put forward the view that some boundaries can be good and beneficial. The boundaries set by international humanitarian law, for instance, learnt from history and hard-won, are worth keeping to preclude unfettered military action in wartime.

That some boundaries are worth having applies particularly as outer space and cyberspace are indispensable to humanity as well as more fragile than ever. These days, with cyberwar and space weapons having moved from science fiction to reality, peaceful use of these two spaces demands greater attention and political backing. The risk of an escalation in space and the consequences of excessive quantities of space debris run counter to the interests of all of humanity, which is dependent on the use of space. And with the advent of the Internet of

Things, we are entrusting the functioning of key parts of our societies – just think of "Industry 4.0" for business or "digital voting" for our political system – to a digital infrastructure that is becoming ever more vulnerable to disruption. In that respect, many experts saw the massive attack by the Mirai botnet consisting of IoT devices in October 2016 as a portent of things to come.

Against this backdrop, the key actors involved in the political negotiation processes concerning boundaries in outer space and cyberspace would be well advised to exercise greater military restraint and great prudence with regard to business and Internet governance policies. After all, it is of paramount importance to retain and expand access to both spaces as well as ensuring their continued effective functioning for the benefit of the whole of humankind. As an inspiration for further exploration of this vision you could do worse than to take another look at the Star Trek universe.

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