

Why the Discovery of the Overlapped Multiplexing Principle is Bound to Cause a Revolution in Communication and Information Technology?

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Abstract—This article firstly introduces the overlapped multiplexing principle discovered by Prof. Daoben Li, and the new channel capacity derived from it, which is far beyond the capacity of Shannon's channel, and then introduces the characteristics and superiority of the waveform coding theory and the brand-new communication system, OVXDM, which is the cornerstone of his work. The article exposes two paradoxes and major errors of Shannon's information theory that violate the basic principles of physics, and makes predictions about the future development of communication and information technology. It criticizes several erroneous views on the development of 6G mobile communications: 6G should move to millimeter-wave terahertz band, the only means to improve the spectral efficiency of mobile communications is ultra-large-scale MIMO, and exposes that the U.S. Starlink and StarShield satellites can realize the global Internet 6G communications when the deception, the essence of which is the seizure of space resources and maintenance of the U.S. space hegemony. He emphasizes the great advantage of overlapped multiplexing waveform coding over Shannon coding, and points out that the Internet is only a network built under the guidance of the old Shannon multi-user network theory, which is as outdated as Shannon's information theory and should be eliminated. The Internet and GPS are the kingpin espionage tools of the United States to control the global information hegemony and steal information from other countries. In order to abandon the U.S. information hegemony, our country must leave the GPS in addition to the Internet! Under the guidance of the theory of subversive overlapped multiplexing multi-user network, the author puts forward suggestions on the establishment of our country's independent ultra-large-capacity wide-area Ov information network, which is a brand-new integrated network including space, sky, ground, ground to underwater, underwater and other

categories, with a capacity much higher than that of the Internet.

FOREWORD

This paper introduces the new principle of Overlapped Multiplexing (Ov) discovered by Prof. Daoben Li after more than 40 years of observation in the field of communication and information, according to which Prof. Li overthrew Shannon's channel capacity and derived a new channel capacity (Ov capacity for short), and laid the foundation of Ov redundancy-free overlapped waveform coding theory and a brand-new communication system - OVXDM (Overlapped X-domain Multiplexing). OVXDM has been repeatedly and independently simulated and verified by thousands of people in many organizations for more than 20 years, which has completely confirmed its amazing performance of overturning Shannon's theory and the correctness of Ov theory.

As we all know, the guiding theory of all present-day technologies in the field of information, such as communication, cryptography, information security, anti-jamming communication, confidential and covert communication, and multi-user network transmission, etc., is Shannon's information theory. Shannon channel capacity is recognized as one of the three most famous formulas of the 20th century, $C = B_{nai} \log(1 + P_S / P_N)$, where C is the channel capacity, i.e., the theoretical maximum transmission rate (in bits per second, bps/Hz), B_{nai} is

the system Nyquist bandwidth (in units of Hz), P_s/P_N is the received signal-to-noise ratio, P_s is the received signal power, P_N is the received noise power. $\eta=C/B_{nai}$ is the insurmountable spectral efficiency (in bits/sec/Hz, bps/Hz), the noise power spectral density is $N_0=P_N/B_{nai}$, the received bit energy is $E_b=P_s T_b$, T_b is the bit duration, and the received normalized signal-to-noise ratio is $\frac{E_b}{N_0}=\frac{P_s}{P_N} B_{nai} T_b$. Because the Ov principle is different from Shannon's theoretical basis, not only is the Ov capacity dramatically higher than Shannon's capacity, but the face of all other information domains should change dramatically as well.

I. THERE CAN BE NO DISRUPTIVE TECHNOLOGY WITHOUT DISRUPTIVE THEORY

For example, the theory of nuclear fission and nuclear fusion produces atomic bombs, hydrogen bombs and new sources of nuclear energy, Maxwell's equations produce wireless communications, and Kao's theory produces optical fiber communications. The Ov capacity derived from the Ov principle and the non-redundant overlapping waveform multiple-access coding theory based on it will also cause a revolution in communication and information technology.

II. THE LAWS OF THE OBJECTIVE PHYSICAL WORLD ARE EQUALLY UNIVERSAL

Objective physical world laws are compatible and universal, science is to explore the study of the regularity of the objective world of learning, the core of science is mathematics, mathematics is the queen of science, is the science of science, the laws of the objective physical world are to be described by mathematical laws. For example, Einstein's general theory of relativity from the Riemann geometry, modern fiber optic communications from the Kao mathematical theory, Shannon information theory from the laws of thermodynamics of physics found proposed, Ov channel capacity is both from the thermodynamics of physics, but also from the laws of physics of the

building and transportation, they have precise mathematical form of expression.

III. TWO PARADOXES OF MODERN COMMUNICATION THEORY

Shannon information theory since it is generated from the thermodynamics of physics, should also comply with the other laws of physics, although it has guided the development of communication technology for nearly 70 years, communication technology under its guidance has indeed had a significant development, but Professor Li found that it which the two major paradoxes, which seriously hindered the development of communication technology, respectively:

- No overlap between neighboring and connected data symbols is allowed in time domain, frequency domain, airspace, or a mixture thereof, or serious "interference" will occur, deteriorating system performance.
- Shannon Channel Capacity: For a given system bandwidth B_{nai} and noise power P_N , the system capacity C (in bps , i.e., bits/second) grows at least exponentially with the received signal power P_s (the velocity of propagation of the vacuum and atmospheric dots dialed is the speed of light).

Architecture in physics points out that the basic construction of the close bite (overlap) will make the building more tough, such as China's famous Zhaozhou Bridge and the Forbidden City and other ancient buildings due to the components of the clever bite, after more than a thousand years of testing and domestic and foreign simulations to verify that they are able to withstand than the strongest earthquakes that have appeared on the earth more powerful earthquakes. Accordingly, the overlap (occlusion) between neighboring and connected data symbols in time, frequency, space and their hybrid domains of the basic building blocks (data symbols) of digital communications should not be worsened, but rather enhance the system's immunity to interference. Obviously, Shannon's information theory is contrary to the laws of construction belonging to physics.

Communications and transportation systems are essentially the same except that one transmits goods and one transmits data bits! According to the physics of transportation, the capacity of a transportation system (in tons/hour) grows at most linearly with its traction power for a given road (similar to the bandwidth and noise of a communication system) and handling speed. Shannon's information theory, however, requires that the capacity of a communication system (in bits/sec/Hz) grows at least exponentially with the received signal power. Why is there such a huge difference between two systems that are essentially the same? Clearly Shannon information theory again contradicts the laws of transportation which belong to physics.

IV. MAJOR ERRORS IN MODERN COMMUNICATION THEORY

A. *Using level splitting or waveform splitting?*

Shannon theory relies on different signal levels to distinguish data. It is well known that it cannot be separated from multi-level tuning to constellation diagrams, such as QAM constellation diagrams, in order for a given Nyquist bandwidth of a data symbol to hold K bits of information, there must be at least 2^K levels (number of constellation points) within the constellation diagrams, such as $K=4$ with 16QAM, $K=12$ with 4096QAM, etc. Thus, in an average power constrained channel, as the desired spectral efficiency increases, the minimum distance between the constellation points (minimum interval of levels) will decrease exponentially, and as soon as the noise level exceeds half of the minimum interval of the constellation points (signal levels), the received data judgment will be wrong. This is the reason why the capacity (spectral efficiency) of the Shannon system grows exponentially with the received signal power.

On the other hand, Ov theory, relies on different signal waveforms to distinguish data. It is well known that in unusually noisy environments, one can still distinguish between very many very weak signal waveforms by utilizing the inherent characteristics of the different waveforms, which is the fundamental reason why the Ov capacity

(spectral efficiency) requires far less received signal power than the Shannon system.

B. *Is redundant or non-redundant waveform coding used?*

Shannon only gave theoretical capacity bounds, i.e., he only proved the existence of approximation to his capacity bounds, and did not give encodings (constructivists) to approximate his capacity bounds. Therefore, more than seventy years after Shannon's information theory, people have been constantly trying to explore various channel coding methods that approach Shannon's bound, but the results are not very effective. Shannon pointed out that the channel coding intelligence by increasing the "redundancy" to reduce the effective bit transmission rate to realize. In coded sequence, "redundancy" is the increase in parity check bits; in coded modulation, "redundancy" is the increase in constellation space. The ratio of the useful space to the coded space is the code rate r .

The ratio of the number of data bits to the number of data plus supervisory test bits in a coded sequence is the code rate r , and the additional supervisory test bits are the "residual" bits; the useful data space for coded modulation with spectral efficiency $\eta = K(\text{bps}/\text{Hz})$ is the constellation diagram of the 2^K constellation points, the coded space is the constellation diagram of the 2^{K+l} constellation points, and the extra 2^l constellation points are the "residual", code rate r . "residual" and the code rate $r = 2^{-l}$.

According to Shannon information theory, Shannon channel coding that realizes the spectral efficiency $\eta = K(\text{bps}/\text{Hz})$ must use a constellation diagram with $2^{(K-\text{Log}_2^r)}$ constellation points whose number of constellation points, i.e., the number of output levels of the Shannon coding system, should grow with the $(K - \text{Log}_2^r)$ index!

The larger the residual, the lower the code rate r , the higher the Shannon coding gain, but the lower the effective bit rate. Such as from BCH, RS, TCM until Turbo, LDPC, Polar coding, etc. are used in this low code rate r , low bit rate coding. Unfortunately, the above coding due to the low code rate, the system spectral efficiency is very low, and are in the bit error rate 10^{-5} when

"approaching" the Shannon boundary. At lower bit error rate ($<10^{-5}$), they are all far away from the Shannon boundary, and there is an error floor, i.e., no matter how to improve the signal noise ratio, the error probability is no longer reduced. High bit rate and spectrally efficient Shannon coding will certainly never be found.

Utilizing the Ov principle, Prof. Li completely discarded Shannon's residual coding and modulation constellation diagrams, and only multiplexed waveforms without residual overlapping multiplexing of time, frequency, and spatial sequences of multiple-access waveform coding, whose immunity to interference is far superior to that of Shannon's coding. The average output power of the waveform coding system grows at most linearly with the spectral efficiency, and both theoretical and simulation results demonstrate that the threshold signal noise ratio required for the Ov system is indeed much lower than that of the Shannon system under the same conditions of spectral efficiency!

V. OVERLAPPED MULTIPLEXING PRINCIPLE

Overlapped Multiplexing Principle is a new principle discovered by Prof. Li after more than 40 years of repeated observation and research, which was firstly published in China in November 2013 in his monograph "Waveform Coding Theory and OVTDM with High Frequency Efficiency" published by Science Press. In March 2018, IEEE Access, the world's leading journal in the field of information, published his "Overlapping Multiplexing Principle and an Improved Capacity on Additive White Gaussian Noise Channel" as a special paper on the cover of the journal and announced this principle to the world. The principle is that the overlapping of transmitted data symbols in time, frequency, space and their mixed domains is definitely not "interference" but a beneficial coding constraint. The more severe the overlap, the higher the coding gain and the better the interference immunity. Only destructive elements from outside the system are considered interference.

VI. THE CHANNEL CAPACITY UNDER THE OVERLAPPED MULTIPLEXING PRINCIPLE IS MUCH HIGHER THAN THE SHANNON CHANNEL CAPACITY

Prof. Daoben Li firstly pointed out the error of Shannon's theory that multi-level modulation constellations must be used to improve the spectral efficiency of the system, and proved that under the guidance of the Ov principle, the optimal input data in both in-phase I and orthogonal Q channels should be ortho-anti (+, -) binary data, and that, in order to improve the spectral efficiency of the system, one should never follow Shannon's theory and use multi-level modulation signaling, but only adopt the overlap-multiplexing method with a greater number of overlapping repetitions. This concept is perfectly reasonable, although multiple data inputs allow more information to be loaded into each input data symbol, in a multiplexed Ov system, to ensure the same spectral efficiency, the number of overlap weights of the system with multiple data inputs will be proportionally lower compared to the binary data, and the Ov coding gain will be reduced, which is more than worth the cost. In this way, in $K \geq 2$ order overlapping multiplexed Ov systems ($K = 1$ order Ov will degrade to Shannon system), Prof. Daoben Li obtained the following three simple Ov theoretical formulas:

- The spectral efficiency of the Ov system is $\eta \triangleq C / B_{nai} = 2K, K \geq 2$;
- The normalized threshold signal-to-noise ratio of the Ov system is $E_b / N_b = 1.5K, K \geq 2$;
- The channel capacity of the Ov system is $C = 2KB_{nai}, K \geq 2$.

This is a single linear equation much simpler than the Shannon capacity formula. It can be seen that the Ov channel capacity and system spectral efficiency grows only linearly with the number of system overlap weights, K, or more rigorously, only linearly with the received bit energy.

According to the Ov principle, the Ov capacity is much higher than the Shannon capacity. The huge difference between Shannon capacity and Ov capacity can be seen in the following three figures. The theoretical and practical performance simulation results for the direct implementation of Ov principle OVXDM are also given in the figures.

The horizontal coordinate of the graph is the normalized signal-to-noise ratio in decibels (dB), $10\text{Log} \frac{E_b}{N_0} = 10\text{Log}(\frac{P_s}{P_N} BT)$; the vertical coordinate is the spectral efficiency of the Ov and Shannon systems $\eta(\text{bps}/\text{Hz})$, i.e., bits/sec/Hz (in Nyquist bandwidth).

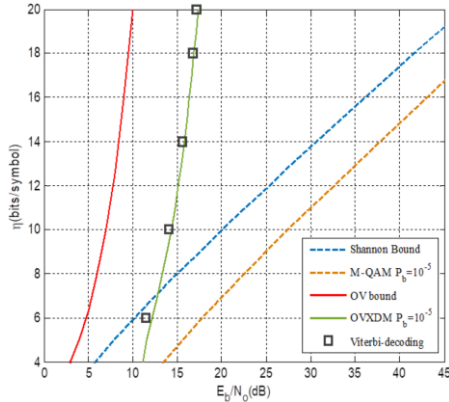


Figure 1. Simulation results of Shannon bound, Ov bound, QAM, OVXDM theory and optimal algorithm ($\eta \leq 20\text{bps}/\text{Hz}$ Nyquist bandwidth)

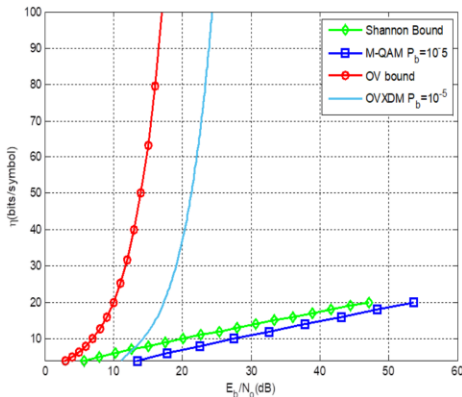


Figure 2. Comparative results of Shannon boundaries, Ov boundaries, QAM, OVXDM ($\eta \leq 100\text{bps}/\text{Hz}$ Nyquist bandwidth)

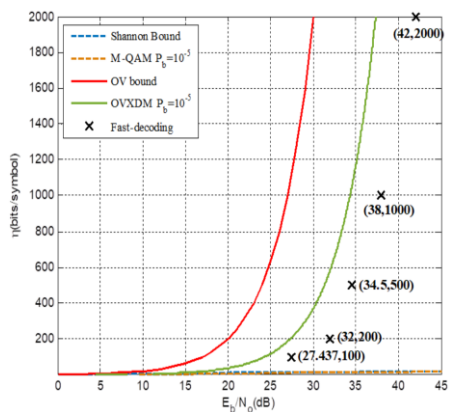


Figure 3. Comparative results of simulation of Shannon bound, Ov bound, QAM, and OVXDM fast algorithms ($\eta \leq 2000\text{bps}/\text{Hz}$ Nyquist bandwidth)

As can be seen from these figures, to achieve $\eta = 16\text{bps}/\text{Hz}$, the normalized SNR of Ov is only $1/1049$ in the Shannon sector; to achieve $\eta = 2000\text{bps}/\text{Hz}$, the normalized SNR of Ov is only $1/10^{596.4}$ in the Shannon sector.

For the Shannon system to also implement $\eta = 16\text{bps}/\text{Hz}$ and $\eta = 2000\text{bps}/\text{Hz}$, it would have to use the constellation maps of the $\geq 2^{16} = 65536$ and $\geq 2^{2000}$ constellation points (the upper bound of the number of atoms of the Earth's matter at $\leq 2^{250}$), and the normalized SNRs would need to be at least $\geq 10\text{Log} \frac{2^{16}-1}{16} \cong 41\text{dB}$ and $\geq 10\text{Log} \frac{2^{2000}-1}{200} \cong 5967\text{dB}$, respectively. That is, the normalized SNR of the Shannon system must be higher than $10^{4.1}$ (41dB) at $\eta = 16\text{bps}/\text{Hz}$ and higher than $10^{596.7}$ (5967dB) at $\eta = 2000\text{bps}/\text{Hz}$, while the maximum physically achievable normalized SNR is about $10^{4.3}$ (4.3dB)!

The Ov system can provide spectral efficiency far beyond the Shannon bound under realizable SNR conditions! The threshold SNR of its Ov capacity bound at $\eta = 2000\text{bps}/\text{Hz}$ is only 30dB (10^3); the threshold SNR of the non-optimal OVXDM regime is only 37dB ($10^{3.7}$); a fast decoding algorithm simulation result is 42dB ($10^{4.2}$), and the threshold SNR of the $\eta = 455\text{bps}/\text{Hz}$ design is 16.1dB (40.6), both of which are within the realizable range!

According to the conventional wisdom, the capacity of mobile communications is increased by an order of magnitude with each new generation, and there is no doubt that Ov's capacity has been increased by more than two orders of magnitude compared to today's 5G, so it is not an overstatement to say that Ov is a post-7G technology.

Information theory is from physics, should comply with all the basic principles of physics, Professor Li in his IEEE article criticized the Shannon information theory and the laws of physics in the transport and construction is

contrary to the principle of conservation of energy is who can not be contrary to the bit of energy can never come out of thin air. If the received bit energy is not up to the standard, and then the good code is also a clever woman can't cook without rice, Shannon has a residual code will only be the icing on the cake, can't send charcoal in the snow, Ov out of control spectral waveform coding can be the icing on the cake, but also to send charcoal in the snow, once found that the received bit energy is not enough, it will automatically increase the code in the carrier frequency and antenna number, in order to increase the total transmit power.

Why is the difference in channel capacity between Shannon theory and Ov theory so dramatic? This is because the noise spectral density N_0 is not controlled by coding, and when the channel capacity grows with spectral efficiency, Shannon theory requires exponentially growing bit energy, while Ov theory only requires linearly growing bit energy. Obviously, Ov theory, in which the channel capacity grows linearly with bit energy, is more in line with physics than Shannon theory, in which the channel capacity grows exponentially with bit energy. In the white Gaussian noise interference environment, the received bit energy is the only index that determines the system performance, although the attained bit energy of Ov capacity is much smaller than that of Shannon's, but no coding can increase the bit energy out of nothing, and Ov is no exception. Communication cannot be separated from the channel coding, in the received signal power is certain, Shannon system of received bit energy is increased by increasing redundancy, reducing the effective bit transmission rate increases, resulting in the Shannon coding gain is higher, the system spectral efficiency will always be one hundred percent, and the higher the spectral efficiency, the higher the Ov coding gain on the contrary.

The Ov principle, which strictly adheres to the fundamental laws of physics, completely subverts Shannon's theory, which states that the spectral efficiency and capacity of the system only grows linearly with the energy of the received bits, and never exponentially with the energy of the received bits as stated in Shannon's theory, thus

pointing out a bright prospect for the development of communications. OVXDM (Overlapped X Domain Multiplexing) is the simplest and most direct application of the Ov principle of transmission system, but also the simplest coding efficiency of 100 percent of the non-redundant waveform coding.

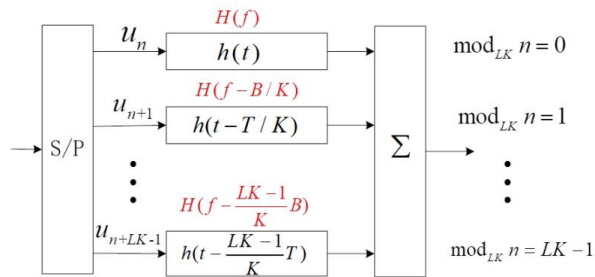
Prof. Li has not only derived the Ov capacity bound, but also found the universal overlapping time, frequency, space sequence multiple access waveform compilation code method that can approach the Ov bound under any spectral efficiency, and found that its decoding complexity is very low, so low that it can be detected bit by bit in a surprisingly low way! The decoding complexity of the optimal non-coded OVXDM also increases exponentially with the spectral efficiency, which means that the decoding complexity of the Ov coding system is extremely reduced compared to that before coding, which shows that the power of overlapping time, frequency, and spatial sequences of multiple-access waveform coding is huge! Excellent Ov sequence multiple access waveform coding should have the following basic characteristics:

- The coded Ov system should exist a steeply falling threshold SNR, which is controlled by the selection of multiplexed waveforms and the length of the Ov intrinsic coding constraints, when the received SNR is lower than the threshold, the error probability of the coded Ov system not only does not improve but worsens, and once the received SNR is higher than the threshold, the error probability will be a sharp and steep decline without a plateau approaching zero;
- The steepness of the error probability of the coded Ov system is controlled by the length of the Ov coding constraints, and the longer the coding constraints the steeper the steeper the drop;
- The receive threshold SNR at which the error probability of the coded Ov system is equal to a particular value such as 10^{-5} is close to the Ov bound;

- the coding Ov system does not exist error floor, that is, the current further increase in the reception of SNR, the error probability will only be further reduced until zero, there will be no irreducible error probability;
- The power spectral characteristics of the coded Ov system are gradually approximated to the ideal rectangle as the coding constraint length increases;
- Coding Ov systems are encoded in a universal way and are used uniformly for any spectral efficiency;
- The decoding complexity of the coded Ov system should not be high, and it is desirable that it can be done on a bit-by-bit basis.

VII. WHAT IS OVXDM?

OVXDM (Overlapped X Domain Multiplexing) is one of the simplest technical means of realizing the principle of overlapped multiplexing in a communication system, e.g., Time Domain $X = T$, Frequency Domain $X = F$, Hybrid Domain $X = H$, etc.



$$H(f) = 0, \forall f \notin [f_c - B/2, f_c + B/2), \quad h(t) = 0, \forall t \notin [0, T)$$

Figure 4. OVXDM system model

OVXDM belongs to a new waveform coding, which is a direct and simple application of the OV principle, but is not optimal overlap multiplexing, and is about 7 dB away from the OV boundary. OVXDM does destroy the one-to-one correspondence between the input data and the output symbols, but retains the one-to-one correspondence between the input data sequences and the overlap-multiplexed output waveform sequences! This will lead to the necessity of sequence decoding for OVXDM, and since the complexity of optimal sequence decoding grows at

an exponential rate with the spectral efficiency, fast sequence decoding algorithms with a loss of performance are generally used when the system's spectral efficiency is high (Fig. 3), whereas after the invention of the three-dimensional overlap-multiplexed waveform coding in time, frequency, and space invented by Prof. Li, the decoding complexity can be reduced to an amazingly low bit-by-bit process instead.

The output power of OVXDM grows not exponentially with the spectral efficiency (number of overlapping reps) of the system as Shannon pointed out, but only at a linear rate, which is the reason why the required transmit power of OVXDM is much smaller than that of existing systems. In addition OVXDM belongs to the new waveform coding, which is known to be able to distinguish the desired weak signals based on the characteristics of the waveforms even in strong background noise environments, which is another reason why OVXDM requires only a small transmit power.

OVXDM's strong anti-jamming capability reflects the truth that unity is strength, and the bigger the team, the stronger it is. Existing communication systems are simply scattered compared to it, and cannot withstand even a small blow (interference).

VIII. WHY THE DISCOVERY OF THE PRINCIPLE OF OVERLAP MULTIPLEXING IS BOUND TO LEAD TO A REVOLUTION IN COMMUNICATION AND INFORMATION TECHNOLOGY?

1) *There are five main requirements for wireless communication systems:*

Large coverage (propagation distance as far as possible); high spectral efficiency (the smaller the occupied spectral resources, the better); high power efficiency (the smaller the occupied energy resources, the better); support for high-speed mobility; high confidentiality and security; high reliability.

2) *With the arrival of the information society, people's demand for information is explosive, and the demand for communication capacity is also explosive growth, has grown from Kbps (kilobits per second) to Gbps (gigabits per second) to Tbps*

(terabits per second). And the achievable SNR is limited by environmental conditions can not be increased indefinitely, half should be satisfied $E_b/N_0 < 43dB$. Then, according to Shannon's boundaries, increasing the system capacity C can only be achieved by expanding the system bandwidth B and thus increasing the carrier frequency f_c . Also according to Maxwell's equation, the propagation loss of radio waves in free space decays with the square rate of the product of the carrier frequency f_c and the transmission distance r $(f_c r)^{-2}$. If the carrier frequency of the system is increased from $f_c = 1GHz$ to $f_c = 100GHz$, the transmission loss will increase by a factor of 10,000 (40dB) at the same distance r ! In addition, as the carrier frequency f_c increases, the ground Doppler frequency spreads more and more, in addition to the coverage area is getting smaller and smaller, and the moving speed that the ground wireless system can support will be lower and lower. Nowadays, the development of 2G, 3G, 4G and 5G is in the trend of deterioration by G. The reality requires that the capacity of the communication system is getting higher and higher. The reality requires that the capacity of the communication system is getting higher and higher, but the coverage of the Shannon system is getting smaller and smaller, supporting the mobile speed is getting lower and lower, and the power consumption is getting bigger and bigger with the bandwidth widening. Power consumption is large in addition to the carrier frequency f_c increase, bandwidth expansion caused by the device itself, mainly because of the modern communication system are required to linear amplifier, there must be power back, power amplifier conversion efficiency itself is low, the higher the carrier frequency f_c , the wider the bandwidth, the power amplifier power consumption and cost is also higher.

3) *The first generation of mobile communications (1G) was analog*, using a carrier frequency of a few hundred MHz, which was optimal for terrestrial propagation, and occupying a bandwidth of 30 KHz. Despite the backwardness of the technology, it was able to cover a range of

5-10 kilometers and support speeds of several hundred kilometers per hour. Subsequent developments in mobile communication systems have been relatively advanced digital technologies, with mobile communication systems being updated about every 10 years from the second generation (2G) onwards, with 5G now being commercially available and 6G already under development.

4) *With the explosive growth of the demand for information*, mobile communication is constantly upgraded, the capacity provided by the mobile communication system, i.e., the highest transmission rate, every new generation than the previous generation of about an order of magnitude; occupies the bandwidth proportionally widened by an order of magnitude; bandwidth expansion of the consequences is the carrier frequency must be increased with it. The consequence of the carrier frequency increase is one generation more than one generation is more unsuitable for terrestrial mobile communication, the scope of the coverage of one generation more than one generation shrinks, 2G can still cover about 2-3Km. to 5G when there are only 200-300m left; support mobile speed is more and more generation by generation reduction, from 2G 200-300 km / h generation by generation shrinks to the basic requirements of the 5G does not support the mobile; base station and cell phone is more and more generation by generation atypical, such as the 5G Base station is power consumption is about 4G 3-4 times, coverage radius is only 4G 1/3-1/4. this is an indisputable fact, no need to repeat. According to the development of this trend, the future of mobile communications systems should be to carrier frequency higher, less suitable for mobile communications millimeter wave and terahertz band into. Consequences are bound to be the base station coverage will only be smaller, more difficult to support mobile state communications, cell phones and base stations will only be greater power consumption, so the development prospects are not complimentary. Unfortunately, at present, domestic and foreign mobile communications will inevitably millimeter-wave and terahertz and even laser frequency bands

into the mainstream trend seems to have been lamentable and sad!

5) *Overlap multiplexing principle can be used to significantly improve the spectral efficiency in addition to the time domain*, frequency domain, air domain three-dimensional coding can also be used in power synthesis to improve power efficiency, that is, in the Ov system, you can use a number of small power amplifiers to synthesize a high-power output, and non-Ov of today's Shannon system is absolutely not possible to do this.

IX. CRITICIZING SEVERAL ERRONEOUS VIEWS OF 6G R&D

A. Using ultra-large-scale MIMO

Cover, recipient of the Shannon Centennial Award for Distinguished Contributions, finds that the capacity and spectral efficiency of a system of independently parallel Gaussian channels is equal to the sum of the independent parallel subchannels in a Gaussian noise interference environment. The system can have extremely high total capacity and spectral efficiency, and the performance is determined by the number of independent parallel channels and the total received signal-to-noise ratio.

An independent parallel Gaussian channel should have the following two basic characteristics:

- Each sub-channel has independent transmission data independent of Gaussian noise;
- All subchannels occupy the same time-frequency space.

It must also have the following four characteristics:

- The total received signal-to-noise ratio is equal to the sum of the received signal-to-noise ratios of the sub-channels;
- The total system capacity and spectral efficiency is equal to the sum of the sub-channels;
- The total system capacity and spectral efficiency grow linearly with the total received signal-to-noise ratio;

- The system has very high capacity and spectral efficiency.

A Multiple Input Multiple Output (MIMO) system in a rich scattering channel is a naturally occurring independent parallel Gaussian channel transmission system, the principle of which will not be repeated. The number of independent parallel channels is equal to the smallest of the number of independent antennas at the transmitter and receiver, i.e., $\text{Min}(T_T, T_R)$, where T_T is the number of independent antennas at the transmitter end (the total transmitter energy increases linearly with T_T) and T_R is the number of independent antennas at the receiver end, and the extra antennas will be designed to provide graded gain to improve the system performance. Apparently, by increasing $\text{Min}(T_T, T_R)$, the total system capacity and spectral efficiency can be increased "without limit", but can this really be the case?

First of all, MIMO must rely on the rich scattering propagation environment, can only work in urban environments of high-density complexes and indoor and other rich scattering environments, for the poor scattering or even no scattering flat open environment, such as large areas of farmland, open plains and grasslands, the sea, airplanes and satellites, deep space, unmanned aerial vehicles, and other channels whose effectiveness will be lost or greatly reduced.

Secondly, MIMO must take up a lot of space resources, which seems to be less of a problem for mobile base stations, but what about cell phones? How many antennas can be placed on a small cell phone to meet the independence requirements? Some people say that we can consider cooperative communication, so that multiple cell phones work together to realize the receiving end of the multiple antennas. Is it possible to realize "cooperative" communication with multiple cellular phones? What if there are not many cell phones around? And how much extra resources does it take to get them to work together? Last but not least, people nowadays attach great importance to personal privacy, so why can't they refuse to provide service to others when they don't need to

communicate with each other? Is there any danger that one's right to privacy will be compromised?

Finally, a MIMO system must have precisely known $T_T T_R$ fading channel characteristics, which will force the system to provide at least $T_T T_R$ "orthogonal" guides for measuring channel characteristics, consuming a huge amount of system resources that increase with the square law of MIMO size.

Is there an independent parallel Gaussian channel that requires only a single antenna for transmission and reception without the disadvantages of MIMO mentioned above? OVXDM, guided by the principle of overlap multiplexing, is the solution, eliminating the need for numerous frequency guides and providing extremely high capacity and spectral efficiency. Since OVXDM implements Gaussianized overlap multiplexing on its parallel input data symbols, and the independence of the shifted Gaussian noise itself, OVXDM has all the two core features and four features mentioned above for independent parallel Gaussian channel, and OVXDM's threshold SNR only grows linearly with the channel capacity and the spectral efficiency, and its system capacity and the spectral efficiency grows linearly with the received SNR, all of which are consistent with MIMO. growth, all of which are known with MIMO. The author fully demonstrates that OVXDM is indeed an independent parallel Gaussian channel transmission system under Gaussian white noise interference environment. The independence of MIMO subchannels is formed by the independent complex Gaussian fading of the subchannels, whereas the independent Gaussianity of the OVXDM subchannels is formed by the independence of the subchannels' Gaussian noises and the overlapping multiplexing of Gaussianization of their parallel independent data symbols. It is valuable that it is not limited by propagation conditions and can work in any channel, both fading and non-fading channels, and the above limitations for practical MIMO systems will disappear!

B. Future mobile communication intelligence to millimeter wave and terahertz band development.

This seems to have become the consensus of the US-led Western bloc and domestic forces following the West, who believe that the potential of the Shannon theory has been nearly exhausted, and that in addition to MIMO, moving to higher frequency bands and further expanding the system bandwidth is the way out (see their 6G white paper).

The transmission distance of mobile communication should be as large as possible, and the bypass penetration ability should be very strong. Millimeter-wave terahertz and even laser band transmission loss is very great, no penetration ability, no bypass ability, atmospheric composition, leaves, dust, haze, water vapor, etc., its absorption loss is very large, blindly tracking the West, refused to resist new theories and new technologies to the high frequency band forward will only lead the country's mobile communications to extinction.

Only in the Ov principle of waveform coding theory, under the guidance of a substantial increase in the narrow bandwidth suitable for mobile communications, lower frequency band spectral efficiency, increase the capacity of the Ov system does not need to widen the bandwidth, higher carrier frequency, all the Shannon theory under the guidance of the system is impossible to solve the contradictions in the Ov system can be solved.

C. "Low-orbit satellite systems such as Starlink and Starshield".

They are a cover for maintaining space hegemony, espionage, military use and seizure of orbital and frequency resources under the guise of claiming to be able to provide global wireless Internet services using tens of thousands of low-orbiting satellites. A measure of wireless Internet quality is the maximum number of gigabits per second (Gbps/Km²) per square kilometer. 4G, for example, has a carrier frequency of a few GHz (5Ghz as an example) covering about 1Km (1Km as an example). Star Chain, Star Shield satellite

from the ground at least 330Km, otherwise it will fall down quickly, the transmission distance is at least 330 times that of 4G, the free space loss in the same frequency band is at least 100,000 times higher than that of 4G ($\geq 50dB$). For this reason, the star chain, star shield satellite two sections have to use high gain antennas, which in turn proportionally reduce its coverage, mobile interconnection indicators Gbps/Km² unchanged. Transmission loss is extremely large, mobile, mobile interconnection index Gbps/Km² is far lower than the ground mobile network is the root cause of its inability to provide global 6G wireless interconnection services. As of August 1, 2023, China has built nearly 4 million terrestrial 5G base stations, has not yet covered ten percent of the country, a few tens of thousands of small microsatellites away from the earth can provide global 6G Internet services? A fool's errand, right? The Americans claimed success in its transceiver two sections are using directional antennas in the laboratory, a little specialized knowledge of the people understand that the success of individual cases can not confirm its inability to provide 6G services to as many as billions of users around the world in essence, can not cover up the pollution of space, the creation of a huge amount of space debris, and military, espionage, seize the frequency, the space orbit resources, the maintenance of hegemony in space of the wolf's ambitions.

X. THE IDEA OF ESTABLISHING CHINA'S ULTRA-HIGH-CAPACITY SPACE, AIR, GROUND, SURFACE-TO-SURFACE AND UNDERWATER NETWORK INTEGRATED WIDE-AREA COMPREHENSIVE OV NETWORK.

The biggest advantage of Ov is to improve the system capacity and spectrum efficiency under the condition of physically realizable SNR, which has nothing to do with the frequency band used! For this reason, we can use Ov technology, synchronous research and development in different networks, and gradually greatly improve the capacity of the ground wireless backbone network, fiber optic backbone network, step by step to build China's unique wide-area air and space integrated Ov core backbone network.

A. *Terrestrial fiber optic cable & wireless backbone.*

It is the economic traversal means of 1G-5G for users in large densely populated areas, but it can not cover all environments, especially it can not provide services in some special and harsh environments, such as vast oceans, high mountainous areas, underwater, ground to underwater, bridges and tunnels, and underground and other special environments. In the future, Ov technology should be used to transform it into an ultra-high-capacity network.

B. Formation of China's unique ultra-high-capacity space Ov backbone network.

The space satellite network can provide global services especially in some special environments, for this reason, it is necessary that the ultra-high-capacity satellite backbone network should be combined with the ultra-high-capacity terrestrial fiber optic cable + wireless backbone network, stratospheric backbone network, unmanned aerial vehicle (UAV) network, ground-to-water underwater network, underwater communication network and so on to form a wide-area integrated ultra-high-capacity Ov-info network in the sky, in the air, on the ground, and under the water.

Millimeter wave, terahertz and even laser should be used for links between most satellite network nodes (including stratospheric or terrestrial fiber-optic cable + wireless network nodes, hereinafter the same) that do not require wide-area coverage. Their wavelengths are extremely short, available very small size antennas to provide star-to-star, star-to-ground or ground base station between the very narrow beam high antenna gain point-to-point links to make up for their transmission loss of large coverage of the small shortcomings of the satellite network of the core node is responsible for linking with the stratospheric or terrestrial fiber optic cable + wireless network, the stratosphere or terrestrial fiber optic cable + wireless network nodes are exactly the same. Millimeter-wave, terahertz, and lasers have extremely wide available bandwidths and can provide very large capacity. Satellites, stratospheric, terrestrial fiber optic + wireless, terrestrial-to-submarine, and underwater can

complement each other to form a powerful integrated wide-area Ov information network. They (including non-wireless terrestrial and underwater fiber-optic cable networks) should be ultra-large-capacity networks using Ov technology, and satellite networks and stratospheric and terrestrial Ov networks can complement each other to form a powerful integrated Ov information network in the air and the sky.

As for the topology of the network, it should not follow Musk's simple chain, but should be the best lattice structure. Due to Musk one-sided pursuit of low orbit, low cost, have to use small micro-satellite, low orbit will make its satellite life is very short, must constantly launch new stars to replenish, small micro-satellite solar panels and antenna size is not likely to be large, the transmitter power is not likely to be high, transmitter antenna gain will not be too high, resulting in the user must be configured with high gain antenna. Coupled with the relative high-speed movement of satellites, and ground communications can only be high-speed chain switching between the stars, switching and consume a lot of resources, and low-cost small micro-satellite and have to use relatively backward and simple signal processing and handover switching technology, the star processing capacity is not likely to be high, and can not be realized on-demand jumping between the satellites to interconnection and interoperability.

Therefore, our space network should be composed of satellite Ov-networks with ultra-high capacity guided by the principle of overlap multiplexing, which may be deployed in low, medium, and high orbits, respectively, as needed, and in the next section are my suggestions for other compositions of an integrated Ov-network of heaven, earth, and space.

C. Deployment of the Ov ultra-high-capacity stratospheric airship communications monitoring network.

Stratosphere is 35Km-55Km from the ground in the atmosphere, the temperature is basically constant (-55 °C or so, also known as the stratosphere), the air velocity is stable and very slow, can make the airships for a long time

relatively fixed in the high altitude, its altitude will not be higher than the orbiting satellites of the 1/10, the ground communication transmission loss will not be higher than the low-orbit satellites of the 1/100 (20dB), which applies to a variety of frequency bands. Airship cost is very low, the volume can be very large, especially tethered airships, and the ground with fiber optic cables and cable links, it is easy to deploy ultra-high-power, large size antennae, ultra-high-capacity stratospheric communication and detection network. Use it to implement the ground detection, can get far more than the satellite detection of the fineness of the image, as a mobile communication base station, preliminary estimates in the Ov system, only need to configure no more than 3G base station airships can be realized in all of the country and territorial sea coverage. Due to the different networking methods with the ground base station, the base station is all high gain downward narrow beam, not the ground base station low gain horizontal wide beam, the signal level in the coverage area is more uniform relative to the ground base station, basically can not consider the interference between base stations, antenna gain can be much higher than the ground base station, cell phones do not need additional configuration of the directional antenna, the automobile, high-speed railroads, airplanes, missiles, sea vessels, etc., including the quality of the users provide Far beyond 5G, far beyond the star chain, star shield of the Internet and special services, stratospheric airship base station can completely replace the traditional ground mobile base station, and floods and earthquakes and other natural disasters will not affect its work, can keep the communication has a higher reliability. In addition, with little additional cost, it can jam or block out the Musk Starlink and local satellites located above it. Because it is higher than all airborne vehicles, it has virtually no effect on their flights, and can be deployed intensively over key areas during war to intercept and provide real-time warning of attacks from space.

D. Deployment of terrestrial, air-to-underwater Ov ultra-long-wave communications networks.

Although the existing ultra-long-wave communication system guided by Shannon's

theory can realize such communication, its capacity is still very low, and with the adoption of the Ov principle system, it is entirely possible to increase its capacity by one or two orders of magnitude over the existing system.

E. Deployment of the underwater mobile sonar Ov communication network.

Although the capacity of existing sonar communication systems under Shannon's theory is still very low and the transmission range is very limited, it is entirely possible to increase its transmission range by one or two orders of magnitude and its capacity by one or two orders of magnitude over the existing system with the adoption of the Ov principle system.

F. Deployment of the Ov ultra-high-capacity ionospheric scattering communications network.

The ionosphere is an atmospheric layer from 50Km to 100Km from the ground, and because the atmosphere in this layer is ionized by solar radiation, it has a scattering effect on electromagnetic waves of short-wave frequency, which can realize long-range communication over several thousand Km. Although the capacity of the existing ionospheric scattering communication system under the guidance of Shannon's theory is very low, after adopting the system of Ov principle, it is completely possible to enhance its capacity by one or two orders of magnitude compared with the existing system.

G. Deployment of the Ov ultra-high-capacity tropospheric scattering communications network.

The troposphere is an atmospheric layer from 8Km to 18Km from the ground, and due to the inhomogeneity of the convective air mass, it scatters electromagnetic waves in the microwave band, allowing long-distance communications over thousands of Km. Although the capacity of the existing tropospheric scattering communication system guided by Shannon's theory is not high enough, it is entirely possible to increase its capacity by one or two orders of

magnitude over the existing system with the adoption of the system based on the Ov principle.

H. Deployment of the Ov UAS emergency communications network.

The low cost of drones and the fact that they can fly at altitudes ranging from near the ground up to the stratosphere allow for the establishment of emergency high-capacity communication networks anywhere and at any time.

F, G, H three to ensure that China's wartime and emergency communications is essential. The above networks are all established under the guidance of the Ov principle, the final formation of a comprehensive wide-area Ov information network is able to provide information services to the global network, a variety of networks are indispensable.

XI. SCENARIOS FOR THE INTEGRATION OF SPACE, AIR AND GROUND INTO THE WIDE-AREA OV INFORMATION NETWORK AND INTERNATIONAL CONNECTIVITY

The world cannot be separated from the Internet without a moment's notice, and there can be no national security without information security! The Internet is the United States according to the Shannon multi-user information network theory established in the 1970s, and then constantly updated and upgraded, but a thousand changes, the core of the ability to control more and more strong, in order to achieve global information hegemony. The United States long-term efforts and even free promotion of the Internet, the same as GPS, the international community generally fooled into using the Internet, so that many people mistakenly believe that the Internet is the Internet. In fact, the Internet is only a network of Shannon's Multi-User Information Network (MUIN), which, like Shannon's theory, should be eliminated. The United States in order to maintain its information hegemony, in addition to controlling the GPS is also firmly held the Internet's "main root", although the hypocrisy of allowing countries to have some of the network "root", but can never touch the "main root"! Although it is hypocritical to allow countries to

have some network "root", it can never touch the "main root", but only the "mirror root". So that the United States can be free to steal the secrets of other countries, to master the global information hegemony, the Internet and GPS is the United States to control the global information hegemony of the killer mace. You enter the GPS, your whereabouts can not be mastered? You enter the Internet, your information secrets can exist? In order to break the U.S. hegemony, our country should not only stay away from GPS, but also firmly abandon the Internet, including its improved version of IPv6! The construction of a wide-area Ov information network with independent intellectual property rights under the theory of revolutionary Ov multi-user network. Initially, only a number of geostationary orbit satellites and fiber optic cable nodes to achieve international interconnection and interoperability with the system swap. the construction of Ov network should take the BeiDou, mobile communications and high-definition point of time to gradually update and iterative way, the initial coexistence of old and new systems, and ultimately, because of the absolute advantage of the Ov will soon be widely accepted, so as to fully replace the old system, and promote the global.

XII. OUTLOOK

Using the overlapped multiplexing theory and its guidance of time domain, frequency domain, air domain overlap sequence multiple access waveform coding technology, only need to use the transformation of the existing system's basic architecture, equipment in addition to the

baseband part of the other parts can be largely retained only need to do the corresponding changes to them, the system performance can be far better than the plan of the 6G, to meet the needs of the future 7G and beyond. Especially the stratospheric base station communication can realize the huge saving of frequency and energy resources and the green communication with higher security, and the safe and reliable national information network investment and will be a huge saving. Chips developed based on the new theory will certainly promote the whole communication and information system, information network upgrading, which will produce the next generation of new green, safe, secure and reliable information system.

Overlap multiplexing principle is discovered by Chinese people, overlap multiplexing waveform coding theory is the foundation of Chinese people, time domain, frequency domain, space domain three-dimensional overlap sequence multiple access waveform coding theory and technology is also the foundation of the Chinese people and the invention of the future of mobile communications, satellite communications, underwater communications, ground to underwater, and even wide-area information network capacity has a huge increase in the huge savings in resources. At the same time, information security, information security, electronic countermeasures, electronic concealment, wide-area information networks and other related fields are bound to change, and will certainly affect the information industry field upgrading. The national economy, especially the defense industry will bring significant social and huge emergency benefits.