Future 5G Network Based Smart Hospitals: Hybrid Detection Technique for Latency Improvement

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ABSTRACT With the rapid increase in the development of a cellular communication system, remote health monitoring and smart health care are improving and getting through a swift transformation. Currently, we are utilizing the advance long term evolution (A-LTE) network to support the modern health care. Nevertheless, smart hospital/health concern is not fully evolved all around the world. The rollout of the fifth generation (5G) will improve the standard of the smart health care. However, requirements of a smart hospital will be different as compared to other applications such as education, industries, and the public. The smart hospital will be connected 24/7, with several small devices integrated with the sensors. In simple words, the future smart hospital will be based on the 5G and the internet of things (IoT), expected to augment the system coverage, effectiveness, and throughput of the system. Further, high speed, low latency, spectral efficiency, and low energy consumption are the requirements of the 5G based modern hospital. In this correspondence, we focused to improve the latency, spectrum, and throughput of the 5G network by implementing a hybrid detection technique based on the QR decomposition and the M algorithm-maximum likelihood detection (QRM-MLD) and beamforming (BF) for massive multiple-input multiple-output (MIMO) and non-orthogonal multiple access (NOMA) system. In addition, a comparison between the proposed and conventional detection techniques is presented. The proposed hybrid detection technique improves the throughput of the system and reduces the computational complexity as compared to the conventional QRM-MLD algorithm, conventional BF and zero-forcing (ZF) techniques on the platform of several parameters i.e. complexity, bit error rate (BER), peak power, etc.

INDEX TERMS 5G, smart hospital, PAPR, detection technique, latency.

I. INTRODUCTION

Medical health care is one of the important concerns of the present world. The lack of proper infrastructure, poor health care legislation, and insufficient resources, create a worry regarding the quality of service in health care. At the same time, it is assumed that the electromagnetic wave generated from the mobile towers is harmful and may cause several deadly diseases in human beings. Researchers,

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academicians, and engineers are trying to utilize the mobile service in health care but so far, it is failing due to several reasons such as poor network coverage, high latency, lack of spectrum, and low data speed. It is a fact that technology can play an important role to improve the health care system. The emerging technologies in the fifth generation (5G) and beyond 5G (B5G) systems such as the internet of things (IoT), massive multiple-input multiple-output (MIMO), and smart antennas are being planned to upgrade the health care service and to reduce the patients' struggle while reducing the budget expenses payable in medical care. Since several users

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will be accessing the network 24/7 in the same geographical area, several challenges will be highlighted such as the high bandwidth, the data rate in the range of Gbps, and the low latency. The routine and necessities of the peoples are altering every time, as they need 24/7 mobile accessing. Any change in mobile will lead to a change in the society. The implementation of 5G technologies will act as an important path in enhancing smart health care performance. The 5G can help to extend the remote health monitoring by developing an optimized modern health care scheme. The health requirements will be different as compared to public demands. Secured network, better access to remote areas, better network coverage, and low latency will be the key issues in designing a network for smart health care. The application related to smart health-commerce will boost and go into further mobile. The improvement of latency and stability is considered to be crucial to back the services affiliated with health monitoring services. High data rate in terms of Gigabyte should be assured with an immense accessible service. In addition, proper spectrum management is needed to back the huge number of devices. The key value is to gratify the above-mentioned demands and handle the expanding budget of the technology. As per the METIS, it is concluded that the design of single new radio access technologies (RAT) will not able to entertain all the new demands. Hence, it is important to integrate the 5G system with existing technologies [1]. The quality of 5G services and applications depend on the development of the infrastructure. The cost involves during the design of advanced network infrastructure is one of the major challenges, which demand to be cut as much as possible. The authors presented a comprehensive study on 5G networks and advanced technologies, which will play a crucial role during the rollout of smart hospitals. The presented work analyses the integration of innovative technologies with the 5G, for different applications such as health care, industry, remote monitoring, and so on. Further, the article provides details of the 5G projects implemented or ongoing in the universe. Finally, it was concluded that the 5G network alone may not help to achieve the vision of a smart hospital. Hence, it becomes a major concern to integrate the 5G with advanced and existing technologies [2]. In this work, it was concluded that the 5G as an independent network cannot deliver the promised health services. Hence, the 5G will be a network of networks; it simply means an advanced radio, which is compatible with the existing radio [3]. In this work, the authors proposed a novel architecture which can be utilized in an advanced wireless network. The suggested architecture will manage the allocation of resources, interference issue among the existed and advanced radios. Further, it was also concluded that the functioning of the 5G network-based health care will depend on different types of services [4]. In addition, a comprehensive review of the role of 5G technologies in modern health care is presented. It is also seen that the 5G communication system is already being practiced in China Hospital of Sichuan University. Hence,

it is concluded that the role of 5G in improving health care is not just an illusion but a reality [5]. Medical health care is a huge problem in developing countries, especially in remote areas. The progress in wireless telecommunication has improved medical health care in many aspects such as by reducing a patient struggle through remote health diagnoses involve in traveling from the remote areas for modern health care centers and also ensuing to receive proper health care without paying huge amounts of money. The remote health monitoring needs a high data-rate, low latency, and high spectrum in order to utilize the medical resources from the high standard hospital. The proposed work introduced a novel health care system integrated with cognitive resource and the 5G data model. The requirements of the former model are low latency, high-speed data, and stability. Similarly, the latter model is dependent on a big data evaluation of patent health [6]. Non-orthogonal multiple access (NOMA) waveforms are one of the superior candidates for the 5G network as it enhances the spectral performance by spreading the consumer multiple domains. It is implemented by using a successive interference cancellation (SIC) and a super coding (SC) technique at the transmitter and receiver. MIMO is since the third generation (3G) communication system [7]. Massive-MIMO will be used in the 5G network, as it significantly improves the throughput of the system by utilizing a massive number of aerials at the sender and the receiver terminal. The large number of antennas improves the spectral efficiency, the data- rate and the latency which are essentials of the smart hospital [8]. We proposed a combination of the MIMO-NOMA system for the 5G network. The integration between the MIMO and the NOMA will increase the performance of the system. At the receiver, it is necessary to use some suitable technique to find the desired signal for individual antenna elements out of the envelope of receiving signals. This process is known as signal detection. It is a very crucial task for a multiple antenna system, especially for a system that is fortified through a huge amount of aerials at the base location. The use of detection techniques is significantly increasing the computational complexity of the system [9]. The QR M based maximum likelihood detection (QRM-MLD) algorithm is regarded as one of the ideal detectors for massive MIMO system. The efficiency of projected hybrid detector is comparable to the QRM-MLD arrangement. In the present work, the channel matrix is divided into uphold triangular matrix (R) and orthogonal matrix (Q). Though, the Q and R have limited consequence on the detected signals since a composite signal corresponding to the transposed of the period of the channel is multiplied by signals communicated by all aerial. Henceforth, the hybrid QRM-MLD and beamforming (QRM-MLDBF) has obtained ideal effectiveness through decoding methods. It is understood that the efficiency of the hybrid detector enhanced with huge amount of signals and vice versa. The detection Process of projected detector is identical to the parallel detection methods. Therefore, the detection delay is reduced in the QRM-MLD. Several detection techniques

were explored and analyzed [10]. The QRM-MLD method for the massive-MIMO structure is projected. The simulation outcomes show the deprivation of bit-error-rate (BER) performance with trivial improvement in the complexity of the system [11]. The authors proposed an ML-QR detection scheme based on a serial communication, utilizes an extra survival symbol to improve the BER and complexity performance of the system. However, the increased delay time is considered as a drawback of the recommended scheme [12]. In this work, the authors investigated the performances of several detection techniques on 802.11ac. The simulation outcomes divulge that the lattice-reduction aided minimum mean square error-successive interference cancellation (LR-MMSE-SIC) significantly improved the power gain of the structure as compared to conventional techniques [13]. The authors introduced a QRM-MLD method for the MIMO scheme. The performance of the suggested technique is examined and equated to the traditional QRM-MLD and ML techniques. The experimental outcomes divulge that the BER of the projected and conventional QRM-MLD detection scheme is identical. However, complexity is slightly reduced in the proposed technique [I4]. With the increase in demand from the operators, industry, subscribers, the next-generation technologies are developing at a faster rate. It is expected that the 5G network will not be available due to different services and applications. Hence, 5G networks based smart hospital may not achieve the required latency. However, the current cloud architecture is specially designed for the 5G network. The integration of other technologies with the 5G network for medical employments will in-flats the performance of 5G in health care, is somewhat ambiguous, and cannot be ignored. To overcome the hurdles of the 5G network, the sixth generation (6G) network can be introduced, providing excellent services and applications in all sectors. Though, the idea of the 6G will become reality, if 5G fails to redeem its promises [15].

In this work, a hybrid signal detector based on the QRM-MLD-BF is employed. The detection is achieved in two steps. In the first step, the QRM applied to reduce the error of the system. In the next phase, the Bf technique is applied to reduce the complexity of the system. Further, we observed and compared the enactment of the low complexity proposed hybrid detection technique and conventional techniques for the Massie-MIMO-NOMA structure. The main contribution of the presented article is given as:

- The estimation of the Q is monotonous which includes several multiplications and convolutions. In this work, computational complexity has been reduced by directly multiplying the output vectors.
- The QRM-MLD-BF is compared to the conventional detectors and it is seen that the novel QRM-MLD detector is projected to reduce the complexity, the BER and the PAPR values of the system.
- The projected QRM-MLD-BF detectors enhanced latency of the massive MIMO system, which is one of the requirements of the 5G based smart health care.

TABLE 1. Technical concerns for smart hospital [16], [17].

#	Technological outline	Important Concern
1.	Huge capacity	Congestion 10 times of Tbps/km2, mobility speed of 1 Gbps, maximum data-rate of 10 Gbps.
2.	Low energy device-to-device (D2D) mass connectivity	The connectivity density should be 100/km2, low energy utilization and cheap technology.
3.	Seamless Connectivity	The mobility data-rate should be 1 Gbps.
4.	Flat latency and immense safety	Latency should be less than 1 ms, The accuracy should be 100%. The detection delay should be less than 1 ns.

TABLE 2. Anticipation from 5G employments for smart health care [18], [19].

Categories	Services
Enveloping 5G employments	Gigantic streaming, practically develop sensibility and low latency.
Smart 5G employments	Jammed area maintenance and customer based computing.
Universal 5G employments	Agile exclusive device, medical care, cognitive city, building and industry
Seamless 5G employments	Intelligent transit, tele-transaction, drone establishment and 3D affinity
Public 5G	Special surveillance, social assurance, holocaust control, emergency employments

The improvement of latency and stability, considered to be crucial to back the services affiliated with health monitoring services

Table 1 and Table 2 indicate the technical requirements of future smart hospital and anticipation from 5G employments for smarter health care.

II. PROPOSED SYSTEM MODEL

The projected hybrid detection model is designed to detect the signal is given in Fig.1. It is the latest frequency domain detection scheme, which integrate the QRM-MLD and the BF detection methods. Table 3 indicates the symbols used in the present work. Table 3 indicate the symbol used in the present work:

The arrangement of the QRM with beamforming outcomes in improved efficiency owing to MIMO schemes and
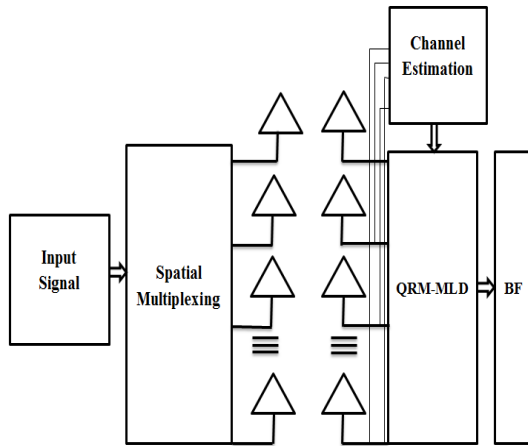
FIGURE 1. Proposed model.

TABLE 3. Symbols.

Symbol	Definition
W(k)	Frequency domain NOMA signal
y(k)	Transmitted vector at a time (t)
y(k-1)	Transmitted vector at time (t-1)
N(k)	Distortion
h(k)	Channel respons
R	Rank of a Matrix
$W^\wedge(k$	Received NOMA signal
$V(k)$	element matrix
$B_m(k)$	braiding matrix
Q	Orthogonal matrix
R	Uphold traingular matrix
$\tilde{Z}(k) =$	Beamforming received signal
$\bar{z}$	Beamforming detected signal

horizontal fadding is attained due to the NOMA [20]. A frequency discerning NOMA signal is given as:

$$W(k) = h(0)y(k) + h(1)y(k-1)$$
$$+ \cdots + h(K-1)y(k-K+1) + N(k) \quad (1)$$

y(k) is the transmitted vector at a time (t), y(k-1) is the transmitted vector at time (t-1), and h(k) and N(k) are the channel respons (NxM matrix) and the distortion, respectively. In a frequency discerning channel, the inter symbole interference (ISI) arises among existing and preceding communicated signals. This obstacle can be eliminated by utilizing the inverse fast Fourier transform (IFFT) and the SC operation of the transmitting aerial. The The N-parallel flat fading NOMA symbol for n^{th} sub-carrier is:

$$W(0) = h(0)y(0) \quad (1.1)$$
$$W(1) = h(1)y(1) \quad (1.2)$$

The NOMA signal with delay is:

$$W(N-1) = h(N-1) - y(N-1) \quad (1.3)$$

In general,

$$W(k) = h(k)y(k) + N \quad (1.4)$$

W(k) is the received frequency domain NOMA signal by a QRM and beamforming detector is for detection of vector y(k). The response of the channel is given as:

$$H = \begin{bmatrix} h_{00} + \cdots + h_{M-1,0} \\ \vdots \quad\quad \vdots \\ h_{0,N-1} + \cdots + h_{M-1,N-1} \end{bmatrix} \begin{bmatrix} y_1^\wedge(k) \\ y_2^\wedge(k) \\ \vdots \\ y_N^\wedge(k) \end{bmatrix} + [n] \quad (2)$$

The rank of the matrix (H) can be written as

$$R = \begin{bmatrix} H_1 rank(N) & \cdots & H_1 rank(1) \\ \vdots & \ddots & \vdots \\ H_N rank(N) & \cdots & H_N rank(1) \end{bmatrix} \quad (3)$$

The rank (m) represents the channel. Utilizing (2), the NOMA signal at the receiver is given as:

$$W^\wedge(k) = h(k)y^\wedge(k) + N(k) \quad (4)$$

$y^\wedge(k)$ is the form of y (k). The channel equation is given as:

$$h(k) = V(k) * B_m(k), \quad \text{known as QRM} \quad (5)$$

where $V(k)$ and $B_m(k)$ are the unit element matrix and the braiding matrix, respectively. The $W(k)$ is given by

$$W(k) = V(k) * B_m(k) * y(k) = B_m(k)y^\wedge(k) + N(k) \quad (6)$$

The distortion can be expressed as:

$$N(k) = V^\wedge(k) * \frac{\sigma}{n}(k) \quad (7)$$

The equation (6) can be written as:

$$\begin{bmatrix} W_1(k) \\ W_2(k) \\ \vdots \\ W(k) \end{bmatrix} = \begin{bmatrix} B_{11} \ldots B_{1m} \\ 0 \ldots B_{2m} \\ \vdots \quad \vdots \\ 0 \ldots B_{nm} \end{bmatrix} \begin{bmatrix} y_1^\wedge(k) \\ y_2^\wedge(k) \\ \vdots \\ y_N^\wedge(k) \end{bmatrix} + \begin{bmatrix} N_1^\wedge(k) \\ N_2^\wedge(k) \\ \vdots \\ N_m^\wedge(k) \end{bmatrix} \quad (8)$$

The QRM-MLD sensed signal ($\bar{Y}$) is given by:

$$\bar{Y} = \left\| w^\wedge(k) - B_m(k)y^\wedge(k) \right\|^2 \quad (9)$$

From (9), it is established that the QRM-MLD efficiently enhances the BER performance, but the complexity of the system is high. In the second step, we introduced a beamforming technique to moderate the complication of the method. It multiplies the symbol transmitted by antenna with the phase inversion of the channel. The low complexity

TABLE 4. Complexity.

Procedure	Convolution
QR disintegration of H	$4C^{3S_c}$
U^H	$4C^2 SN_d$
Euclidian expanse	
	$2(1 + \sum_c^{c-1} S_s N_d S)$

beamforming received signal is made by:

$$\tilde{Z}(k) = \begin{bmatrix} h_1(k) \, h_2(k) \, h_3(k) \ldots \ldots h_{N_T}(k) \end{bmatrix} \begin{bmatrix} e^{-i\theta 1} \\ e^{-i\theta 2} \\ e^{-i\theta 3} \\ . \\ . \\ . \\ e^{-i\theta N_R} \end{bmatrix}$$

$$\times \begin{bmatrix} \bar{y}_1(k) \\ \bar{y}_2(k) \\ \bar{y}_{3(k)} \\ . \\ . \\ . \\ \bar{y}_{N_{R(k)}} \end{bmatrix} + n \quad (10)$$

Thus, the received signal is:

$$\tilde{Z}(k) = \left(|h_1(k)| + |h_2(k)| + \cdots + |h_{N_R}(k)| \right) * \bar{Y}(k) + n \quad (11)$$

The BF detected symbol $(\bar{z})$ is estimated mathematically as:

$$\bar{z} = \tilde{Z}(k) + \frac{n(k)}{(|h_1(k)| + |h_2(k)| + \cdots + |h_{N_{R(k)}}|)} \quad (12)$$

In order to reduce the complexity, we utilize (10) to select M antennas for the modulated signals. Mathematically, it is expressed as:

$$S_{1.c} = Q \left(\frac{1}{B_{1,1}} \left(\tilde{Z}(k) - \sum_{i=2}^{M} B_{1,i} S_{i,c} \right) \right) \quad (13)$$

The Q function estimates the contiguous constellation point.

III. COMPLEXITY
The convolution obligatory for the detection is understood as a complexity in the projected method, indicated by Table 3 [21], [22].

IV. PERFORMANE OF PROPOSED MODEL
The afflictions of the QRM-MLD identification is the lengthy dormancy that happens because of the sequential preparation of the symbols [23], [24]. The QRM-MLD recognition plot is executed with equal preparation that sizes of the dormancy and unpredictability. The objective of the hybrid method is to identify the number of NOMA symbols. The projected method estimates the rank of y^(k). The additional means to determined positi on W^(k) subsequently QR deterioration and QR revision. The positioning strategy for the channel is shown in Fig. 2.a. The rank of every segment is specified by the circles that are distributed in like manner to all squares. The quantities of squares are organized descending way beginning from the rightward cross. The hover of dark, white, and dim shows the relative force. The intensity of the dark circle is more noteworthy than white and dim. In the following stage, the triangular framework $\tilde{Z}(k)$ is changed over into flight of stairs lattice. This is accomplished by taking out the $\tilde{Z}(k)$ by utilizing the Gauss-Jorden disposal strategy. The equal recognition decides the progression of flight of stairs lattice. In other words, the flight of stairs network step relies upon the number of squares: for instance, when 4 and 2 squares are utilized then $\tilde{Z}(k)$ is given in Fig.2a, 2.b and Fig. 2.c which are free of one another.

Let us consider a 4×4 matrix. The rank of $H(k)$ may be defined as:

$$\begin{bmatrix} H_{1,Rank(4)}(N) & H_{1,Rank(1)}(N) & H_{1,Rank(3)}(N) & H_{1,Rank(2)}(N) \\ H_{2,Rank(4)}(N) & H_{2,Rank(1)}(N) & H_{2,Rank(3)}(N) & H_{2,Rank(2)}(N) \\ H_{3,Rank(4)}(N) & H_{3,Rank(1)}(N) & H_{3,Rank(3)}(N) & H_{3,Rank(2)}(N) \\ H_{4,Rank(4)}(N) & H_{4,Rank(1)}(N) & H_{4,Rank(3)}(N) & H_{4,Rank(2)}(N) \end{bmatrix}$$
$$(14)$$

Hence the received signal is given by:

$$\begin{bmatrix} \tilde{Z}(k)_4 \\ \tilde{Z}(k)_1 \\ \tilde{Z}(k)_2 \\ \tilde{Z}(k)_3 \end{bmatrix} = \begin{bmatrix} H_{11}(N) & H_{12}(N) & H_{13}(N) & H_{14}(N) \\ 0 & H_{22}(k) & H_{23}(N) & H_{24}(N) \\ 0 & 0 & H_{33}(N) & H_{34}(N) \\ 0 & 0 & 0 & H_{44}(N) \end{bmatrix}$$
$$\times \begin{bmatrix} \bar{z}_4(K) \\ \bar{z}_1(K) \\ \bar{z}_2(K) \\ \bar{z}_3(K) \end{bmatrix} \quad (15)$$

Therefore, $H_{13}(N)$ and $H_{23}(N)$ are removed by $\bar{z}_2(K)$ and subsequently $H_{14}(N)$ and $H_{24}(N)$ are removed by the $\bar{z}_3(K)$. The NOMA signal receive by the BF is given by:

$$\begin{bmatrix} \bar{z}_4(K) \\ \bar{z}_1(K) \\ \bar{z}_2(K) \\ \bar{z}_3(K) \end{bmatrix} = \begin{bmatrix} H_{11}(N) & H_{12}(N) & 0 & 0 \\ 0 & H_{22}(N) & 0 & 0 \\ 0 & 0 & H_{33}(k) & H_{34}(N) \\ 0 & 0 & 0 & H_{44}(N) \end{bmatrix}$$
$$\times \begin{bmatrix} \tilde{Z}(k)_4 \\ \tilde{Z}(k)_1 \\ \tilde{Z}(k)_2 \\ \tilde{Z}(k)_3 \end{bmatrix} \quad (16)$$
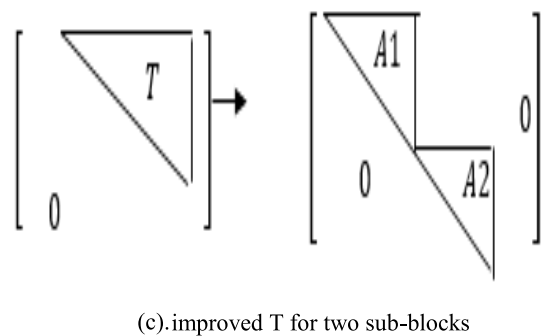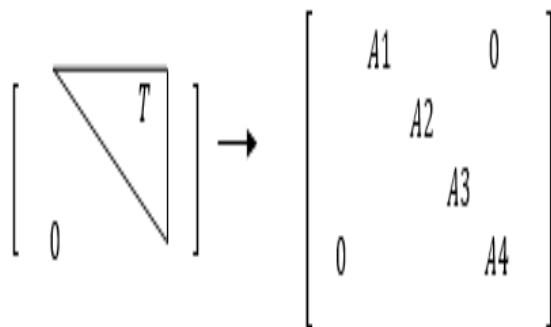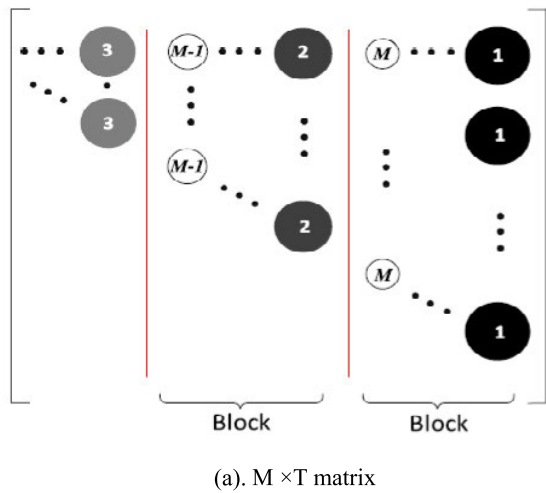
(a). M ×T matrix

(b). **improved T for four sub-blocks**

(c).improved T for two sub-blocks

FIGURE 2. a. M × T matrix. b. improved T for four sub-blocks. c. improved T for two sub-blocks.

From equation (15), it is noted that the signals are individually detected:

$$\begin{bmatrix} \bar{z}_4(K) \\ \bar{z}_1(K) \end{bmatrix} = \begin{bmatrix} H_{11}(N) & H_{12}(N) \\ 0 & H_{22}(N) \end{bmatrix} \begin{bmatrix} \tilde{Z}(k)_4 \\ \tilde{Z}(k)_1 \end{bmatrix} \quad (17)$$

$$\begin{bmatrix} \bar{z}_3(K) \\ \bar{z}_2(K) \end{bmatrix} = \begin{bmatrix} H_{33}(N) & H_{34}(N) \\ 0 & H_{44}(N) \end{bmatrix} \begin{bmatrix} \tilde{Z}(k)_3 \\ \tilde{Z}(k)_2 \end{bmatrix} \quad (17.1)$$

TABLE 5. Simulation parameters.

Parameters
Modulation :256-QAM and 64-QAM
Channel : Rayleigh
Carrier: 62
FFT: 256*256
Data signal : 30
Forward Error Correction: Constraint length (Lc) = 8, (Coding rate)R=1/4

Therefore, the NOMA signals $\frac{\bar{z}_4(K)}{\bar{z}_1(K)}$ *and* $\frac{\bar{z}_3(K)}{\bar{z}_2(K)}$ are identified instantaneously in the double stage.

V. SIMULATION RESULTS

The projected work is simulated by using the Matlab-2014b. The proposed work focuses to simulate the hybrid and conventional signal detection techniques to improve the latency performance and the computational complexity. Simulation parameters are specified in Table 5.

The complexity of the conventional QRM-MLD is (2+ 6M) C real convolutions [14]. The complexity of the hybrid techniques is (2 + 4C) M real convolutions. From (10), it is concluded that simply M divisions are deliberated as a replacement for the MC. The division by $B_{1,1}$ was not calculated since this process can be escaped. The assessment margins of a constellation points have only needed to be convolved by $B_{1,1}$ real factor. For 16 × 16 256-QAM NOMA, the requirement of real multiplications of hybrid technique is 16416 and conventional QRM-MLD is 25088. For 16 × 16.256-QAM NOMA, the requirement of real multiplications of hybrid technique is 65663 and the conventional QRM-MLD is 98816. Similarly, multiplication requirements for the BF are 36896, 36896 and ZF 102400, 397312, for 16 × 16 and 64 × 64 NOMA system [25], [26]. The BER performance of the different detection techniques for Massive-MIMO-NOMA structure is indicated in Fig.3. We have considered a 16 × 16 antennas at the transmitter and receiver part of the system and applied following detection techniques such as: (a) the hybrid (QRM-MLD-BF), (b) the conventional QRM-MLD, (c) the conventional BF and (d) ZF. At 10^{-3} BER, the proposed hybrid technique achieved a power gain of 12 dB, as equated to the 14 dB in the QRM-MLD, 18 dB in the conventional BF and 24 dB in the ZF. Hence, it is established that the suggested hybrid techniques achieved a minimum 2 dB power gain. In directive to further enhancement in the BER performance of detection techniques, we have considered 64 × 64 antennas at the transmitter and receiver part of the 256-QAM-NOMA
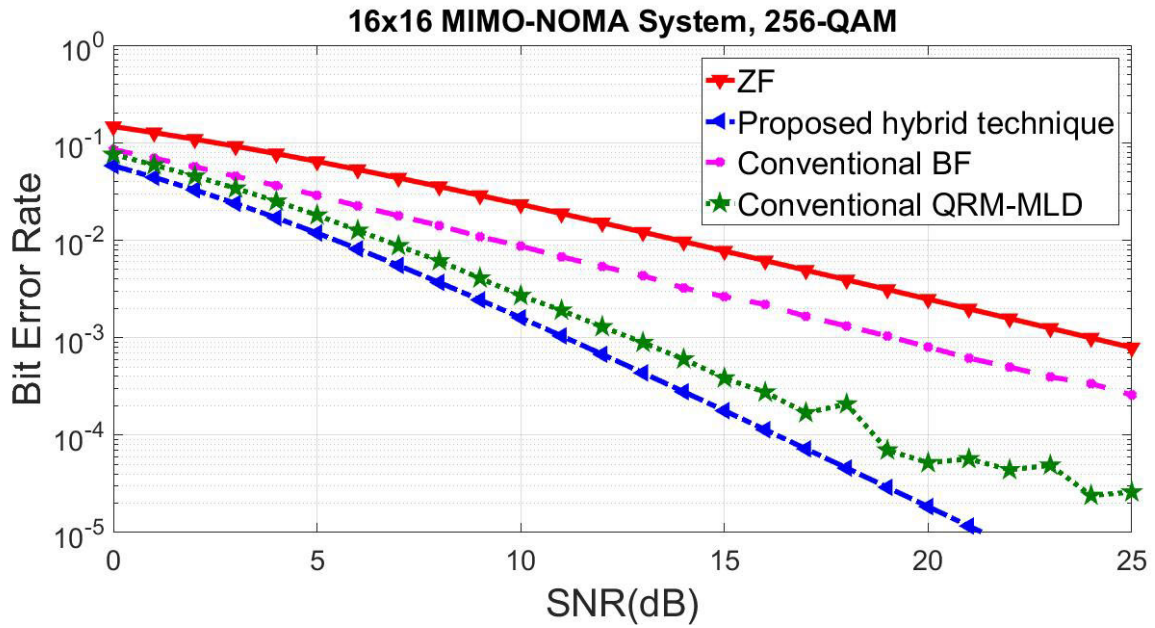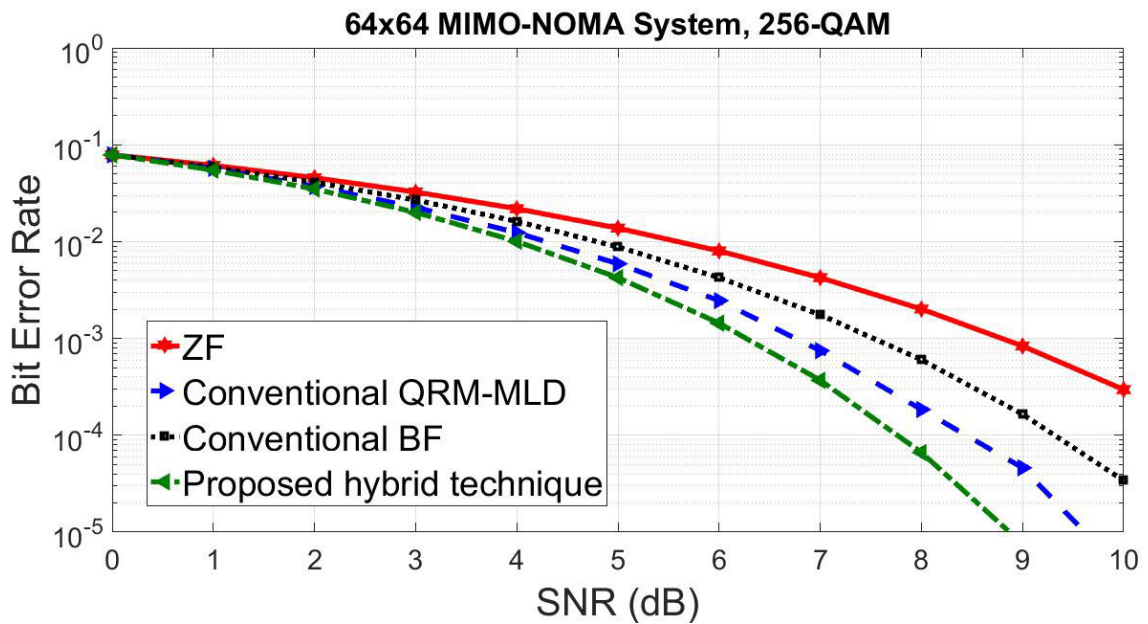
FIGURE 3. SNR vs BER 64-QAM.

FIGURE 4. SNR vs BER 256-QAM.

system. Figure 4 shows that the proposed hybrid technique achieved a better error performance as paralleled to the other detection techniques. At BER of 10^{-3}, the proposed hybrid technique achieved a power gain of 6.2 dB, as compared to the 7.1 dB using the conventional QRM-MLD, 7.8 dB using the conventional BF and 9 dB using the ZF. Hence, the proposed technique achieved an approximately 1dB gain. However, it is also noted that the performance of the detection techniques for 64×64-NOMA is better than the 16×16-NOMA system.

The peak to average power ratio (PAPR) performance of the detection techniques for 16×16-NOMA system is given in Fig.5. At the CCDF of 10^{-3}, the proposed hybrid techniques reduce the PAPR to 7.4 dB as compared to the 8.6 dB conventional QRM-MLD, 9 dB conventional BF and 9.7 dB ZF. Similarly, PAPR performance of detection techniques for 64×64 NOMA is shown in Fig.6. At the CCDF of 10^{-3}, the proposed hybrid techniques reduce the PAPR to 4 dB as compared to the 6 dB conventional QRM-MLD,
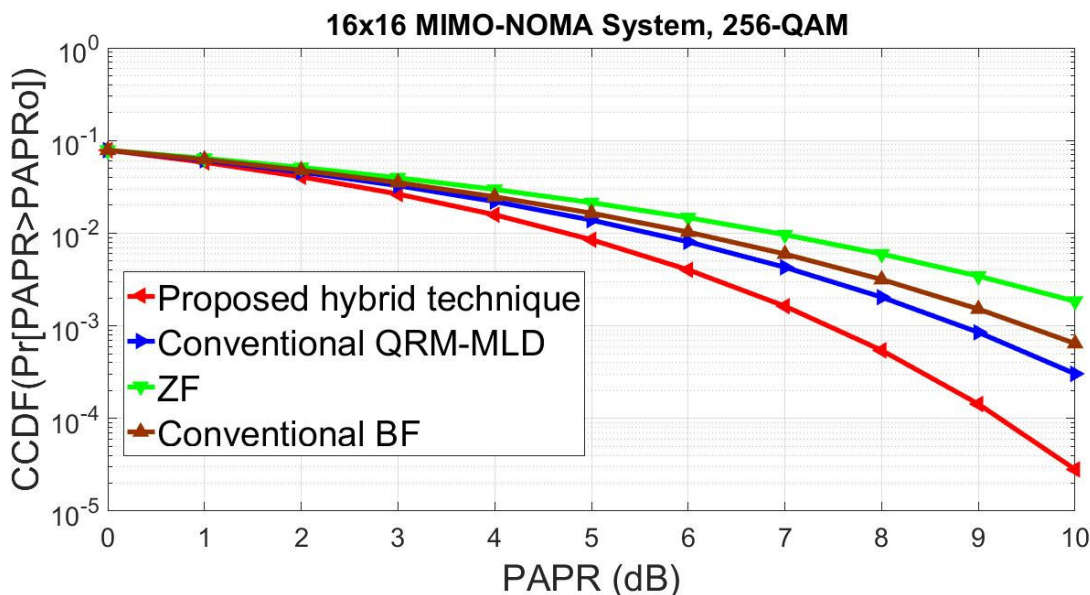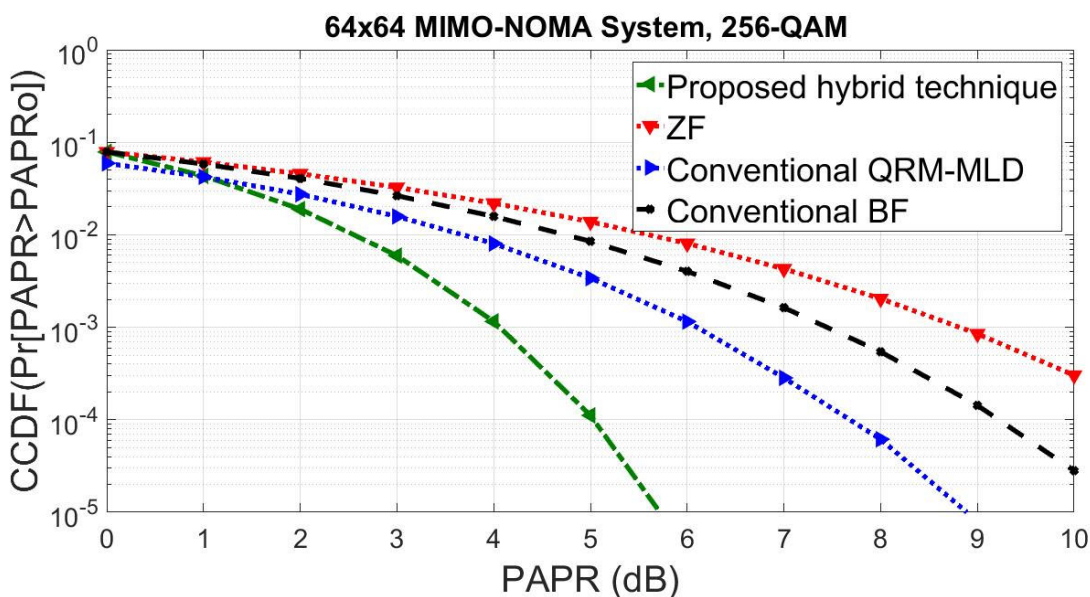
FIGURE 5. 16 × 16 SNR vs PAPR.

FIGURE 6. 64 × 64 SNR vs PAPR.

7.5 dB, conventional BF and 9 dB ZF. However, it is concluded that the 64×64 NOMA gives a better performance than 16×16 NOMA.

VI. CONCLUSION

The utilization of advanced technologies in smart hospital will reduce the time and cost involve in travelling from remote area to a standard hospital in town. It is predicted that the 5G technology will be utilize in almost all sectors like: hospital, education, industries, public and so on. The 5G network can attain the smart health care requirements by designing a cyber-system (also called healthcare 4.0). The 5G network has seen the needs of smart health care and IoT. The features of the 5G such as: low latency, seamless and deterministic network, smart spectrum policies make the 5G an important technology to sanction smart hospital with the IoT. In this article, we proposed a hybrid detection technique for the 5G network to improve the throughput and the computational complexity as compared to the conventional detection techniques. We investigated and established that the proposed low computational technique has enhanced the BER and the PAPR performance, and reduced the computational

complexity at the same time. It is also noted that the throughput of the scheme is boosted by increasing numbers of antennas at the transmitter and the receiver terminals. However, the complexity is also increased with increasing antennas.

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