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Major John W. Greenacre British Army

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# Assessing the Reasons for Failure: 1st British Airborne Division Signal Communications during Operation 'Market Garden'

MAJOR JOHN W. GREENACRE, BRITISH ARMY

Not since 1854, when Captain Lewis Nolan's vague dispatch of Lord Raglan's poorly conceived orders condemned Lord Cardigan and the Light Brigade to devastation, has the role of communications in a military defeat come under such scrutiny as it has at the Battle of Arnhem. An entire industry has grown around the literature of Arnhem, from contemporary accounts to modern analysis. Each author in turn has attempted to identify the seeds that grew into that heroic disaster. Many causes and contributing factors have been identified and many of the facts have become obscured by myth and hearsay during the intervening years. The issues surrounding the contribution of signals communications during the battle have not escaped that obscurity. Why does Arnhem provoke such emotion? Of the 8,969 men of the British 1st Airborne Division who took part in Operation 'Market Garden' between 17 and 26 September 1944 only 3,910 escaped to fight again.<sup>1</sup> Although Field-Marshal Lord Montgomery described the operation as being '90 per cent successful',<sup>2</sup> the Division was unable to take any further part in World War II.

Much of the popular knowledge of the Battle of Arnhem is based on Richard Attenborough's 1977 epic film *A Bridge Too Far*, based in turn on Cornelius Ryan's 1974 book of the same name. On the screen, we see meek officers of the Royal Signals not wishing to 'rock the boat'<sup>3</sup> before the battle, despite being aware of the inadequacies of their radio equipment. Later, upon arrival at the drop zone, those same officers report to the divisional commander that the radios are all quite useless having been delivered with the wrong crystals. The divisional commander himself, Major-General

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Major John W. Greenacre, British Army, Advanced Command and Staff Course .

Robert Urquhart, instigated the commentary in 1958 with his book *Arnhem*. He describes the same moment on the drop zone when, finding his signallers were having difficulty raising communications, he received 'the first intimation of a snag that was to grow and bedevil us almost to the end'.<sup>4</sup>

These two accounts of the same incident illustrate the way in which facts, when mixed with emotion can become misinterpreted or can be attributed with undue significance. In fact only two individual radio sets were delivered with the wrong crystals, those that were allocated to the US Air Support Signals Team from 306th Fighter Control Squadron in order to call for air support. Vital as these two sets were, the problems incurred by being delivered with the wrong crystals were far outweighed by untrained operators who received little or no briefings and the equipment being unable to be dismantled from their vehicles.<sup>5</sup> The latter failure caused the sets to be destroyed by enemy fire prior to them ever beginning to serve their purpose. As for Urquhart's account, his division had been condemned to destruction long before his signal communications began to bedevil him.

The 1st British Airborne Division was dropped over 60 miles into the enemy held Netherlands on the northern bank of the Neder Rijn, near the town of Arnhem. It was to seize and hold a bridge or bridges over the river. Between it and the relieving troops of the British 30 Corps were two further United States airborne divisions dropped to seize other river crossings, the 82nd at Nijmegen and the 101st at Eindhoven. Thus 30 Corps would drive north from the Dutch/Belgian border, linking each division in turn to form a bridgehead that would extend over the Rhine. This would allow Montgomery to launch his assault on the industrial heartland of Germany and end the war by Christmas.

Many risks had been accepted during the planning of Operation 'Market Garden': Urquhart's division would have to be dropped over a three-day period. The drop zones selected were over ten kilometres from the bridges in Arnhem. Moreover 30 Corps had only a single narrow road over which to advance over sixty miles. Intelligence identifying General Wilhelm Bittrich's II SS Panzer Corps in the Arnhem area had been largely ignored. These risks and others were realised in a catastrophic manner that even perfect signal communications would not have overcome.

There is no dispute that 1st British Airborne Division's communications were not as effective as was required. Had they been they might have at least been able to mitigate against some of those problems encountered during the early part of the operation. Due to those risks taken during planning, the Division during the first 36 hours, was under strength and found itself largely blocked by unexpectedly strong opposition still some distance

from its objective, the bridges in Arnhem. Urquhart's plan to seize the road bridge by *coup de main* had failed when the jeeps of Major 'Freddie' Gough's Reconnaissance Squadron were stopped in their tracks by elements of Major Sepp Krafft's SS Panzer Grenadier Training and Reserve Battalion. Even Lieutenant-Colonel John Frost's 2nd Battalion The Parachute Regiment, despite reaching the northern ramp of the main road bridge failed to seize the southern end following the demolition of the rail bridge further up the river. However the situation was not irrevocable at this point. Both 1st Battalion and 3rd Battalion The Parachute Regiment might still have been directed around the enemy blocking line to follow 2nd Battalion's route through to the bridge. With the full brigade holding the road bridge over the Neder Rijn the course of the battle may well have been altered.

In the event, coordinated efforts to redirect these battalions were hampered by a lack of effective communications between the Divisional Headquarters (HQ), 1st Parachute Brigade and its constituent units. With so much at stake it is hardly surprising that the reasons for the Division's communications being ineffective have received so much attention. Nearly every written account of the battle makes some comment on the role of communications and suggests possible reasons for failure. The men that took part in the battle have written many of these accounts themselves. Frost, commander of the 2nd Battalion The Parachute Regiment, Major Lewis Golden and Major Anthony Deane-Drummond, the adjutant and second in command of the Divisional Signals Regiment respectively and, of course, Urquhart. Understandably, their reports are subjective to some degree but most blame difficulties in communication on inadequate radio equipment and environmental factors.

This article will examine if it is possible to objectively assess if poor radio equipment alone was responsible for communication failures at Arnhem. If an objective assessment can be made and the equipment is found to have been theoretically capable of the tasks it was set then other possible reasons for failure will be explored. A modern signal communications prediction software model is used to assist this objective assessment. Focus is placed upon communication links between 1st British Airborne Division Headquarters, its subordinate brigades and battalions and between the divisional artillery headquarters and sub-units. All the links studied are high frequency (HF) band sky wave communications. The purpose of this piece is not to retrospectively lay the blame at any one door but rather to assess how risks taken in communications planning impact on operations during their execution.

On initial investigation it is difficult to understand why 1st British Airborne Division's communications failed at all during Operation 'Market

Garden'. The Divisional Signals Regiment had been in existence for over 18 months prior to the operation, having been formed in spring 1942. The initial 'organisation of this regiment, as might be expected, was largely experimental',<sup>6</sup> however the order of battle had been refined through constant exercise and experimentation. Lessons had also been learnt in this area from the experiences of 6th Airborne Division's operations in Normandy during Operation 'Overlord'. Although the Regiment had not fought as an entire entity before Arnhem, most of its personnel had taken part in previous airborne operations. Golden had fought in North Africa, Sicily and Italy and Deane-Drummond in the latter theatre both as signals officers with 1st Parachute Brigade. Likewise, the standard operating procedures of the regiment had been refined over that 18-month period through observation, trial and practice so that the officers and men were confident that they could fulfil their role in battle. The radio equipment to be used for communications within the division was tried and trusted. The limitations of all of these sets were recognised, but they had worked well during the Normandy landings and beyond with 6th Airborne Division. With a practised if not battle-experienced signals regiment and radio equipment with a proven track record just what did precipitate the recorded communications failures?

In order to consider all those factors that possibly contributed to the early failures in communication, the training, planning and preparation that took place before the battle must first be examined. Airborne operations brought unique challenges to the signals community beyond the technical restrictions that will be considered later in this article. In particular airborne signals would always be at a disadvantage due to the nature of airborne warfare. 'The more conventional formations could ensure that their radio networks were tuned in and poised ready to open up as soon as the start line was crossed and radio silence was lifted. In an airborne division there would be no such possibility.' Added to this is the prospect of signals equipment being damaged or destroyed on landing and the probability of having to reconfigure the radio network if a unit fails to arrive on the drop zone. High standards of training and preparation were the only way in which to compensate for these complications. 'Reliance would have to be placed to an exceptional extent on good training and experience on exercises.'<sup>8</sup>

Royal Signals personnel were responsible for maintaining communications from Divisional HQ to the headquarters of the brigades and to the relieving force of 30 Corps. Communications from brigade headquarters to the battalions was also a Royal Signals responsibility as was artillery communications at regimental headquarters level. Communications within battalions and through the other arms, such as the Royal Engineers

(RE) was the responsibility of those respective units. Communications from Forward Observation Officers (FOO) to 1st Airlanding Light Regiment Headquarters was a Royal Artillery (RA) responsibility. Royal Signals personnel were trained at the School of Signals and at Signal Training Centres. Other arms signallers were trained with the assistance of Royal Signals instructors at signal training wings within their primary training establishments.<sup>9</sup>

Inevitably there was some disparity in the level in training between Royal Signals personnel and other arms signallers. The discrepancy in the level of training between the other arms was even more apparent. The Royal Engineers for instance commented after the battle that, 'the Divisional RE had only recently been issued with their sets which were manned by clerks, tradesmen and sappers and all sorts of people already with other primary tasks. Much more training by personnel whose sole job is WT [wireless transmission] is required in the future.'<sup>10</sup>

Contrast this with the RA who established its own signal training regiments throughout the war. This resulted in a level of signals communication capability at Arnhem that 'the divisional gunners demonstrated, as gunners had done before, displaying an expertise that seemed to be denied to other operators'.<sup>11</sup> The imperative behind the requirement for the highest levels of skill in signals communication for the RA is clear. Infantry battalions and armoured regiments could still operate to some extent even in the event of a complete communications failure. For the artillery a break in communications between guns and observers would render those guns useless without target information to prosecute. The communication links studied for the purposes of this article were all manned by Royal Signals or RA personnel all of whom were trained to high levels. Training therefore is unlikely to have been a factor in those early communication failures.

As has been described, 1st British Airborne Division's mission in Operation 'Market Garden' was doomed to failure before the first Horsa glider or Dakota aircraft ever left the runway due to excessive risks taken during planning. How the planning process impacted specifically on signals communications is less obvious. Since the Operation 'Overlord' landings the Division had been held in reserve. During that time 1st Allied Airborne Army had planned some 16 operations for the Division, following the progress of the allies out of Normandy, across France and into Belgium and Holland. Those operations, represented by splendid titles such as 'Wastage', 'Wild Oats' and 'Transfigure' were cancelled one after the other as the circumstances for which they were planned were overtaken by events. In late August the planning for one such operation, "Linnet" was begun. The plan was for the entire 1st Allied Airborne Army to be dropped behind the

enemy and seize roads in the areas of Tournai, Lille and Courtrai in order to cut off the Germans' retreat. The second iteration of this plan was eventually cancelled on 5 September 1944.

At the beginning of September the 1st Allied Airborne Army was put under command of Montgomery. Planning began on Operation 'Comet'. 'Comet' was a carbon copy of what would become 'Market Garden' except that it expected 1st British Airborne Division and 1st Polish Parachute Brigade only to seize all the bridges from Grave to Arnhem. 'D-Day' was to be 10 September and take off at 0600 hours, but at 0200 hours on 10 September, senior officers at division headquarters were awakened and told that the operation was cancelled.<sup>12</sup> By 1500 hours on the same day the Divisional staff had been given new instructions to begin planning 'Market Garden' to take place in less than one week's time. 'Market Garden' would closely follow the plan for Operation 'Comet' but would use the same order of battle for Operation 'Linnet'. Signals instructions issued for 'Market Garden' nearly all referred to orders issued for 'Linnet'; 'Sig[na]l arrangements are almost exactly as for Op 'Linnet'. The [orders] issued for that op[eration] will therefore hold except where amended herein.<sup>13</sup> These were orders that were by now over two weeks old and had been superseded by two further operations. Extracts of the signals instructions for 'Linnet' were copied in 'Market Garden' orders including references to locations around Tournai. A lack of time for planning inevitably drove these short cuts but confusion was bound to occur as a result.

Despite all this the Division had performed well in the past albeit not as an entire formation. It is not possible that the level of training could have fallen to such an extent since the North Africa campaign so as to precipitate the signals failures at Arnhem. Likewise, while the planning process may have been difficult it would have been similar to that experienced by 6th Airborne Division that performed admirably during Operation 'Overlord'. Planning and training therefore can only be considered subsidiary factors in the communications failure experienced during the first 36 hours of the battle. Other causes must have been responsible for more considerable effects.

To the men fighting the battle, both signallers and otherwise, some of the possible causes would have been all too apparent. As the operation progressed enemy action intensified. On the bridge in Arnhem 'the Brigade Staff and their signallers never ceased in their efforts to establish communication. The attic in which they laboured was hit repeatedly, but they never flagged.'<sup>14</sup> The most obvious effect of enemy action was the physical loss of valuable, highly trained signallers. By the end of the battle of the 348 men of the Divisional Signals Regiment that flew into Arnhem, 28 were

dead and 171 were missing, a casualty rate of more than 50 per cent.<sup>15</sup> These losses could be ill afforded as the order of battle had been scaled down to a minimum so as to save aircraft. In addition 'experience showed that reserve detachments must be provided on a lavish scale to allow for initial casualties',<sup>16</sup> reserves that at Arnhem simply were not available. The communication plan was bound to suffer.

The attrition of signallers was not the only consequence of the unexpectedly fierce enemy opposition to impact on signals communication. As well as soldiers, equipment was also bound to suffer. 'A mortar bomb had landed in the attic during the day and... it had burst amongst the signaller's wireless sets.'<sup>17</sup> Resupply of vital signals equipment was essential. Equipment was dropped by air throughout the battle including 6 No. 76 radio sets, 17 No. 68P sets and 29 No. 22 sets.<sup>18</sup> However, the same enemy attention that was causing the attrition of equipment was also making movement in order to collect dropped stores very difficult, those that is which did not fall directly into enemy hands. In fact the divisional logistic personnel only managed to collect 7.4 per cent of the total 106 tons of stores dropped in and around Arnhem.<sup>19</sup> Again, as radio sets failed or were destroyed communications were eroded.

More predictable than the loss of radio sets was the use of batteries. Battery resupply and recharging was another casualty of enemy action. The No. 68 set ran off primary batteries, which needed exchanging when they ran flat. The Divisional Field Workshop held 240 spare batteries for the No. 68 set.<sup>20</sup> It is unlikely that all these batteries were flown in as the Workshop was only allocated four Horsa gliders for the landings.<sup>21</sup> In any case, as the battle extended beyond the predicted three to four days, battery resupply would be required. A supply of 110 batteries of all types per day was expected by air-drop during the battle.<sup>22</sup> Collection of these batteries would have suffered in the manner already described. The Nos. 19, 22 and 76 sets all ran off secondary batteries that required recharging. Recharging was an activity that had been fraught with problems throughout the war. Originally the responsibility solely of signals electricians, the process had been decentralised to be carried out by unit driver mechanics. The advantage of more accessible recharging was countered by battery life being reduced through less expert handling. Battery charging required the movement of batteries between radio sets and charging points. 'This was often quite impossible to guarantee under battle conditions and.... communications were liable to failure due to batteries running down.'<sup>23</sup>

Along with the batteries, petrol had to be distributed to keep the charging sets running and the enemy also restricted this process. This is evident



by the 300 gallons of petrol that remained not issued in the divisional administrative area at the end of the battle.<sup>24</sup>

Although debilitating in the long term, failures in signals communication were apparent before the attrition of signals manpower, equipment and batteries through enemy action became acute. Apart from at the bridge, the enemy did not severely affect the signals effort until later in the battle by which time the Division was drawn into the perimeter formed at Oosterbeek. By then many of these difficulties were overcome by the close proximity of all units. The enemy then can only be considered to have had a subsidiary effect on signals communication during the early part of the battle.

### **The Role of Other Methods of Communication**

‘Signals failures were no new phenomenon’.<sup>25</sup> The Division had experienced limitations in signals communication on both exercise and operations. Alternate methods of communication were often used in order to complement and bolster radio signalling. This was highlighted during an exercise held in England just weeks prior to the operation. Captain Bill Marquand of J Section, 1st Parachute Brigade Signal Section had experienced particularly poor radio communication during the exercise in the urban environment of Grimsby. ‘He therefore ensured that a greater than usual supply of field telephones and cable was taken [to Arnhem], hoping that this might compensate for radio failures’.<sup>26</sup> In the event, the effect of enemy action on the cable negated the results of Marquand’s foresight.

Dispatch riders (DRs) riding 125cc Royal Enfield ‘Flying Flea’ motorcycles were available to carry messages between HQs as an alternate communication method. Unfamiliarity with the ground, enemy action and the confused nature of the battle were all against the DRs getting the message through. A DR sent to inform 1st Parachute Brigade of a frequency change on D-Day returned to Divisional HQ ‘to report that he could not find them’.<sup>27</sup>

The Dutch telephone system could have provided an effective alternative means of communication. This was recognised before the battle and orders were issued that no destruction of infrastructure communications was to be allowed during the battle. The Germans made good use of the telephone system throughout the battle.<sup>28</sup> The British were more reluctant to do so. They believed that Dutch staff with German loyalties might intercept their communications and use them against them. This is not surprising when it is considered that The Netherlands ‘contained a higher proportion of NAZI sympathisers, always willing to betray resisters, than

any other occupied country'.<sup>29</sup> In actual fact the Dutch Resistance 'had reliable men and women placed in the local telephone exchange'.<sup>30</sup> In the event the British failed to make widespread use of this method of communication.

With alternate means of communication either rendered ineffective or not fully utilised there was little to reinforce or replace radio signals communication when it began to fail. This lack of alternative methods was another subsidiary factor in the wider failure of communications during the battle.

### **Technical Factors**

If it is taken that all those subjects discussed so far made only a subsidiary contribution to early failures in signals communication then clearly some other factor must bear the majority of the blame. Although the Division was contained, harassed and physically worn down in the Oosterbeek perimeter from D+2 until D+9 the damage to the Division's mission was done during the initial 36 to 48 hours of the battle. By the evening of D-Day 2nd Battalion The Parachute Regiment was isolated on the main road bridge in the centre of Arnhem. The 1st and 3rdst Battalions had stalled on their approach into Arnhem, checked by unexpected opposition. Over the following 24 hours a series of uncoordinated attacks attempted to reach the bridge, each along the same route. The attacks were repulsed resulting in four battalions, 1st, 3rd and 11th Battalions The Parachute Regiment and the 2nd Battalion The South Staffordshire Regiment, being practically destroyed as fighting units. The lack of coordination was the crux and the failure of communications between Divisional HQ and the bridge was a significant factor within it.

Communications failure at Arnhem has traditionally been blamed upon the technical inadequacies of the signal equipment employed combined with unfavourable environmental factors. This was certainly the opinion of Urquhart. 'We were soon to learn that our radio sets were inadequate for the purpose, and their effectiveness was to be further limited by the sandy, heavily-wooded terrain.'<sup>31</sup> The official report agrees stating that on the divisional command net, 'it is found that the range of the [No. 22] set is not always sufficient, and the receiver owing to its lack of sensitivity frequently made communications most difficult'.<sup>32</sup> It is true that even Deane-Drummond was, before the operation, concerned with 'the inadequacy of the wireless sets' and advised that 'communications would be most unreliable, especially in view of the built-up nature of the ground'.<sup>33</sup> How did an elite fighting formation such as 1st British Airborne Division, on the

cutting edge of military development come to be so poorly equipped in such a key area?

Between the wars the Army had suffered more than the RAF and Royal Navy from a chronic lack of funded development in the area of radio signals communications. Ships and aircraft required radios in order to conduct routine peacetime activity; the Army did not. By the time of the 1940 inception of airborne forces in Britain development had only just begun to catch up. 'The effect of this poor start was to bedevil army radio performance for much of the period of hostilities.'<sup>34</sup> Airborne forces brought their own problems to the process of radio development and manufacture. Widely spread airborne units needed powerful radios in order to bridge the gap. However, being delivered by air the equipment had to be light enough to be carried in a glider or under a parachute. 'Thus the ideal equipment had not only to give a higher performance than standard types, but had to be more portable or more easily transportable and at the same time be capable of withstanding very much rougher handling. Since these very same ideals had for many years been striven after to a large extent in the design of all new standard equipment there could be no rapid solution.' Airborne communicators were pursuing the holy grail of smaller, lighter, tougher more powerful radios. They simply did not exist at the time of Operation 'Market Garden'.

Of the four main sets in use for intra-divisional communications three had been used extensively in operations by both airborne and conventional formations and units. By 1942 vehicleborne 'short range wireless sets had been standardised into two new types, the Nos. 19 and 22'.<sup>36</sup> Both were carried in jeeps into Arnhem by the gliderborne element of the Division. They had been used extensively since their introduction in all theatres in armoured and non-armoured vehicles. During the Battle of Arnhem the No. 19 High Powered (HP) was planned for use for artillery rear link communications while the No. 22 was used widely throughout the division, brigades and battalions. The No. 68 set provided manportable communications and the No. 68P and the No. 68R were both used in the brigades and battalions. The fourth set in use was the No. 76. This had been conceived in 1941 in direct response to the requirement for 'medium range wireless sets suitable for airborne formations'.<sup>37</sup> The No. 76 differed from the previous three sets in several key areas. It was crystal controlled and therefore did not require manual tuning. It used a long wire antenna rather than a rod and was therefore immobile. It could only operate in carrier wave (CW) mode i.e. it could only send Morse code whereas the other three sets could work in CW or radio telephony mode (RT) and send voice as well. It had the advantage of much greater range over the Nos 19, 22 and 68 sets.

Because of its characteristics it was used mainly as a backup set, monitoring the divisional secondary frequency.

Of the mobile sets available at Arnhem the most powerful was the RA's No. 19 HP Set. It was bigger and heavier than the No. 22 Set but as both were carried by jeep this was largely immaterial. The No. 19 HP Set generated up to 30 times as much power as the No. 22 and had a range up to five times greater and yet only two sets were included on the operational signals instructions to be used for artillery rear link communications. In the post operational report the RA were clear that 'the No. 19 HP set with its greater range and better receiver is more suitable [than the No. 22]'.<sup>38</sup> However, at the time of the operation the 'higher current consumption'<sup>39</sup> of the No. 19 HP and its consequent requirement for more batteries and bigger, heavier charging equipment were considered to outweigh its advantages in performance. That advantage was eventually realised and one of the available sets was switched in order to take command of the RA net. However this was not done until late on D+1 when the situation had already become very difficult. When the situation had deteriorated further still a spare No.19 HP 'was moved to an attic in the [Hartenstein] Park Hotel and a 34 foot rod aerial erected to try and get early as possible contact with ground [Forward Observation Officers] FOOs'.<sup>40</sup> Significantly the post operation report strongly recommended that No. 19 HP Sets should replace the No. 22 Sets as a temporary measure for intra-divisional communications.<sup>41</sup>

An even more pervasive factor than weak equipment was also working against the signallers at Arnhem. The Army had restricted itself to utilising a relatively narrow frequency band for ground communications. The band of frequencies below 1.5 MHz was considered unsuitable for use due to the number of high power civilian transmitters using this area. Frequencies above 30 MHz were considered to be susceptible to screening by terrain, rendering communications far too unreliable.<sup>42</sup> Thus the band available stretched from 1.5 to 30 MHz, considered HF in modern terms. The range of HF signals in the sky wave, (in which the rod antennae available were designed to be used) is very limited. It was 'all too patently evident that the ranges fell far short of what was required for modern operations' and that 'nothing less than a drastic change of policy' could effect a complete remedy.

That change of policy could have been prompted by the work of the Army Operational Research Group (AORG). The AORG had been formed to develop, assess and bring into service new systems and pieces of equipment. As early as August 1943 the AORG concluded that 'the Army could benefit greatly by using [Very High Frequencies] VHF from formed 30 to 50 MHz ... regardless of the topography of the land or its electrical features'.<sup>44</sup> The

report containing the assertion went against the accepted contemporary principles of communication. There was therefore no 'drastic change of policy' and the new ideas were not immediately taken up. The AORG warned in late 1943 that persisting in using HF for sky wave communications would result in 'a particularly difficult problem for Army mobile sets. In some theatres of war the ranges are bound to dwindle to insignificance.'<sup>45</sup>

A knock-on effect of the narrow frequency band available was that 'even by the most careful assignment of adjacent frequencies to users who were geographically as widely separated as possible considerable interference was inevitable'. Highly accurate tuning was required in order to overcome the probability of interference.<sup>46</sup> This was often difficult while mobile or when under the sort of conditions experienced by the signallers at Arnhem.

The technical limitations of weak equipment combined with the narrow frequency range, do appear therefore to have been a plausible reason for the failure in communications in the early stages of the Battle of Arnhem. This plausibility has, by some commentators been rashly translated into stated fact that in the intervening years has become the accepted truth. However the technology is now available to test the theory.

### **Assessing the Technical Factors**

Communications on the divisional command net and artillery net have been studied for both D-Day and D+1. The location of various radio sets during these two days has been extracted from many of the sources listed in the bibliography. The radio nets and frequencies themselves have been taken from net diagrams contained in the official Report on Operation 'Market Garden' held at the Public Record Office. The official report is at Appendix 3. The locations and portions of the nets studied are represented below superimposed on a modern map of Arnhem.

This information was then fed into the ICS Telecom radio modelling and analysis tool supplied by Advanced Topographic Development and Images Ltd (ATDI). Other factors were also fed into the model by ATDI in order to replicate the types of radios being used and the conditions around Arnhem at the time of the battle. These included antenna characteristics, atmospheric noise and environmental conditions.

The results of the analysis demonstrated a probability of communication between two stations. This was derived from a judgement based on the margin between the signal that a receiving station required to operate and the actual signal received based on the model. This was expressed in

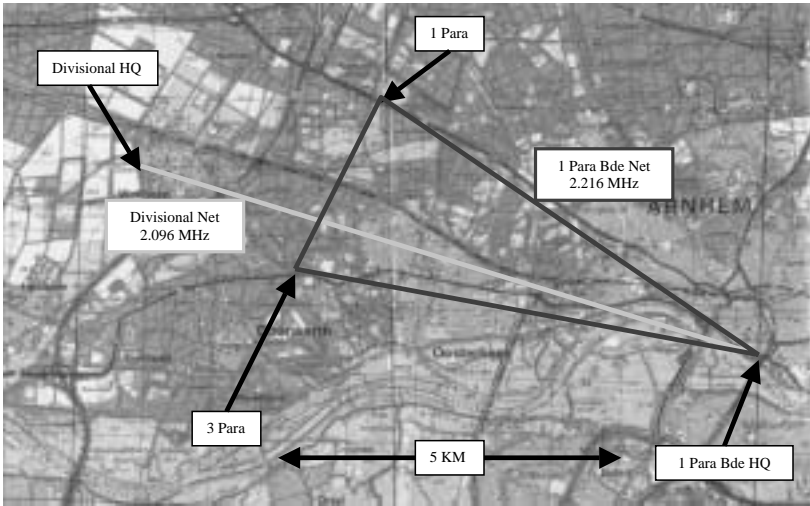


FIGURE 1 PART OF THE DIVISIONAL COMMAND AND 1 PARACHUTE BRIGADE NETS AT THE CLOSE OF D DAY

decibels (dB). It was judged that a margin of 10dB would be required for a signaller to be able to effectively work a communications link. Modern signallers are expected to work down to a margin of only 6dB but this

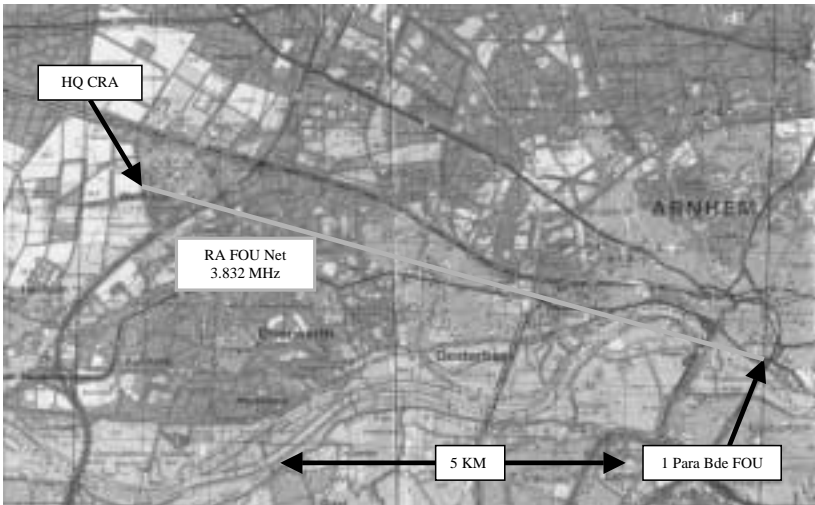


FIGURE 2 THE LINK BETWEEN HQ RA AND 1 PARACHUTE BRIGADE FORWARD OBSERVATION UNIT (FOU) ON D DAY

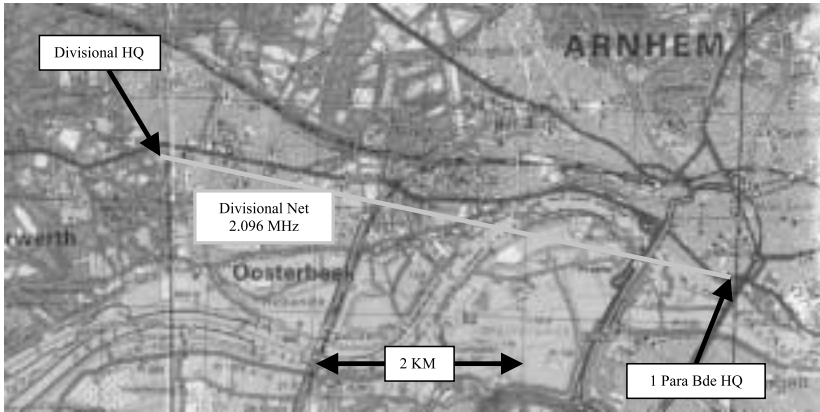


FIGURE 3 THE DIVISIONAL HQ LINK TO HQ 1 PARACHUTE BRIGADE ON D+1 ONWARDS

margin was increased to 10dB in order to take account of the difficulties that operating during the battle would have presented. Any margin below 6dB (including negative margins) was judged as having a low probability of communication, offering perhaps only a ten per cent chance of success. This probably represents an unworkable link. A link with a margin of 6dB to 9dB was judged as having a medium probability of communication. This might represent a 50 per cent chance of establishing a workable link.

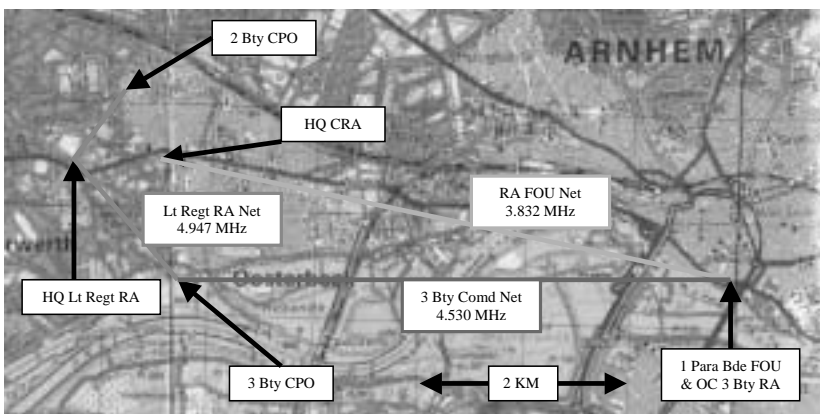


FIGURE 4 PARTS OF THE RA FOU NET AND THE LIGHT REGIMENT RA COMMAND NET AND 3 BATTERY NET

TABLE 1 RESULTS FROM RADIO MODELLING ANALYSIS

Net	Station A	Station B	Radio Set	Frequency MHz	Margin dB	Communication Probability
<b>D-Day</b>						
Divisional Command	Divisional HQ	HQ 1st Parachute Brigade	22	2.096	6	Medium
	HQ 1st Parachute Brigade	1st Parachute Battalion	68		3	
	HQ 1st Parachute Brigade	3rd Parachute Battalion	68		3	
	1st Parachute Battalion	3rd Parachute Battalion	68		16	
HQ RA FOU	HQ RA	1st Parachute Brigade FOU	22	3.832	4	Low
<b>D+1 (and onwards)</b>						
Divisional Command	Divisional HQ	HQ 1st Parachute Brigade	22	2.096	13.5	High
HQ RA FOU	HQ RA	1st Parachute Brigade FOU	22	3.832	15	High
	HQ LT Regt RA	2 Battery RA	22		29	High
	HQ LT Regt RA	3 Battery RA	22		40	High
3 Battery RA	3 Battery RA CPO	OC 3 Battery RA	22	4.530	13	High

Source: Extracted from Unpublished Report: John Berry, *Communications at the Battle of Arnhem: A Modern Day Technical Analysis* (ATDI 2003).

Nonetheless it would take very little change in conditions, such a No. 22 Set poorly tuned to its antenna, in order to render the link ineffective. A high probability of communication arises when there is a high margin, over 10dB. These links are considered robust and can withstand significant problems through tuning error or antenna damage. These links were considered to have a 90 per cent or better chance of providing communications.<sup>47</sup> The results of the analysis from the model are expressed in the table above.



### **Interpreting the Analysis of Technical Factors**

On initial sight these results are difficult to interpret. The results from D-Day in particular appear somewhat confusing. The low probability of communications between HQ 1st Parachute Brigade and 1st Battalion and 3rd Battalion The Parachute Regiment at the close of D-Day is certainly a function of the limitations of the No.68 Set attempting to communicate over the distances involved between them. At the close of D-Day both battalions had been halted by Major Kraftt's hasty blocking line nearly five miles in a direct line from the Brigade HQ on the bridge. The No. 68 Set had a predicted maximum range of only five miles on RT, however as noted by the official report, 'the range attributed to sets was nearly always found to be grossly exaggerated'.<sup>48</sup> The lack of communications predicted by the model is confirmed by the official report. The 3rd Battalion The Parachute Regiment recorded that 'during the night [of 17 September] there had been no wireless communication [with Brigade HQ]'.<sup>49</sup> Commander 1st Parachute Brigade's diary states that from 1900 hours on D-Day 'communications with 1 Para Bn were bad and from this time and [Brigade HQ] had practically no more information from them'.<sup>50</sup> Likewise the high probability of communications between the two battalions at this stage is also unsurprising considering the distance involved. In the evening of D-Day the two battalions were less than two miles apart, well within the capability of the No. 68 Set.

The model shows that there was likely to be a medium probability of communications between Divisional HQ on the edge of landing zone Z and 1st Parachute Brigade HQ on the bridge. The official report shows that communications between the two HQs was achieved at 1607 hours on D-Day when both were still on their respective drop or landing zones. The brigade moved off the drop zone at 1645 hours and by 1730 hours communications had been lost when a dispatch rider was sent to locate them.<sup>51</sup> This loss of communications is not surprising. The margin predicted by the model is only 6dB, on the lower limit of what might be possible. Only a small error in tuning or radio configuration would be enough to lose communications well before the bridge was reached. The artillery link between HQ RA and 1st Parachute Brigade FOU, over the same path but on a different frequency, produced a slightly lower margin and was therefore less likely to have communications although little evidence exists to support this.

The analysis from the model appears to present a far more coherent picture for D+1. All links, whether command or artillery, show a high probability of communications. This is to be expected as Divisional HQ,

HQ RA and the artillery gun lines moved off the landing zones and into the village of Oosterbeek. This closed the distance to the bridge down to around three miles, well within the capability of the No. 22 Sets involved. On the ground however, communications between Divisional HQ and HQ 1st Parachute Brigade did not improve in line with the results of the analysis. There was still no reliable radio communications between the bridge and Divisional HQ when they reopened in the Hartenstein Hotel at 1740 hours on D+1. In fact communications were not established until 0820 hours on D+3, 20 September. So momentous was this occasion that normal routine was disturbed in order to announce the fact. 'The [Divisional] Commander held a conference at 0800 hrs. In the middle, GSO 3 (Ops) reported that 1 Para Bde had come up on the command net.'<sup>52</sup> Unfortunately by this time 1st Parachute Brigade HQ and the fighting force led by Frost's 2nd Battalion were in a desperate situation on the bridge. Within 12 hours of establishing communications they were overwhelmed, the bridge was back in German hands and 1st British Airborne Division's mission was all but unachievable. Why then was this communication link so difficult to establish when the analysis of the model suggests that the probability of communications should have been high?

Some veterans have suggested that it was the location of Arnhem itself that was to blame for poor communications. A few veterans, both German and British have made comments to the effect that 'the location was a wireless mystery'.<sup>53</sup> There is no obvious reason why this should be the case. The ground conductivity of the area is not unusual (3–30 milli-Siemens per metre) and does not present any difficulties to communication. There was no recorded electrical storm activity at the time of the battle and the barometric pressure would have had only negligible effect on communications.<sup>54</sup>

If the area had presented unique challenges to communication then it might be expected that all links would be affected by it. This however is not the case. All of Light Regiment RA's links appeared to function although many of these were over relatively short distances. The HQ RA net was working. Even the Divisional HQ link to the bridge was reliable after 0820 hours on D+3. Of particular note is the link maintained by 3 Battery of the Light Regiment RA. This link was maintained from D+1 until the evening of D+3 between the Officer Commanding 3 Battery, Major Dennis Munford on the bridge and the battery command post near Oosterbeek lower church. The battery's gun lines were in support of 1st Parachute Brigade hence the Officer Commanding, Major Munford was attached to the Brigade HQ on the bridge. The comparison of this link with the Divisional HQ link to HQ 1st Parachute Brigade is interesting. They were

almost exactly the same in terms of length and both used the same equipment at either end of the link. In addition, the margin that leads to the probability of communications expressed in Table 1 is almost identical for the two links. What then caused one of them to not function for the first 60 hours of the battle while the other was perfectly operational 'apart, that is, from a few minor hic-ups and interruptions on the way'.<sup>55</sup> It is true that the 3 Battery link had a more direct path over the flood plain of the Neder Rijn while the Divisional HQ link had a path over urban areas. However the frequencies in use were very low and 'at the lower end of HF terrain shows no appreciable additional loss [to a signal]'.<sup>56</sup> In fact there appears to be no technical reason for the discrepancy. If 3 Battery was able to maintain their link there should have been no reason technically why Divisional HQ should not also have had communications with the bridge. 'Communication from Hartenstein to the bridge was not only possible, but should have been easy.'<sup>57</sup>

The radio modelling and analysis tool, in conjunction with evidence from reports and accounts, has therefore demonstrated that the failure of communications during the early part of the battle for Arnhem was unlikely to be the fault of equipment failure. Furthermore a summary of historical reports and contemporary accounts shows that there was no widespread failure of communications within the Division. However, the crucial link between Divisional HQ and 1st Parachute Brigade on the bridge did not function for 60 vital hours from D-Day until D+3. If not technical factors, what then did cause this link to fail and how significant were the repercussions?

### **Procedural Factors in Failure**

With technical factors largely discounted, the true reason for the failure of the radio link between Divisional HQ and 1st Parachute Brigade HQ during the critical early stages of the battle can be traced in reports and first-hand accounts. In particular the official operational report and Golden's account provide a clear view of the procedural events that led to the failure of this vital communications link. In addition a further procedural signals lapse can be demonstrated to have contributed indirectly to the command, control and communications confusion that blighted the attempts to mount a coordinated reinforcement of the troops on the bridge on D+1 and D+2. On another day these procedural faults may have gone unnoticed and the operation could have proceeded without remark. At Arnhem the time and circumstances under which they were exposed and to some extent pure bad luck lowered the chance of success of the entire operation.

## HQ 1st Parachute Brigade and Divisional HQ Procedures

The procedural factors leading to the failure of the crucial commander to bridge radio link have in fact already been alluded to elsewhere in this article. They began as HQ 1st Parachute Brigade moved off the drop zone. The HQ should have had four No. 22 sets, one for the commander's jeep, one to communicate back to Divisional HQ and two spares. It had been decided to use one of these spare sets to replace the No. 68P Set designated to control the brigade command net thus boosting communications to the three parachute battalions. In fact only two of the four No. 22 sets arrived intact on the drop zone.<sup>58</sup>

Now there is some discrepancy between the two main sources. Golden reports that the Brigade Commander decided to retain one of the No. 22 sets in his jeep and continue to utilise the second to control the brigade command net. This left only a No. 68P set available to maintain the link rearwards to Divisional HQ.<sup>59</sup> The official report presents a different explanation for the presence No. 68P set on the divisional command net. It reports that 1st Parachute Brigade HQ was configured in this manner 'since they had not waited for their glider element to join them before moving off'. Hence they never married up with their No. 22 sets that arrived by glider.

Whichever account is accurate a conscious decision was made by the Brigade HQ and consequently 'by design it was using a No. 68P set for its link to divisional headquarters instead of the higher powered 22 set'.<sup>61</sup> This severely decreased the margin detailed in Table 1 and by 1730 hours on D+1, only 45 minutes after moving off the drop zone, 1st Parachute Brigade HQ was beyond the range of effective communications with Divisional HQ.<sup>62</sup>

This situation might have been recovered once a No. 22 Set was put back onto the brigade's rear link. However at 1900 hours 'a decision was taken which had a lasting effect on this radio net'.<sup>63</sup> The primary frequency of the divisional command net was experiencing heavy interference. The source of this interference is subject to debate. Golden and the official report agree that it was a powerful British transmitter while Deane-Drummond suggests that it may have been a German station.<sup>64</sup> Whichever was the case the interference made the primary command frequency unworkable. The decision was therefore made to change over the divisional primary and secondary frequencies. As standard procedure all stations on the divisional command net would have been given warning of the frequency change over the net and a time to effect that change. This would ensure a coordinated frequency change and minimal loss of communications.

However, 1st Parachute Brigade HQ, operating its No. 68P set was already out of range and therefore were not informed of the frequency change. Aware of this, Divisional HQ made repeated attempts to contact Brigade HQ by other means. A motorcycle dispatch rider was sent to inform the subordinate HQ of the change but returned at 2050 hours having failed to find them.<sup>65</sup> At first light on D+1 Deane-Drummond himself set off with his driver to try to get the message through to 1st Parachute Brigade HQ. Eventually he reached 1st Battalion The Parachute Regiment and used its radio to get a message through to Brigade HQ on the bridge. Despite this 1st Parachute Brigade HQ did not reappear on the divisional command net for almost another 48 hours. Aware that his message via 1st Battalion may not have been sufficient, Deane-Drummond decided to push through to the bridge with the battalion and assess the situation first hand. It was a decision that resulted in his capture on D+5 having never reached his objective.

Therefore as D-Day progressed with no communication with the bridge, Divisional HQ had little or no idea of 1st Parachute Brigade's situation. This situation led directly to Urquhart leaving his Divisional HQ in his jeep and attempting to assess the situation for himself. It was 'a bad mistake, if an understandable one'.<sup>66</sup> Now another minor fault in signals procedures would be about to make itself apparent and compound Urquhart's 'mistake' resulting in unforeseen repercussions that would have significant impact on the outcome of the operation.

### **Reconnaissance Squadron and Divisional Commander Procedures**

The Airborne Reconnaissance Squadron commanded by Major 'Freddie' Gough had a vital part to play in the plan to seize the Arnhem bridge. Heavily armed, the jeeps of the squadron were to race to the bridge directly after landing, seize and hold the objective and wait to be reinforced by the parachute battalions. Shortly after landing on D-Day a false message reached Urquhart reporting that the majority of the Reconnaissance Squadron's jeeps had failed to arrive on the landing zones. Concerned with this turn of events the divisional commander needed to speak to Gough in order to amend the original plan. Here the problem with communications became apparent. The Reconnaissance Squadron operated its own radio net reporting to a liaison officer in Divisional HQ, and was not on the divisional command net. This seemingly innocuous fact would have far reaching consequences.

Urquhart told his Divisional HQ that he wished to speak to Gough as he left to try to assess 1st Parachute Brigade's situation. By the time Gough

received the message Urquhart was mobile in his jeep and Gough was therefore unable to contact him by radio. Gough had no choice but to leave his squadron (which had in fact arrived in relatively good order) at this vital moment and attempt to physically link up with divisional commander. As Gough left the squadron began its advance from the landing zone towards Arnhem. With C Troop in the lead the squadron set off at 1545 hours on D-Day. Minutes later and less than half a mile to the east the lead jeeps of C Troop were engaged and badly shot up by the northern edge of Krafft's blocking line. The remainder of C Troop manoeuvred out of the ambush and returned to their initial rendezvous, along with the other two troops.

With Gough absent the squadron lacked direction as to what to do now that their original plan had been arrested. The squadron commander remained out of contact for the rest of the day and 'Divisional HQ [had] no information regarding Major Gough'.<sup>67</sup> From this time the squadron appears to have been employed directly from Divisional HQ in an ad hoc manner and 'no attempt was made to send either of the Reconnaissance Squadron's remaining two troops, at least thirteen of whose jeeps were available, to the bridge'.<sup>68</sup>

Concurrent to this a frustrated Urquhart ordered his driver and radio operator to attempt to establish radio contact with Gough. This meant changing the frequency on the jeep's radio, a procedure that proved to be 'a forlorn endeavour'.<sup>69</sup> The difficulties with tuning have already been described. Attempting this from one vehicle to a second vehicle that was probably moving was next to impossible. While this protracted attempt to re-tune was going on Urquhart had no communications with his HQ and had effectively isolated himself from his division. On the evening of D-Day Urquhart did meet up with the Commander of 1st Parachute Brigade, Brigadier Gerald Lathbury (who was with 3rd Battalion) but by this time the divisional commander's jeep had been destroyed along with his radio and his radio operator was wounded. Of course Lathbury at this point had no communications with Divisional HQ. Urquhart remained isolated in this manner, depriving his division of effective command until the morning of D+2.

On the morning of D+1 the situation was not irrevocable: 2nd Battalion and HQ 1st Parachute Brigade were on the bridge; 1st and 3rd Battalions were poised in Arnhem ready to reinforce 2nd Battalion. Shortly the entire 4th Parachute Brigade would arrive in accordance with the divisional plan. All it would take would be a properly commanded, controlled and coordinated attack towards the bridge by a grouping of the available battalions and the divisional objective would be secure. However, HQ 1st Parachute Brigade was not in communication with Divisional HQ and was therefore

unable to offer advice on any attack and unable to coordinate their own actions with any attempt to reinforce them. The Reconnaissance Squadron's jeeps, deprived of command, sat impotently in the divisional area when they could have reverted to their proper role and scouted routes towards the bridge. The divisional commander was not in contact with his HQ and had no effective communications with the vast majority of his division.

Consequently as the attempt to reinforce the bridge progressed on D+1 and D+2 four battalions were fed piecemeal, blindly and with little coordination into the battle. So 1st, 3rd and 11th Battalions The Parachute Regiment and 2nd Battalion The South Staffordshire Regiment were practically destroyed. Over 2,500 men were committed to this phase of the battle, 'no more than 500 returned'. Minor signals procedural errors with unforeseen consequences helped to lead to this situation. By the end of D+2 any attempt to reinforce 2nd Battalion The Parachute Regiment was abandoned. Thirty-six hours later the bridge was back in German hands. The 1st British Airborne Division had failed.

### **The Causes of Failure**

Following Operation 'Market Garden' the men that had fought at Arnhem were hailed as heroes. Five Victoria Crosses were awarded for acts of outstanding bravery during the battle. Of the 8,969 men who landed at Arnhem only 3,910 escaped with their lives and their freedom intact. Field-Marshal Montgomery eulogised the actions of the Division. With such a reputation almost immediately established it was extremely difficult to criticise those that took part for any contribution to the failure of the operation. It is however natural in such circumstances to search for causes and apportion blame. How much simpler therefore to point the finger at equipment failure, inanimate objects rather than blemish the reputation of men rightly considered heroes.

So among the wider (and more significant) causes of failure the inadequacy of radio equipment during the battle became prominent. The official report constantly highlights the inadequacy of the equipment, 'the No. 22 Set has not adequate range nor is its receiver sufficiently selective'; 'the No. 68 Set is quite inadequate'; 'the No. 22 Set has proved quite inadequate for [its] role'.<sup>71</sup> Some of this criticism is perfectly justified, particularly if the official report was being used as a vehicle to attempt to expedite the procurement of better radio equipment. However the radio modelling referred to during this article and firsthand accounts prove that the equipment, when correctly and skilfully operated was adequate for the task, if only marginally at times.

Urquhart himself may have been partially responsible for initiating the myth. While the battle was still underway he declared that radio communications were 'a complete failure' and that the 'radio sets were inadequate for the purpose, and that their effectiveness was to be further limited by the sandy, heavily-wooded terrain'.<sup>72</sup> Both comments were substantially untrue. The official report does clearly describe those procedural errors and mishaps that have been detailed in this article. These were far more consequential in effecting communications than the perceived inadequacies of the equipment. However, while the procedural path can be traced through the official report it is not highlighted and no conclusions are drawn from it.

Golden made an attempt to rectify the situation. His book *Echoes From Arnhem* was published in 1984. While he does refer to the concern felt by the divisional signallers over equipment inadequacies he places far more emphasis on those procedural mistakes that led ultimately to the situation described above. 'If signals had failed it was through a misuse of signals'. He was though fighting a losing battle. Cornelius Ryan's book *A Bridge Too Far*, published in 1974 had perpetuated Urquhart's opinion of signals failure. The Hollywood blockbuster three years later cemented the popular perception of the myth. Golden's book was never going to have the impact to reverse it.

Golden's clearly articulated views, drawn from impeccably well informed firsthand experience were correct. This article has drawn similar conclusions based on thorough research and the use of modern radio modelling analysis. The radio equipment used at Arnhem was not wholly responsible for those failures in communications that affected in some degree the outcome of the battle. Several minor factors may have had a subsidiary effect on the state of communications during the early part of the battle including training, planning and enemy action but were not significantly consequential. Procedural errors and mishaps combined with poor timing and in some cases just bad luck were largely responsible for the breakdown of 1st British Airborne Division's internal radio communications during the early part of the Battle of Arnhem.

### **Lessons to be Learned**

Radio signalling, still immature during World War II, was far from an exact science. Many of the nuances were not fully understood. Equipment was weak and unreliable by today's standards. Good planning was essential if effective communications were to be established and maintained. 'The essence of a good plan was that it should produce a scheme which could be executed within the limitations of time and resources; which would be



sufficiently flexible to stand up to all foreseeable courses of action; and which provided adequate safeguards against breakdown.<sup>74</sup>

Many risks were accepted during the planning of Operation 'Market Garden'. One of those risks was that communications for 1st British Airborne Division would be stretched. Deane-Drummond advised Divisional HQ of the difficulties that were likely to be encountered and the risk that this represented. 'It was known, it was explained, it was recognised, it was accepted.' The signals plan therefore had to be formed in the knowledge that they would be operating at the very limit of their resources. There was little flexibility available in the signals plan and adequate safeguards against breakdown either were not available or possible or were negated by the situation during the battle. Consequently when procedural mistakes were made the plan did not stand up to the situation.

No one is to blame; the divisional signallers pointed out the risks, the divisional planners and the Commander accepted those risks. In the light of the situation in late 1944 those risks were justified when measured against the possible gains. In the event those risks and others combined to cause a catastrophic failure. Under slightly different circumstances the plan may have worked.

The British Army today relies more heavily than ever on effective communications, not just to transmit orders by voice. In an era of Network Enabled Capability and Digitisation data is constantly transmitted which informs, controls and coordinates nearly every aspect of warfare. More than ever robust communications cannot be taken for granted. The signals plan must still adhere to all those principles outlined in 1953 and reproduced above. Calculated risks will always be necessary. Higher risks than necessary may be accepted when a new and largely untried formation, such as 1st British Airborne Division is keen to demonstrate its capabilities. New technology combined with new formations, whether airborne, air assault or Rapid Effect increases the risk exponentially. Risks in the signals plan alongside all others must be carefully considered. 'No signal plan [is] an isolated affair'.<sup>76</sup> In the modern era communications failure may have far reaching and unforeseen consequences. Remember Arnhem.

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