Brief Notes on a Designs Department Feasibility Study on Possible New Communication Systems for use on TV Outside Broadcast Sites

The basis for the study was established at a meeting on 12th December 1975 at Kendal Avenue, those present were Messrs. Vitty, Penrose, Kitson and O'Clarey.

Mr. O'Clarey wrote a summary of the meeting which included the following statement:

"A feasibility study should seek to answer the following points.

a) What is the maximum number of circuits of what bandwidth that would need to be multiplexed? Are any relaxations possible for mobiles?

b) What are the possible ways of achieving these needs? Which is the best, bearing in mind technical performance, size, weight and cost?

c) How much effort would be needed to develop such a system and when could it be started and completed?"

Mr. Penrose stated that the study should not be concerned with camera communications.

The full report contains 18K words, and as this takes a considerable time to read, brief answers to the above questions are given below:

a) Requirements

It is not possible to define the maximum number of circuits that would need to be multiplexed because the complexity of future O.B.'s is not defined. This fact, together with an analysis of the typical requirements of each position on an O.B. site leads to the requirement for a very flexible multiplex system.

b) Solutions

Ideally all the communications should be carried out without any cables, however this is not practical, but an alternative is to use just one cable which is routed through each position on an O.B. site. The output from the multiplex equipment at each position should occupy a different part of the frequency spectrum (time division multiplex is not practical) and the following centre frequencies are recommended:

Vision	-	baseband and 30 MHz
Sound	-	7.5 to 21 MHz at intervals of 1.5 MHz.

Two alternative sound multiplex/modulation systems are proposed, the first is more flexible in the number and quality of channels provided,

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but it uses delta modulation (a simplified form of P.C.M.) and further work (30 man days) is needed to confirm its suitability. The facilities provided by each system would be as follows:

System 1

Minimum equipment would provide –	1 talkback channel 1 telephone channel
and this could be expanded to –	3 commentary channels 1 talkback channel 1 telephone channel 15 data channels

Each commentary channel could be converted to two talkback channels or four telephone channels by simple switching.

System 2

Minimum equipment would provide –	1 commentary channel 3 talkback channels
and this could be expanded to –	1 commentary channel 1 talkback channel 3 telephone channels 15 data channels

System 1 uses time division multiplex of several delta modulator outputs to produce a bitstream of 2048 kbit/s which is then used to differentially four phase modulate a carrier in the range 7.5 to 21 MHz.

System 2 uses frequency division multiplex of several amplitude modulator outputs, and the resultant signal is used to frequency modulate a carrier in the range 7.5 to 21 MHz.

c) Effort required

30 man days to confirm the predicted performance of delta modulators and carry out subjective tests. The results of this work would influence which of the following options were taken.

700 man days to develop equipment based on system 1
or 500 man days to develop equipment based on system 2
or 1000 man days to develop both systems.

The estimates are all pessimistic and it is quite likely that after finalising the requirements initial design work may indicate a total effort less than half the above estimates.

The overall design work could be split into several relatively small projects, each of which may have useful applications in O.B.'s or elsewhere in the BBC.

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Brief Notes on a Designs Department Feasibility Study on Possible New Communication Systems for use on TV Outside Broadcast Sites

The terms of reference were as follows:

a) What is the maximum number of circuits that would need to be multiplexed? (The study should not be concerned with camera communications.)

b) What are the possible ways of achieving these needs? Which is the best, bearing in mind technical performance, size, weight and cost?

c) How much effort would be needed to develop such a system?

The full report (6.134(76)) contains 18,000 words, and as this takes a considerable time to read, brief answers to the above questions are given below.

a) Requirement

An analysis of typical communications at each position on O.B. sites leads to the requirement for a very flexible multiplex system. It would be somewhat impracticable to specify a system capable of multiplexing all the communications on an O.B. site because the complexity of future O.B.'s is not defined, also it would be unwise to rely solely on one cable for all the communications. Therefore the proposed system has sufficient capacity for most of the communications around a typical O.B. site, but extra communication channels (possibly a second multiplex system) would be required to provide an emergency back-up and in some cases extra capacity.

b) Solutions

Ideally all the communications should be carried out without any cables, however this is not practical, but an alternative is to use just one cable, which is routed through each position on an O.B. site, for most of the communications. The diagram below shows a possible arrangement of the proposed system.

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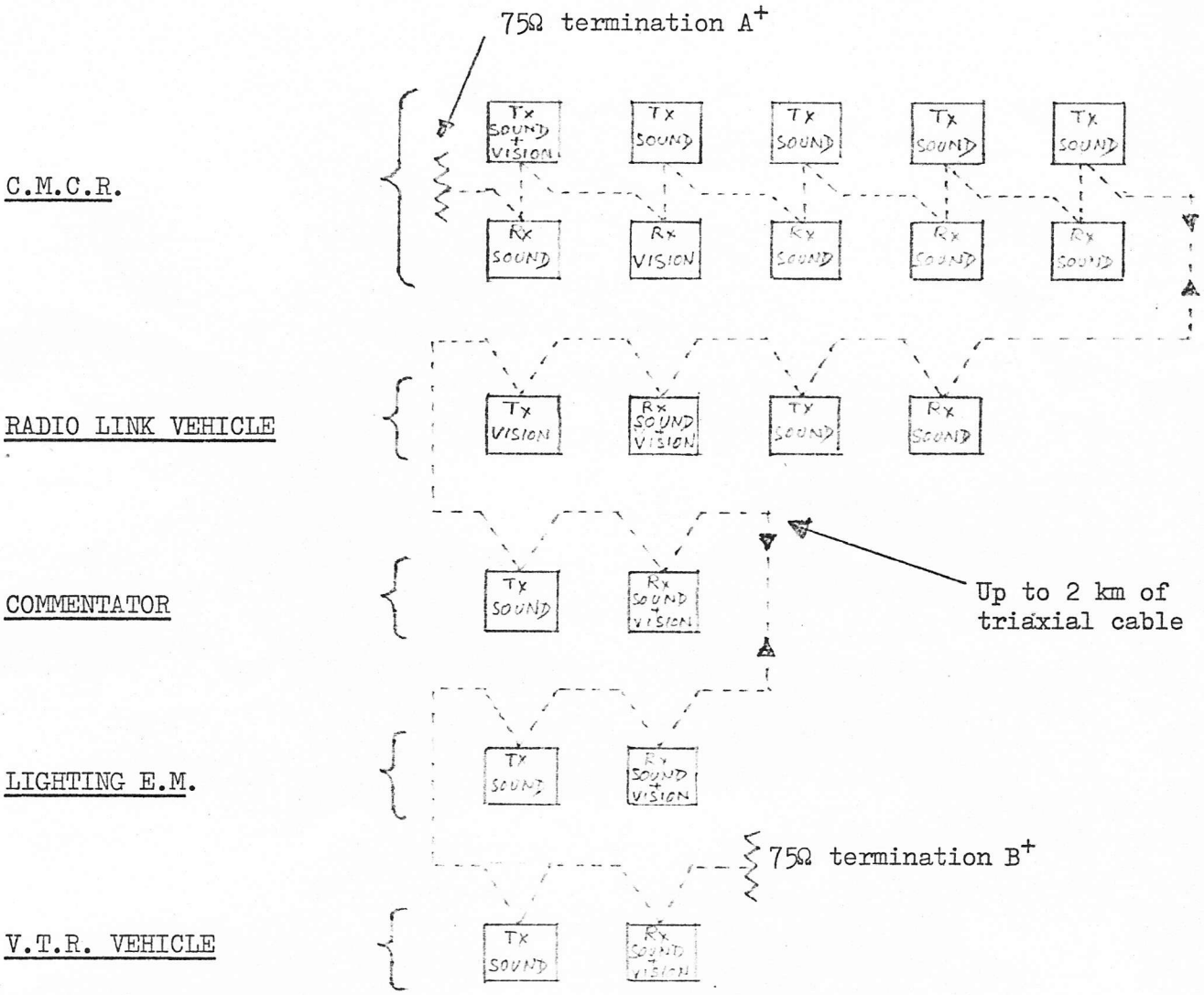

\+ It may be possible to interconnect points A and B to provide protection in the event of damage to the cable.

The outputs from the line transmitters (Tx) at each position occupy different parts of the frequency spectrum (time division multiplex is not practicable) and the following centre frequencies are recommended:

Vision - baseband and 30 MHz

Sound - 7.5 to 21 MHz at intervals of 1.5 MHz (but not 10.5 MHz)

Two alternative multiplex/modulation systems are proposed, the first is more flexible in the number and quality of channels provided, but it uses delta modulation (a simplified form of P.C.M.) for sound and further work is needed to confirm its suitability. The facilities provided by each line transmitter (Tx) and receiver (Rx) would be as follows:

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System 1

The minimum equipment would provide	1 talkback channel 1 telephone channel 1 vision channel*
This could be expanded to	3 commentary channels 1 talkback channel 1 telephone channel 15 data channels 2 vision channels*

Each commentary channel could be converted to two talkback channels or four telephone channels by simple switching.

System 2

The minimum equipment would provide	1 commentary channel 3 talkback channels 1 vision channel*
This could be expanded to	1 commentary channel 1 talkback channel 3 telephone channels 15 data channels 2 vision channels*

* Subject to a maximum of 2 vision signals being transmitted along the cable, one at baseband and one on a 30 MHz carrier using suppressed carrier double sideband amplitude modulation.

System 1 uses time division multiplex of several delta modulator outputs to produce a bitstream of 2048 kbit/s which is then used to differentially-four-phase modulate a carrier in the range 7.5 to 21 MHz, for sound and data.

System 2 uses frequency division multiplex of several amplitude modulator outputs, and the resultant signal is used to frequency modulate a carrier in the range 7.5 to 21 MHz, for sound and data.

The telephone channels referred to above are simply sound channels with a bandwidth of 300 to 3,400 Hz, signalling could be carried out using voice frequency generators and detectors or one of the data channels, but signalling equipment is not included in the estimates given below.

c) Size, Cost and Development Time

	Size (mm)	Cost
Line transmission equipment		
Minimum facilities	150 x 150 x 300	£500
Maximum facilities	150 x 300 x 300	£800

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	Size (mm)	Cost
Line reception equipment		
Minimum facilities	150 x 150 x 300	£500
Maximum facilities	150 x 300 x 300	£800

Both systems are limited to nine line transmitters and only two of them may send vision signals; assuming an equal number of receivers (which need not be the case) the total cost of the entire system would be about £11,000 typically. This estimate is for either system 1 or system 2, and it does not include cable.

The development time would probably be about 18 months.

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