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APPLICATION NUMBER: ***60/518,327***
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FEE RECORD SHEET

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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
David Mark J.	BAKER MOORE	United Kingdom United Kingdom

☐ *Additional inventors are being named on the ____ separately numbered sheets attached hereto*

1751 0 U.S.PTO 60/518327

TITLE OF THE INVENTION (280 characters max)

COMMUNICATIONS SYSTEMS AND METHODS

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* **35**
☒ Drawing(s) *Number of Sheets* **15**
☐ Application Data Sheet. See 37 CFR 1.76
☐ CD(s), Number
☐ Other (specify)

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☒ Applicant claims small entity status. See 37 CFR 1.27.
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE Daniel E. Fisher

Date **11/10/03**

TYPED or PRINTED NAME **Daniel E. Fisher**

REGISTRATION NO. *(if appropriate)* **34,162**

Docket Number: **33746P**

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Communications Systems and Methods

This invention generally relates to networks of communications devices, in particular ultra wideband (UWB) communications devices.

Techniques for UWB communication developed from radar and other military applications, and pioneering work was carried out by Dr G.F. Ross, as described in US3728632. Ultra-wideband communications systems employ very short pulses of electromagnetic radiation (impulses) with short rise and fall times, resulting in a spectrum with a very wide bandwidth. Some systems employ direct excitation of an antenna with such a pulse which then radiates with its characteristic impulse or step response (depending upon the excitation). Such systems are referred to as "carrier free" since the resulting rf emission lacks any well-defined carrier frequency. However other UWB systems radiate one or a few cycles of a high frequency carrier and thus it is possible to define a meaningful centre frequency and/or phase despite the large signal bandwidth. The US Federal Communications Commission (FCC) defines UWB as a –10dB bandwidth of at least 25% of a centre (or average) frequency or a bandwidth of at least 1.5GHz; the US DARPA definition is similar but refers to a –20dB bandwidth. Such formal definitions are useful and clearly differentiates UWB systems from conventional narrow and wideband systems but the techniques described in this specification are not limited to systems falling within this precise definition and may be employed with similar systems employing very short pulses of electromagnetic radiation.

UWB communications systems have a number of advantages over conventional systems. Broadly speaking, the very large bandwidth facilitates very high data rate communications and since pulses of radiation are employed the average transmit power (and also power consumption) may be kept low even though the power in each pulse may be relatively large. Also, since the power in each pulse is spread over a large

bandwidth the power per unit frequency may be very low indeed, allowing UWB systems to coexist with other spectrum users and, in military applications, providing a low probability of intercept. The short pulses also make UWB communications systems relatively unsusceptible to multipath effects since multiple reflections can in general be resolved. Finally UWB systems lend themselves to a substantially all-digital implementation, with consequent cost savings and other advantages.

Figure 1a shows a typical UWB transceiver 100. This comprises an transmit/receive antenna 102 with a characteristic impulse response indicated by bandpass filter (BPF) 104 (although in some instances a bandpass filter may be explicitly included), couples to a transmit/receive switch 106.

The transmit chain comprises an impulse generator 108 modulatable by a baseband transmit data input 110, and an antenna driver 112. The driver may be omitted since only a small output voltage swing is generally required. One of a number of modulation techniques may be employed, typically either OOK (on-off keying i.e. transmitting or not transmitting a pulse), M-ary amplitude shift keying (pulse amplitude modulation), or PPM (pulse position modulation i.e. dithering the pulse position). Typically the transmitted pulse has a duration of <1ns and may have a bandwidth of the order of gigahertz.

The receive chain typically comprises a low noise amplifier (LNA) and automatic gain control (AGC) stage 114 followed by a correlator or matched filter (MF) 116, matched to the received pulse shape so that it outputs an impulse when presented with rf energy having the correct (matching) pulse shape. The output of MF 116 is generally digitised by an analogue-to-digital convertor (ADC) 118 and then presented to a (digital or software-based) variable gain threshold circuit 120, the output of which comprises the received data. The skilled person will understand that forward error correction (FEC) such as block error coding and other baseband processing may also be employed, but such techniques are well-known and conventional and hence these is omitted for clarity.

Figure 1b shows one example of a carrier-based UWB transmitter 122, as described in more detail in US 6,026,125 (hereby incorporated by reference). This form of

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