A Bluetooth Low Energy (BLE) Based System for Livestock Tracking and Localization

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DSAIL
SOLVING REAL WORLD PROBLEMS

- Livestock production supplements crop farming
- Small scale farmers contribute 90% beef and 80% milk (Political Report, 2019)
- Livestock theft
- Management of veterinary activities such as breeding and medicine among others
- Livestock resource management

Figure 1: Livestock pasturing

Figure 2: A cow with collar device and ear tags (top), cattle with ear tags only (bottom)

- Available methods face range, connectivity, power challenges and are costly
- Limited outdoor applications
- Animal identification and management
- Available methods are Global Positioning System (GPS), ear tags and Radio Frequency Identification (RFID) technology

1. To design farm animals management BLE IoT based solutions to monitor animals.

2. To develop peripheral collar devices to advertise data information pertaining to animals.

3. To develop a central device for scanning animal data and visualizing.

4. To deploy the solution at DeKUT's farm on sheep and goats.

- *Design built around Arduino MCU*
- *Arm Cortex-M4 processor (nRF52840)*
- *Bluetooth 5 stack*
- *Low power Consumption*

Figure 3: Arduino Nano 33 BLE Sense development board (Arduino MCU)

Bluetooth Low Energy (BLE)

It is a wireless personal area network technology designed and marketed by the Bluetooth Special Interest Group (Bluetooth SIG) aimed at novel applications for instance healthcare, fitness and beacons among others (Wikipedia). It belongs to the unlicensed Industrial Scientific Medical (ISM) band and operates at a frequency of 2.4GHz.

Recent advancements on range and improved power management has extended its application to various areas such as industries and agriculture among others.
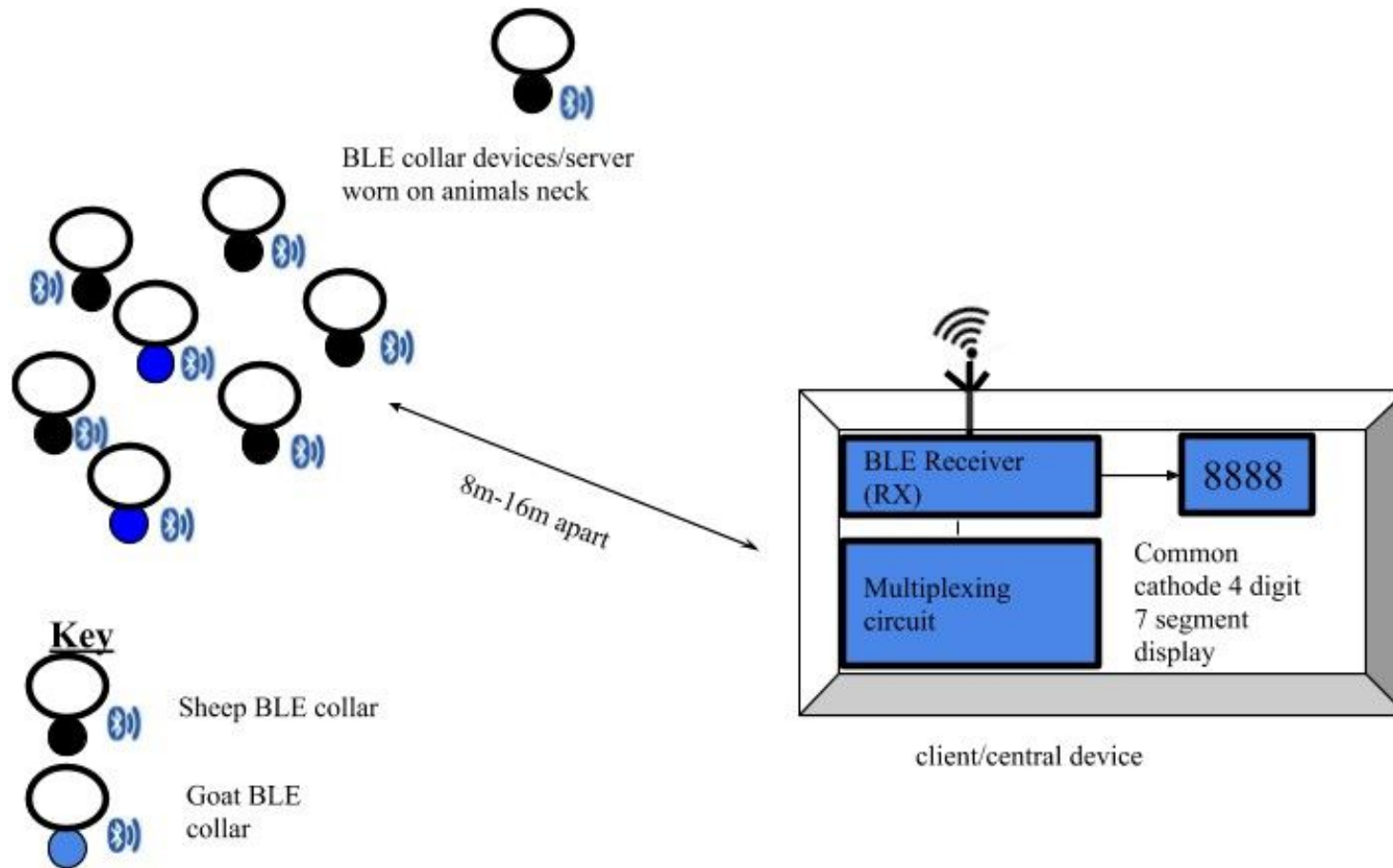
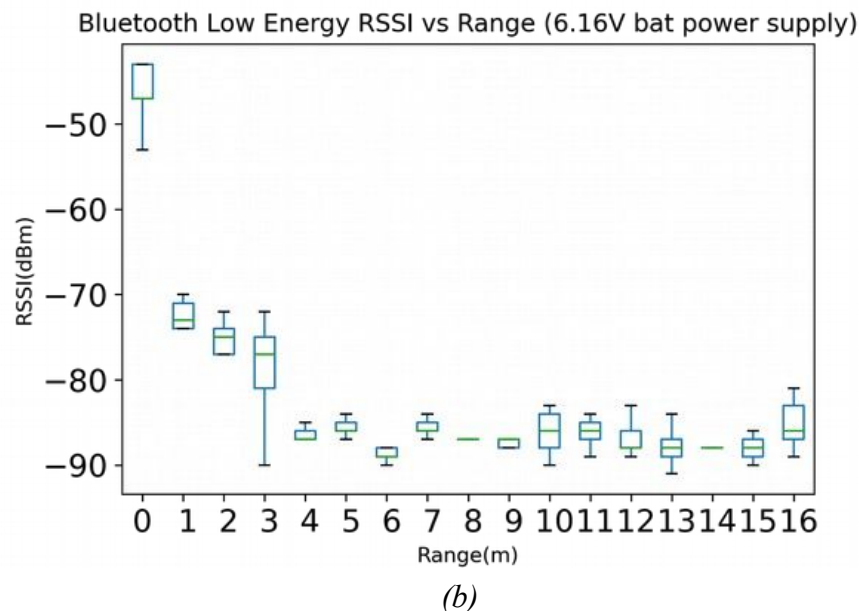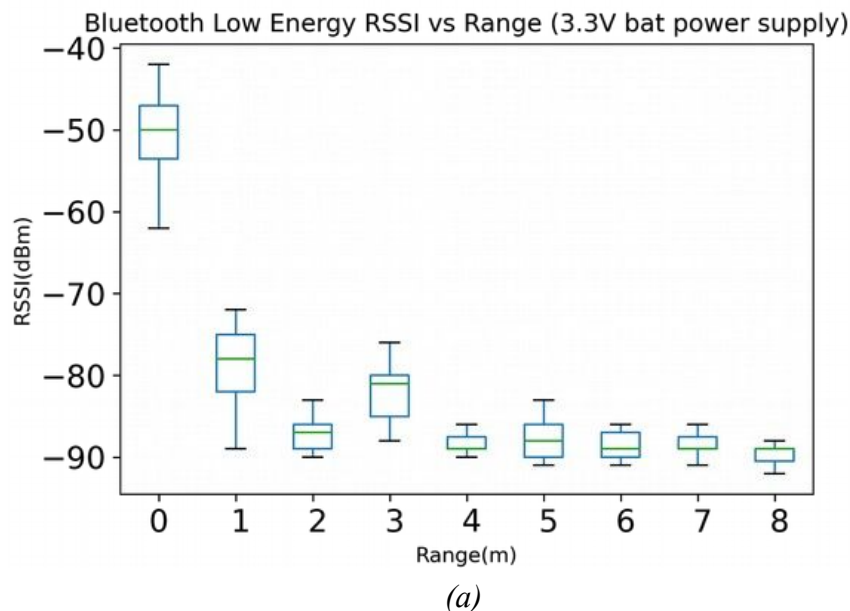Figure 4: The IoT BLE based animal tracking and localization system design

Figure 5: BLE range testing by varying the power sources 3.3V (a) and 6.16V.

- *Both central/client and collar/peripheral/ server communicate within a range of 8m – 16m with varied power sources.*

- *Average range being 12m radius.*

- *As the power source is increased range also is increased hence can send data over a long range*
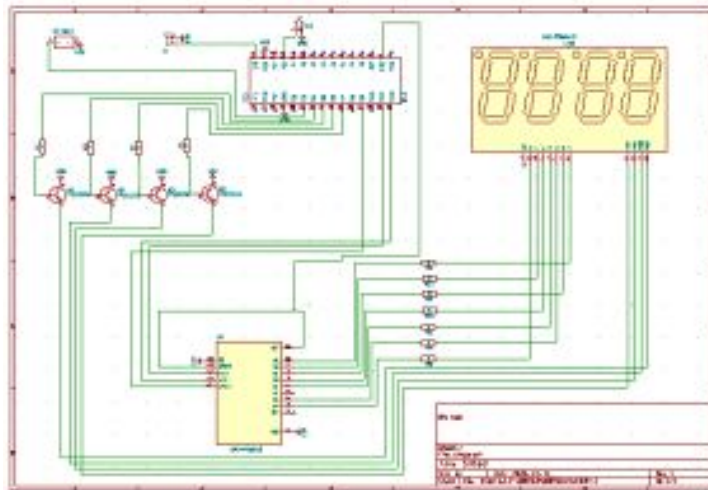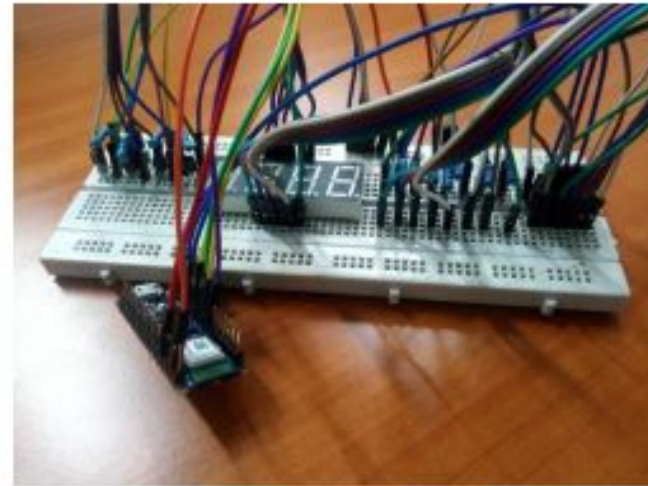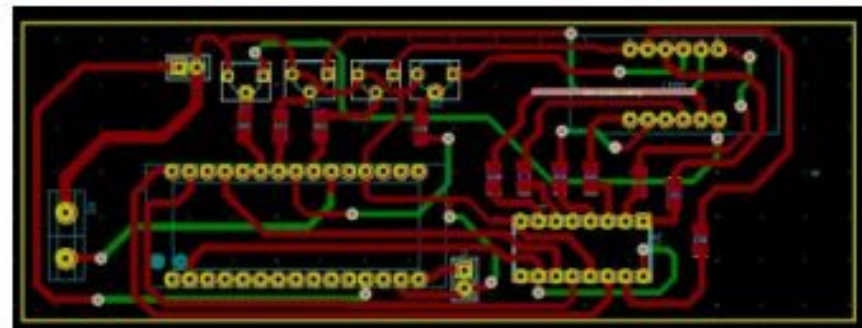
Figure 6: Central device circuit design (a), breadboard prototype development (b) and central device PCB design with KiCad open source PCB design software (c)
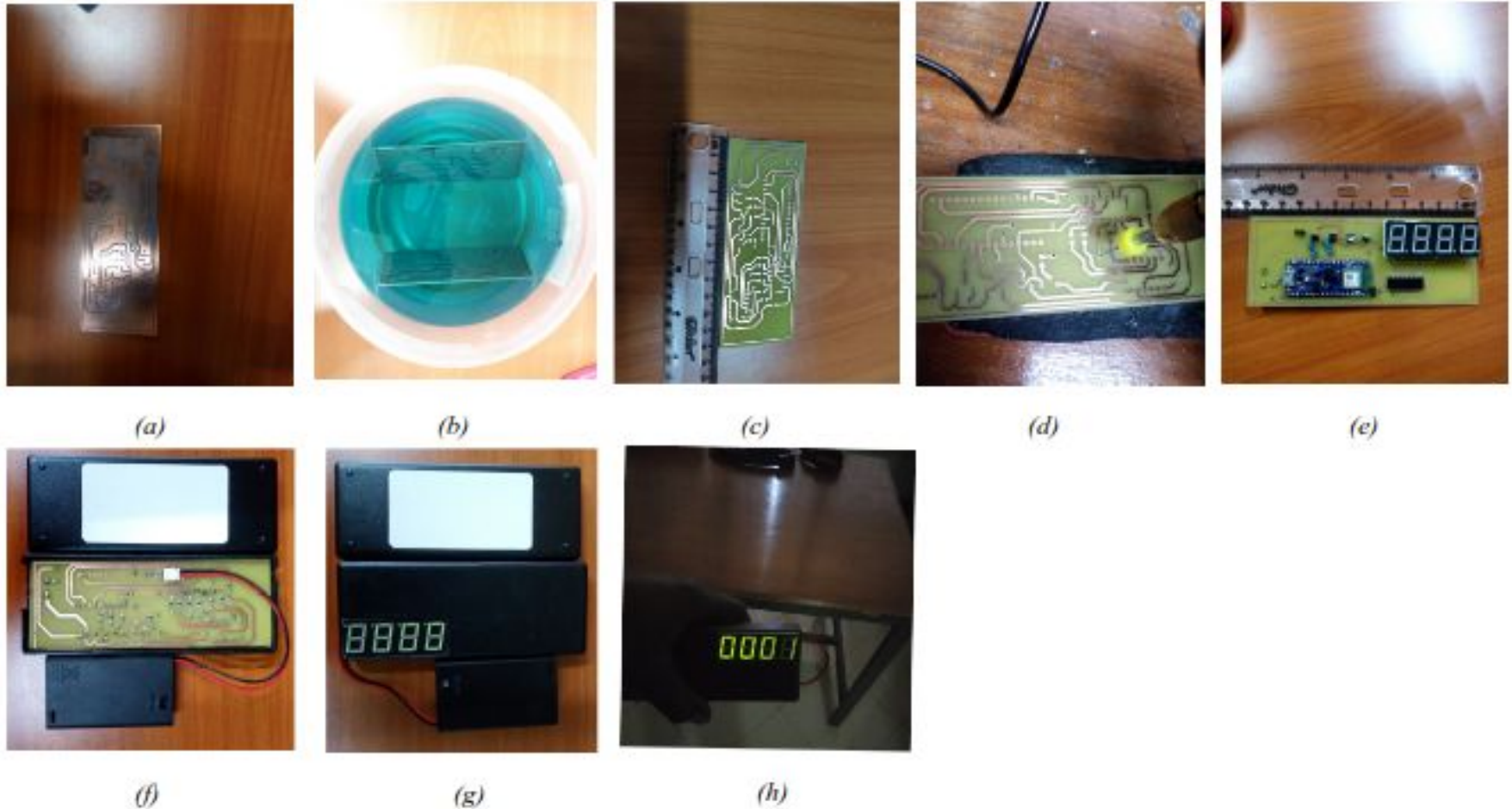
Figure 7: Printed circuit transfer on PCB (a), etching with sodium per-sulphate solution (b), etched PCB board (c), drilling through holes for components (d), mounted components and Arduino board (e), assembled and powered (4.5V) (f), counter display (g) and testing of the system with peripheral devices (h)
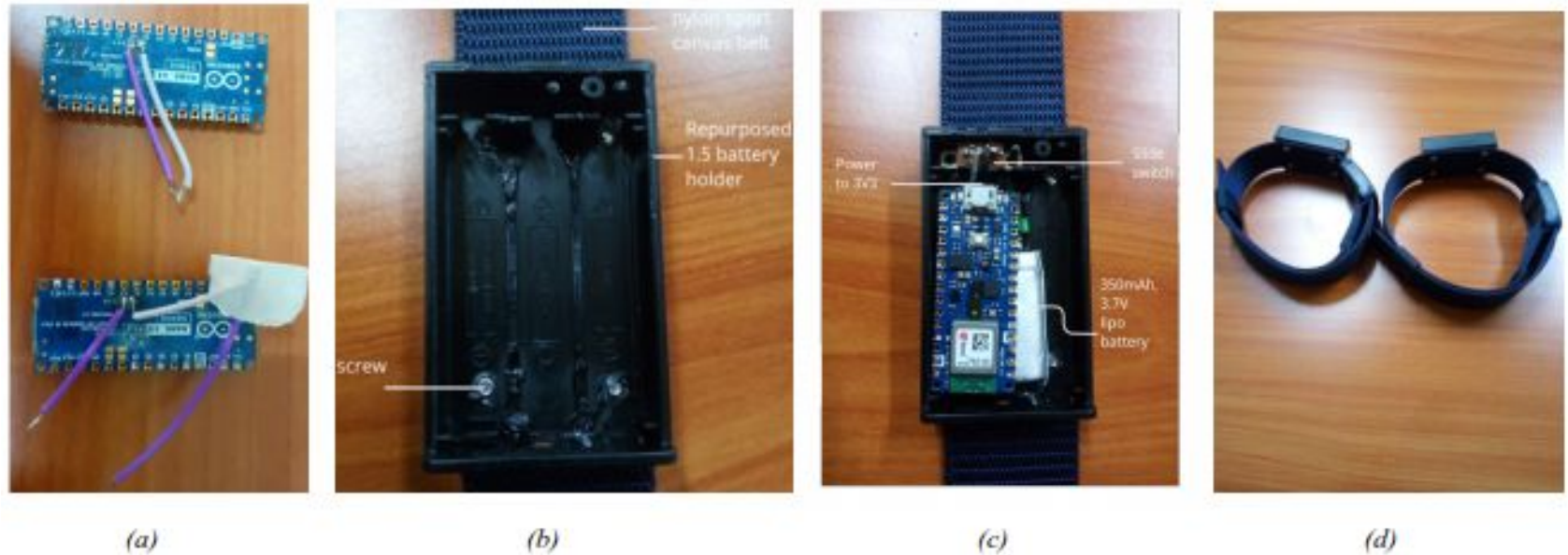
Figure 8: Arduino Nano 33 BLE Sense at the core of the collar device (a), collar device casing (b), assembled collar device (c) and finished collar devices (d)

- *Each collar weighs a total of 82g*
- *Up to 10 days 350mAh battery life advertising at 2 sec interval*
- *Long and adjustable strap (60 cm)*
- *Water proof casing*

Figure 9: Deployment of collar device on a sheep (a) goat (b), pasturing sheep with collar on (c)
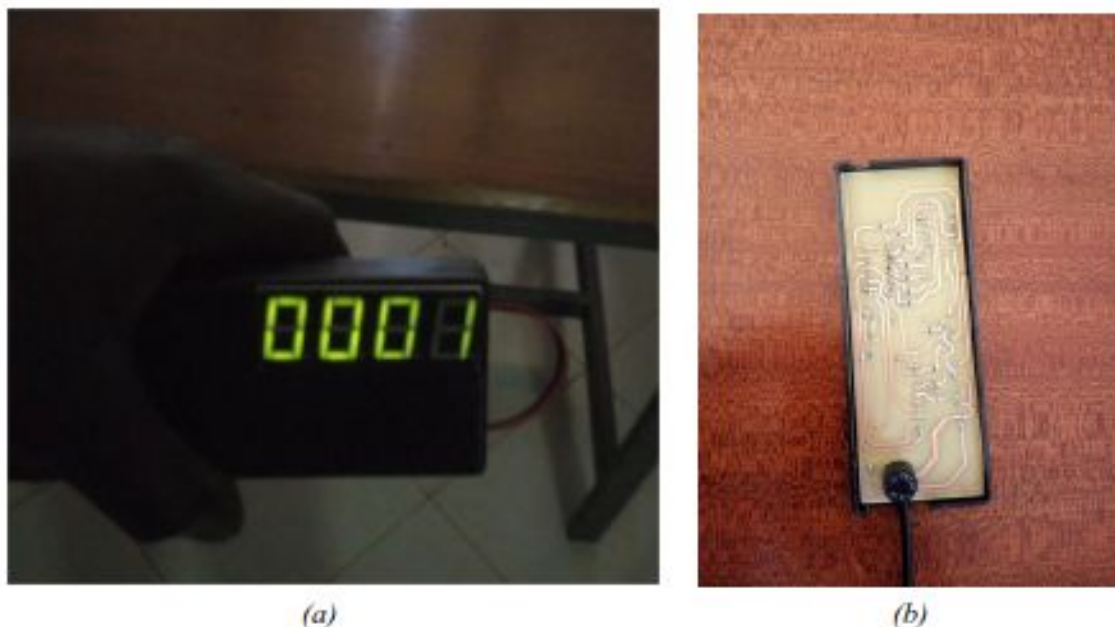
Figure 10: Displaying number of nearby animals with collar devices on central device (a) and buzzer for tracking and location a specific animal with collar device within range (b)

- *Counting number of livestock with collars on*
- *Up to 7 days 350mAh battery life scanning at 2 sec interval*
- *In built buzzer for tracking and locating an animal within 2m range using RSSI*
- *Switch for turning device on and off to save on power.*

- *Livestock management, tracking and localization using IoT BLE based system*
- *Development of cost effective devices, long range, connectivity and low power application.*
- *BLE integration with other LoRaWAN data transmission protocols for long range date communication*
- *Integration of Low Power GPS (LGPS) for accurate geo-positioning.*

Thank You

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