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Kaval is state-of-the-art peer-to-peer ad-hoc event detection sensor network utilizing Android devices to provide signature identification capabilities in near real-time to users in the field.

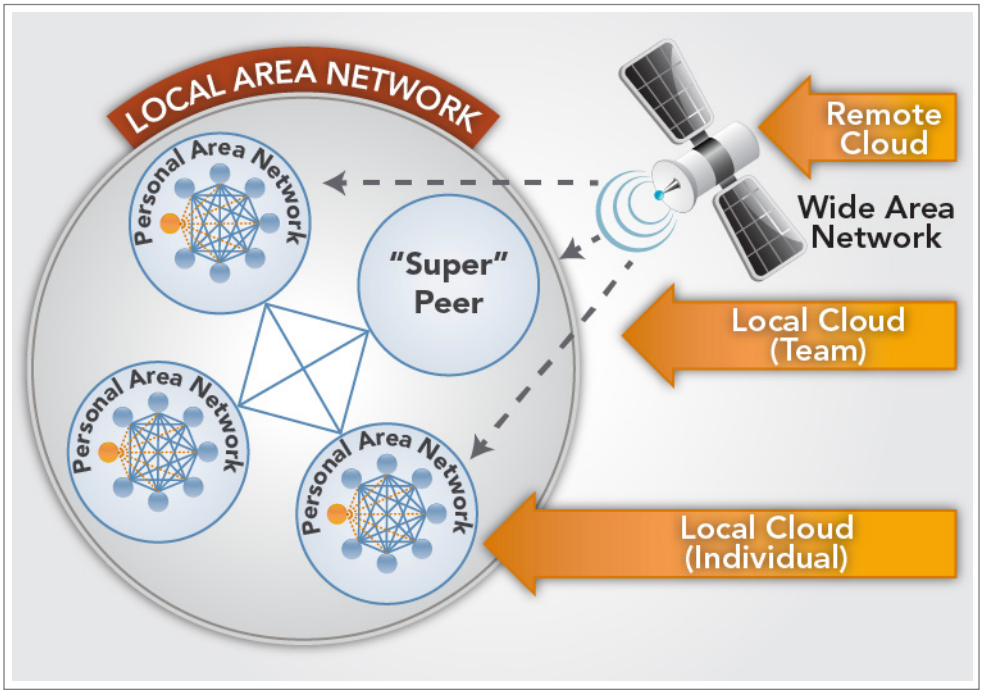
Kaval: Cooperative Signature Identification on Mobile Devices

Kaval is an Android-based signature analytics framework capable of collecting and analyzing data in an environment where analysts in a broad range of domains are often tasked with collecting data, building compressed representations of that data (signatures), and comparing that data to a database in search of a match. The goal of Kaval is to develop state-of-the-art ad-hoc mesh networking utilizing Android devices to provide signature identification in near real-time to multiple users.

HOW IT WORKS

Technological advances have made mobile devices an intriguing candidate for use outside of the traditional single user application. Wireless Sensor Networks (WSN) provide location-based situation awareness from multiple connected devices, allowing interested parties to aggregate data from multiple devices in the field. Smartphones and tablets make an ideal WSN development platform, as they offer a number of sensors for gathering data, have sufficient processing power and memory, and provide communication capabilities to perform the job of a traditional dedicated sensor node device. Using a mobile device allows users to capture data from a team of users and process that data using a peer-to-peer distributed mechanism.

WSNs provide a great tool for interested parties to gather data out in the field. A traditional WSN is made up of specialized nodes, designed to perform a single task. Mobile devices, however, extend the basic concept of a WSN to a general purpose device, helping overcome some of the challenges associated with building a WSN, such as limited network capacity, processing and memory constraints, power consumption and reliability. Mobile devices have been used to build a WSN in a number of different areas, including: traffic monitoring, secure data delivery to a compute grid, and health care monitoring. Kaval extends the principles used by those other applications by performing signature analysis on the data that the device is collecting, while also communicating with its peers in an ad hoc network.



U.S. DEPARTMENT OF ENERGY

Devices would be equipped with the necessary sensors to capture data from the environment---whether that be on-phone capabilities such as the camera or microphone or an external peripheral such as a radiation detector attached via USB or Bluetooth---as the individual carrying the device operates in the environment. The application would process and characterize the data in near real-time. The signatures derived from the captured data would then be compared against a set of pre-computed signatures stored locally on the device. A centralized server is proposed to push out signatures of interest as mission goals evolve over the course of the operation. Additionally, this application could detect abnormal events it does not recognize---events whose signatures are not found in its database---and notify the other devices in its mesh network that it has found something of potential interest that it does not recognize. The other devices in the mesh network would then be able to analyze that data as well, attempting to match signatures derived from that data with their own local database. This provides two benefits:

1.) The ability to distribute a large signature database across multiple devices. A signature database might be too large for one device to use efficiently. If multiple devices are communicating in a mesh network, the whole signature database can be split between each of the devices---with some redundancy in case devices leave the network---and data can be shared until a match is found amongst at least one of the devices, and

2.) If multiple devices contain signatures that match the data, an operator can have increased confidence in the veracity of the results returned by Kaval.

Capabilities

Kaval utilizes a generalized signature analysis framework for operating in a mesh network and sharing data between different nodes in the network. As such, Kaval can be applied in the following domains:

- Audio Event Detection
- Image Matching
- Radiation Signature Detection
- Biometric Identification

S&T Focus Areas

- Create a peer-to-peer ad-hoc network of Android devices that cooperatively capture and analyze audio and images
- Rapidly transmit Biometric identification information across multiple devices
- Improve accuracy of event processing and signature identification
- Improve response time by sharing data and distributing processing among peers

Long-Term Goals

Improved identification performance

- Devices perform signature comparisons against subset of pre-defined library
- Utilize local GPU acceleration for analysis
- Real-time local library updating from a Super Peer
- 2D and 3D Image and Video processing
- Integrated multi-modal device input
- Location identification of events

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ABOUT PNNL

Interdisciplinary teams at Pacific Northwest National Laboratory address many of America's most pressing issues in energy, the environment and national security through advances in basic and applied science. PNNL employs 4,600 staff, has an annual budget of nearly $1 billion, and has been managed for the U.S. Department of Energy by Ohio-based Battelle since the laboratory's inception in 1965.

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