FILAMENT

Filament v3.0

THING NIRVANA

WHITE PAPER

Executive Summary

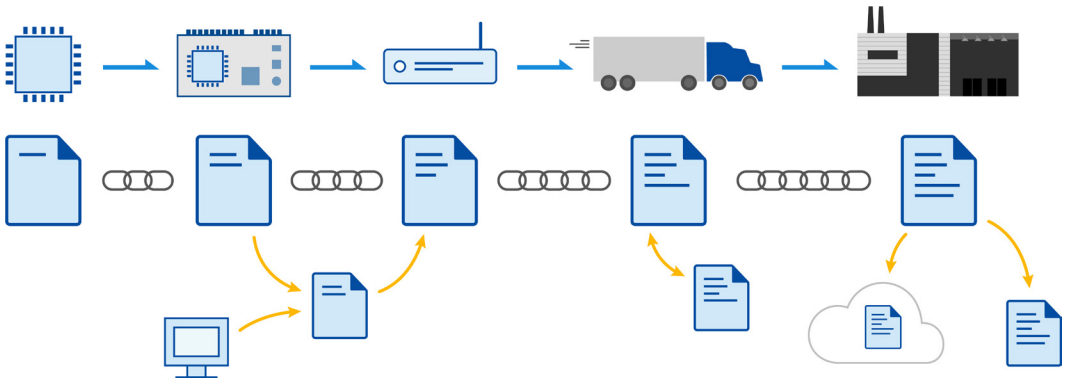
We were inspired more than five years ago to create these **little futuristic Things**, ones that we knew would grow in population quickly and live out there in the wild, talking to each other solving problems, and creating value that the big things and cloud things just couldn't reach.

Our inspiration **expanded rapidly** just three years ago as we discovered ways to empower these Things with new autonomy and security, building towards a future where they can independently derive trust and transact value at the edge of the network.

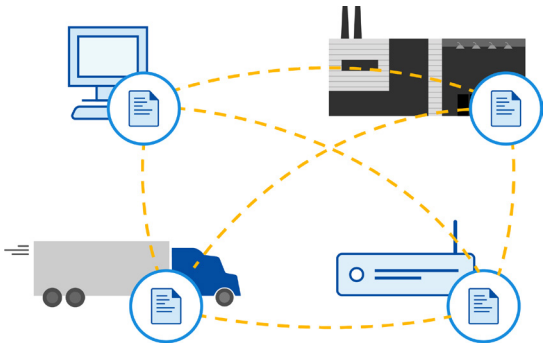
Today we've reached our Thing Nirvana: a single, low-power, low-cost chip that makes the future possible now. By combining best-of-breed embedded security hardware with a new generation of Trusted Apps that natively support blockchains and distributed ledger technology, Filament is dedicating itself to ensuring that the Internet of Things (IoT) is secure and scalable.

Blocklet

One of the innovations we've been using for some time in the field is a secure contract system designed for embedded devices named Blocklet™. It manages a cryptographic chain-of-custody all the way from individual components through printed circuit board (PCB) assembly, product manufacturing, delivery to customers, and on-site provisioning.



Building on that secured foundation, every device is governed by a prime contract that elects services to manage different aspects of its capabilities, including the ability to form sub-contracts and assign temporary user permissions dynamically. This has been used to govern and secure network access, route end-to-end encrypted sensor data, safely change states on attached hardware, and facilitate deployment of encrypted updates to configuration and firmware.



All of these capabilities are now packaged in our Blocklet Chip™ with a significant addition: every request or action taken within Blocklet will generate a transaction log event for a public or private distributed ledger. This enables entire networks of devices performing a diverse array of functions to output an interoperable trustworthy history of all activities that can be audited for authenticity, with every event containing a proof of the chain of custody for the entire lifetime of the device.

Trusted Apps

There is a modern security architecture now in wide global deployment with at least **50 billion devices** supporting it: Secure Elements and Trusted Execution Environments (TEEs). These have evolved from earlier forms of trusted computing, smart cards, and sim cards, and are now embedded on most modern CPUs such as SGX for Intel and TrustZone for ARM.

Filament's new Blocklet capabilities are delivered through Trusted Apps, operating within this framework on existing CPUs as well as our new hardware component, Blocklet Chip, designed to be a low-cost, IoT-optimized TEE with a small footprint and less than coin-cell power requirements.

There is a growing family of Trusted Apps being developed and targeted for different use-cases, the initial set combining our existing Blocklet capabilities with the open-source Hyperledger Sawtooth permissioned chain implementation. These initial Trusted Apps will be the world's first deployment of Sawtooth transactions in a dedicated chip running on IoT-class devices.

Additional Trusted Apps are under active development that support Ethereum and ERC20 tokens, Hyperledger Fabric, and cryptographic device identities such as Intel's EPID and X.509 certificates. We are also actively researching support for microtransactions via Bitcoin's Lightning Network and Ethereum's Raiden Network.

Real-World Usage

A common argument made against blockchain technologies is that there isn't significant adoption outside of cryptocurrencies. It's difficult to account for all of the private blockchain/ distributed ledger usage that is in production due to the private nature of those deployments.

This year, Filament is working with its closest partners and customers to highlight some of the practical ways that these technologies are being deployed. While supply-chain, manufacturing, and industrial use-cases aren't as headline-worthy as Bitcoin, they are becoming very impactful in those verticals as they start to turn traditionally manual business-to-business (B2B) relationships into highly efficient transactive ones.