Chapter 5
Multi-Layered Blockchain-Based Security Model for Electronic Health Record Systems

Mrutyunjaya S. Hiremath
https://orcid.org/0000-0002-1338-9946
eMath Technology, Bangalore, India

Rajashekhar C. Biradar
Reva University, India

ABSTRACT

The multi-layered blockchain-based electronic health records (ML-BbEHR) framework aims to address persistent healthcare issues such as data privacy and access control. Utilizing a multi-layered blockchain architecture, ML-BbEHR segments EHR data into categories like medical histories and clinical datasets, each managed within its distinct blockchain layer. This enhances security and optimizes data management. Unlike single-layer systems, this architecture mitigates latency issues. Additionally, the framework incorporates fingerprint authentication as an alternative to traditional cryptographic keys, bolstering patient identity verification. Smart contracts are also deployed across layers to delineate rules and permissions for healthcare data access, enhancing data integrity and security. This architecture is built on a general, non-specific blockchain platform chosen for its robust security features.

1. INTRODUCTION

The transition to Electronic Health Record (EHR) systems has been accelerating in the healthcare industry, driven by the anticipated benefits for patients and healthcare providers. The U.S. Department of Health and Human Services, through its Office of the National Coordinator (ONC) for Health Information Technology, defines an EHR as a digital counterpart to a patient's traditional paper chart. Unlike static paper records, EHRs are dynamic, patient-centric digital repositories that enable real-time and secure access to medical information.

DOI: 10.4018/979-8-3693-0659-8.ch005

EHR systems are designed to go beyond merely storing standard clinical data generated during provider visits; they offer a comprehensive view of a patient's healthcare journey. These systems facilitate seamless information sharing with other entities in the healthcare ecosystem, including laboratories and specialized medical practitioners. As a result, an EHR encapsulates data from multiple healthcare providers involved in a patient's care, promoting a more integrated and holistic approach to healthcare delivery. The advantages of Electronic Health Record (EHR) systems as outlined by the Office of the National Coordinator (ONC) for Health Information Technology:

- EHR systems serve as comprehensive repositories that continuously update and synchronize key aspects of patients' medical profiles, including but not limited to medical history, diagnostic outcomes, medication regimens, treatment protocols, immunization timelines, allergenic susceptibilities, radiological imagery, and results of laboratory analyses.
- The systems are engineered to facilitate real-time access to evidence-based decision-making tools, thereby empowering healthcare providers to render more informed and effective patient care.
- Through automation and computational intelligence, EHR systems are designed to optimize the workflow of healthcare providers, enhancing operational efficiency and reducing the scope for manual errors.

Concurrent with advancements in Electronic Health Record (EHR) systems, the inception of blockchain technology (Nakamoto et al., 2019) heralded a significant technological shift. This innovation has attracted extensive scrutiny from both academic and commercial research sectors. Characterized by its decentralized structure and cryptographic security measures, blockchain technology has substantial potential to serve as the underlying framework for many distributed systems. While initially restricted to financial use cases, most notably in the form of cryptocurrencies such as Bitcoin, the scope of blockchain technology has substantially broadened over time.

The inclusion of smart contract functionalities in blockchain platforms (Rathee et al., 2022) has introduced programmability features, amplifying the technology's versatility. This enhancement has extended the applicability of blockchain technology beyond the financial sector, offering new avenues in diverse domains, including healthcare, education, governance, and manufacturing. Specifically, blockchain technology in healthcare and EHR systems (Rathee et al., 2021) provides a range of features capable of meeting the complex requirements associated with EHR systems (McGhin et al., 2019). These features and capabilities are expounded upon in the following sections.

1.2 EHR System Requirements

Data Integrity and Security: The imperative for data integrity and robust security measures cannot be overstated in the healthcare sector, especially in EHR systems. Blockchain technology is viable for ensuring data integrity through cryptographic algorithms (McGhin et al., 2019).

Interoperability: The capacity for diverse healthcare systems to communicate and exchange information seamlessly, known as interoperability, represents a critical requirement for EHR systems. Blockchain technology fosters interoperability by providing a standardized protocol for data exchange across disparate systems.

Related Content