



***Advanced Telecommunications/Information
Distribution Research Program
(ATIRP)***

**Authentication Scheme for
Distributed, Ubiquitous, Real-Time
Protocols**

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Introduction



- **Authentication for ubiquitous, real-time protocols such as Network Time Protocol**
- **Current scheme uses one-way hash functions and private keys**
- **New scheme combines with public-key cryptosystem and certificates**
 - **Avoids public-key computations for every packet**
 - **Requires no per-client state at busy servers**
 - **Requires only occasional verification of server credentials**





NTP capsule summary



- **Network Time Protocol (NTP)**
 - **Synchronizes clocks of hosts and routers in the Internet**
 - **Provides submillisecond accuracy on LANs, low tens of milliseconds on WANs**
 - **Reliability assured by redundant servers and diverse network paths**
 - **Engineered algorithms used to reduce jitter, mitigate multiple sources and avoid improperly operating servers**





NTP authentication - issues



- **Configuration and authentication and synchronization are inseparable**
 - **Clients and servers must require no manual configuration**
 - **Ultimate security must be based on private values known only to servers and public values obtained from directory services**
 - **Must be fast**





NTP authentication - approach

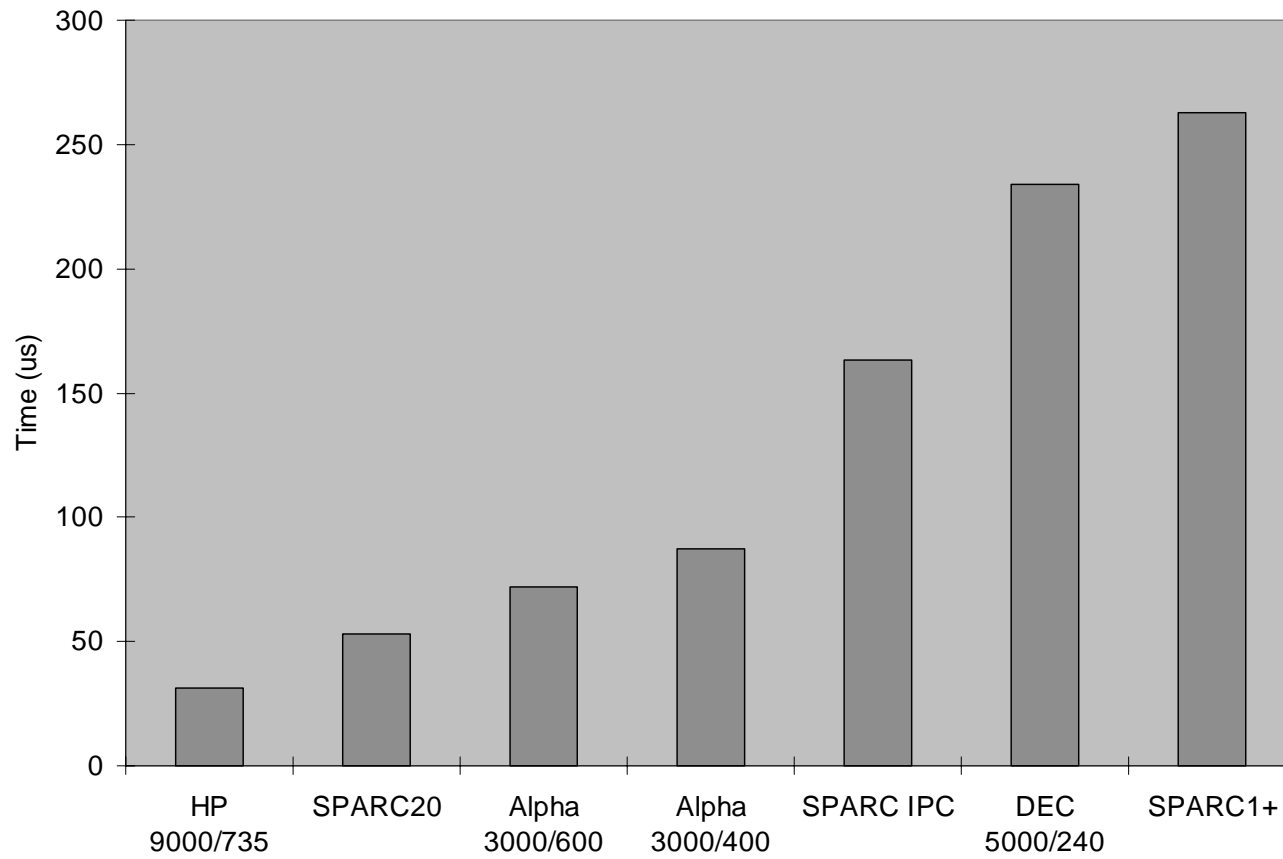


- **Authentication and synchronization work independently for each peer server**
 - **Public keys and certificates are obtained and verified relatively infrequently**
 - **Session keys are derived from public keys using fast algorithms**
 - **Only when time and authentication are independently verified is the local clock set**



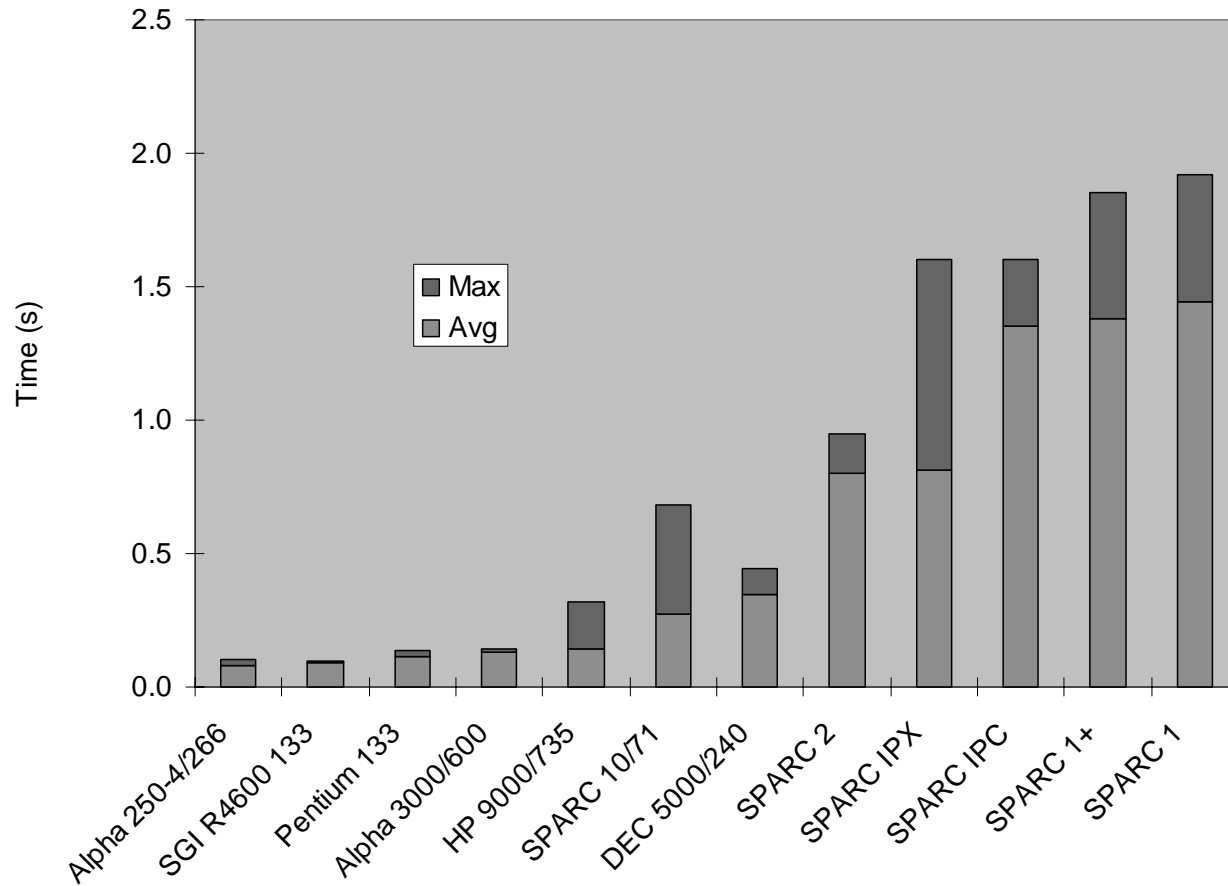


MD5 message digest





MD5/RSA digital signature





Authentication scheme A (Kent)



- **Scheme is based on public key encryption and one-way hash function**
 - **Certificated public values for each server provided by Secure DNS or X.509**
 - **Server computes session key as one-way hash of server private value, server/client IP addresses and key identifier as each client request is received**
 - **On request, server sends session key to client using public-key cryptography**





Authentication scheme B (S-Key)



- **Scheme is based on public key encryption and S/KEY scheme**
 - **Server generates list of session keys, where each key is a one-way hash of the previous key**
 - **Server uses keys in reverse order and generates a new list when the current one is exhausted;**
 - **Clients verify the hash of the current key equals the previous key**
 - **On request, the server signs the current key and sends to client**





Current status



- **Complete analysis of security model and authentication scheme in TR 96-10-3**
- **Preliminary design for integration in Unix/Windows NTP daemon completed**
- **Implementation plan in progress**
- **Complete set of status reports and briefing slides at:
<http://www.eecis.udel.edu/~mills>**

