ENABLING EFFICIENT AND OPERATIONAL MOBILITY IN LARGE HETEROGENEOUS IP NETWORKS

Deploying Home Agent Load Sharing in Operational Mobile IPv6 Networks

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Information Society Technologies

Mobility – what the user wants

- Growth of the Mobile Internet
  - Growing number of mobile Internet users
  - Growing diversity of mobile Internet devices (PDA, cellphone, smartphone, …)
  - Increasing heterogenity of access networks (GSM, 3G, WLAN, WiMax, …)
- Efficient support of mobility in the Internet required
- Importance of transparency
  - Mobility support should be transparent to users and applications
- MIPv6 approach
  - MIPv6 offers this transparent mobility support by influencing the routing of IP packets

Overview of ENABLE project

- ENABLE at a glance
  - Research project funded by the European Commission
  - 8 European and one Chinese partner
  - Duration: 2006 – 2007
  - Budget: 3,792 M€
- Goal of ENALBE
  - Enable deployment of efficient and operational mobility as a service in large scale IPv6 network environments
  - Research and contribution to standardization fora (IETF, 3GPP, etc.)
  - Validation through laboratory experiments (prototypes, testing, etc.)
- More information
  - ENABLE project web site http://www.ist-enable.org

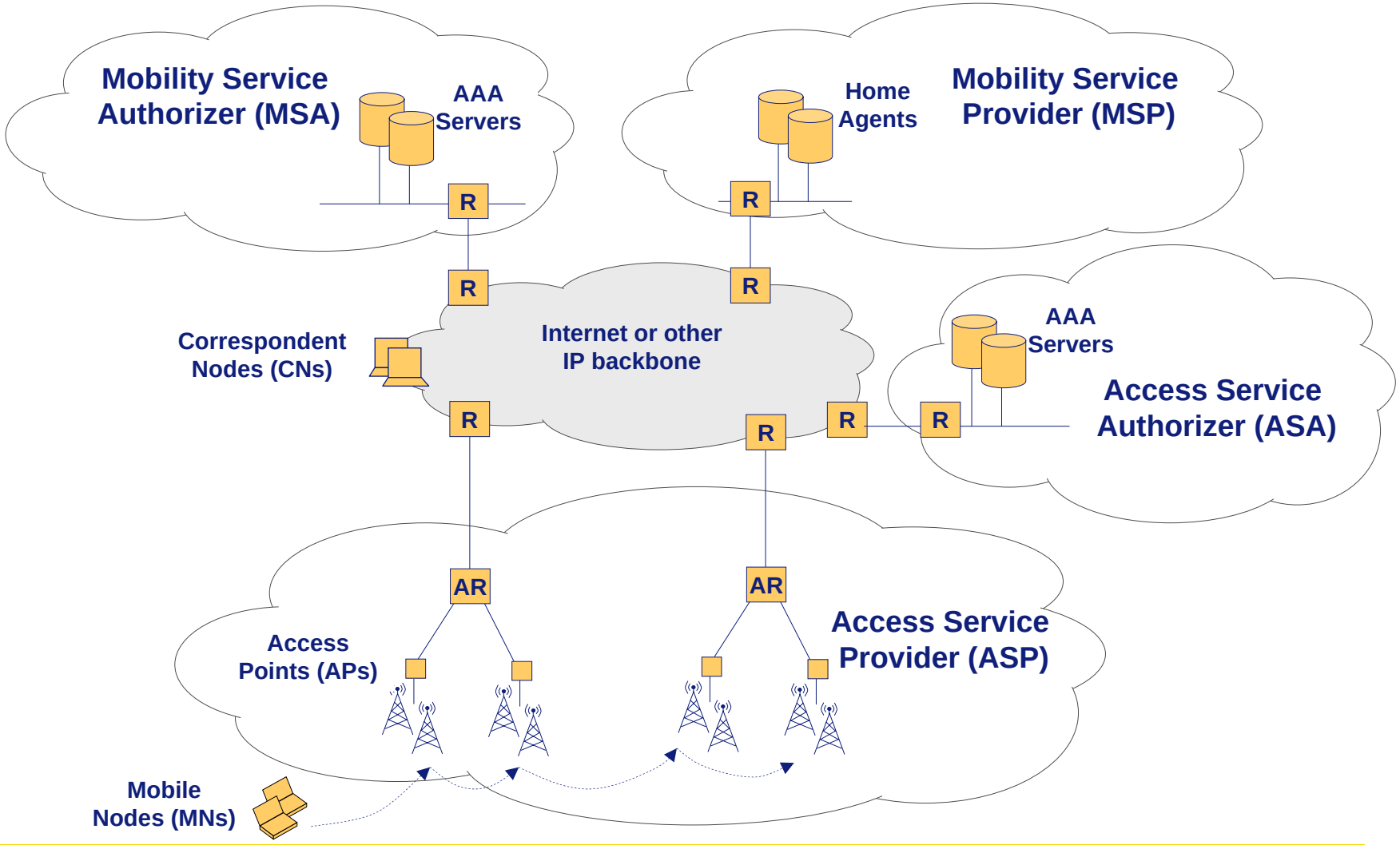
Requirements for operational deployment of MIPv6

- Improvement of Mobile IPv6 scalability
  - **Dynamic provisioning** of configuration data on terminals and HAs
  - **Load-sharing** across HAs
- Improvement of reliability
  - Solutions for **HA failover** (no single point of failure)
- Control of mobility service
  - **Service authorization** based on a AAA infrastructure
- Enable offering of “premium” network features
  - **On-demand and secure activation** of fast handovers, QoS, etc.
- Integration of Mobile IPv6 in real-life environments
  - Coexistence with **middle-boxes** (firewalls, VPN concentrators, etc.)
  - Deployment of **Mobile IPv6 in IPv4-only accesses**

Bootstrapping - Motivation

- Goal
  - Addressing the operational requirements for
    - dynamic provisioning of configuration data on terminals and HAs
    - MIPv6 service authorization
- Configuration data
  - HA address
    - Required on MN
    - Used for registering Binding Updates with HA
  - MN‘s Home Address
    - Required on MN
    - Used for communication with other nodes
    - Could change if home network change
  - Keying Material
    - Required on MN and HA
    - Used to set up a security association (IPsec, Authentication Protocol) between MN and HA

Bootstrapping – Involved service entities



Bootstrapping - Architectures investigated by IETF

- Split scenario
  - Mobility Service Authorizer (MSA) is different from Access Service Authorizer (ASA)
  - Assignment of Home Agent done using DNS
- Integrated scenario
  - Mobility Service Authorizer (MSA) is the same as Access Service Authorizer (ASA)
  - Assignment of Home Agent done using DHCPv6

Bootstrapping - Steps of the split scenario

- Getting network access
  - Using DHCPv6 or IPv6 stateless address autoconfiguration
- Home Agent assignment done by DNS request from MN
  - Requesting for a FQDN of a HA (e.g. ha.service-provider.com)
  - Requesting for a MIPv6 service (e.g. mip6.ipv6.service-provider.com)
- Setting up an IPsec security association between HA and MN
  - Use of Internet Key Exchange version 2 (IKEv2) for this purpose
  - For this purpose the HA at the MSP has to contact the AAA service of the MSA for MN authentication and service authorization
- Assignment of a Home Address to MN
  - Done within the IKEv2 exchange
  - MN could propose a Home Address
- Update of the MN‘s DNS entry with the new Home Address
  - Triggering of DNS update within Binding Update from MN to HA
  - HA updates DNS directly or further delegates this to AAA

Bootstrapping - Steps of the integrated scenario

- Getting network access
  - Using DHCPv6 or IPv6 stateless address autoconfiguration
- Home Agent assignment can be done in different ways
  - HA is always selected by the MSP
  - HA can be assigned in different ways
    - with support of DHCPv6 extensions in the access network
      - with or without support of EAP in access network
    - without DHCPv6 extensions using EAP to assign FQDN / IP address of HA
  - ENABLE designs an architecture supporting several bootstrapping alternatives, the operator can select the most appropriate one
- Remaining steps identical to split scenario
  - Setting up an IPsec security association between HA and MN
  - Assignment of a Home Address to MN
  - Update of the MN‘s DNS entry with the new Home Address

HA load sharing - Motivation

- Efficiently sharing the load between multiple HAs
- Assignment of the most suitable HA
  - Concerning the available resources
  - Concerning the geographical location („local“ HA assignment)
  - Concerning the supported functionality
  - ...
- Relocation of HAs
  - in case of HA failure
  - in case initial HA assignment has been inefficient (split scenario)
  - ...

HA load sharing - Requirements

- The MSP as HA owner has to finally decide about HA selection
- Support of arbitrary distribution of HAs
- Efficient integration with bootstrapping
- Support of HA relocation
- Approach must be transparent to MNs
- Approach must be independent from specific HW and SW
- Approach should limit additionally required signaling, especially on wireless links
- Approach should limit additional delay during bootstrapping
- No introduction of new security issues

HA load sharing - Existing approaches

- Existing approaches have been analyzed
  - DHAAD
  - Extensions to VRRP
  - HAHA protocol
  - ...
- Problems found with existing approaches
  - Don‘t integrate with bootstrapping (e.g. DHAAD not used in bootstrapping)
  - All HAs need to be placed on single subnet
  - HA relocation not supported
  - ...
- Decision for designing own HA load sharing approach

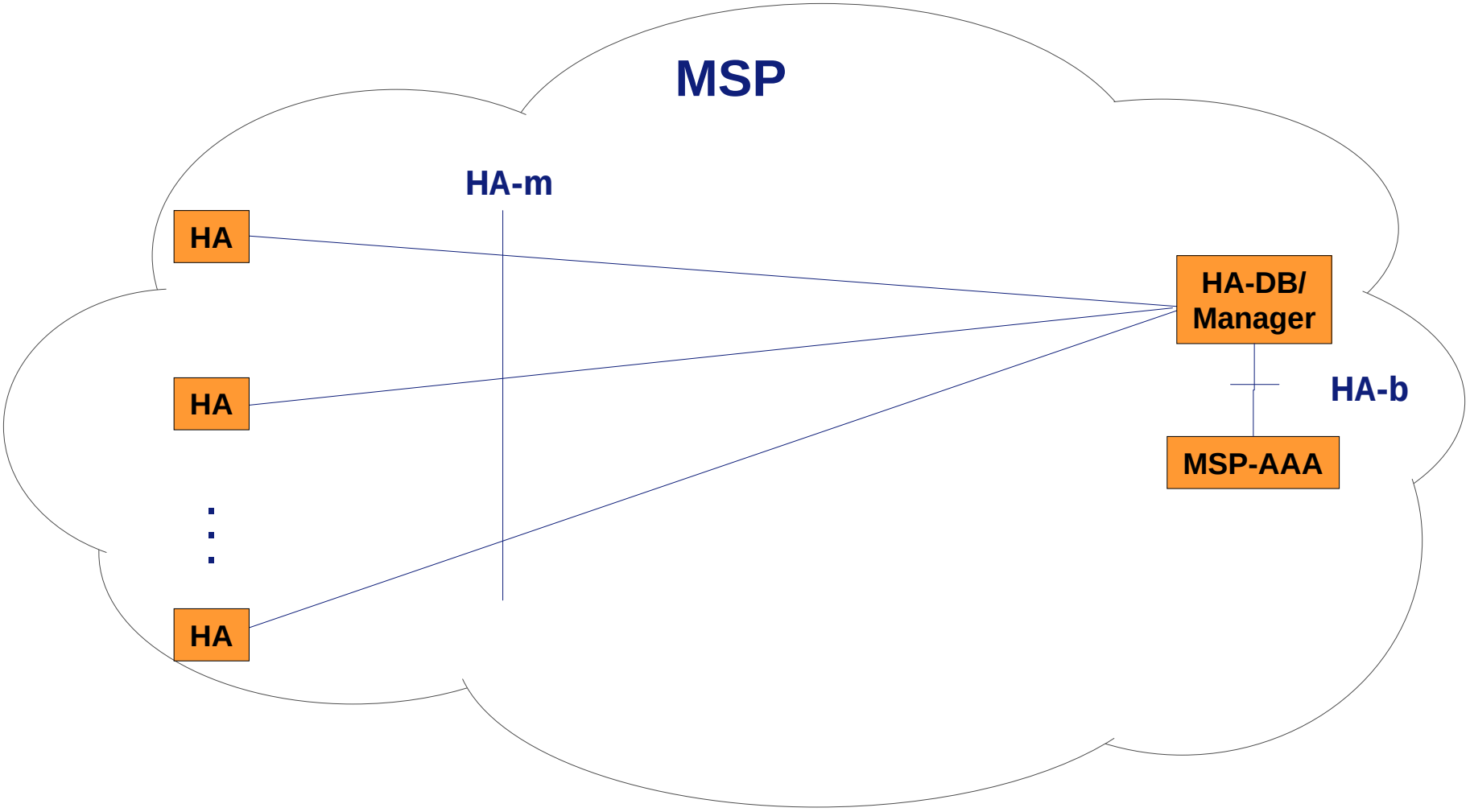
HA load sharing – Architectural components

- Identification of a set of HA selection parameters measured on each HA
- Distributed collection of the selection parameters from the HAs
- Selection of the most suitable HA based on the collected selection parameters
- Assignment of the selected HA

HA load sharing – Possible selection parameters

- The following, possible initial set of selection parameters has been identified by ENABLE:
  - number of active home registrations
    - The closer a HA gets to its maximal foreseen number of active home registrations, the less preferred it should be selected
  - current bandwidth availability at HA
    - The closer a HA gets to its maximal available bandwidth, the less preferred it should be selected
  - upcoming maintenance of HA
    - If there is a HA maintenance service upcoming, the HA shouldn‘t be selected
- The HA load sharing architecture will leave room for additional parameters, which can be specific to some deployment/vendor/operator

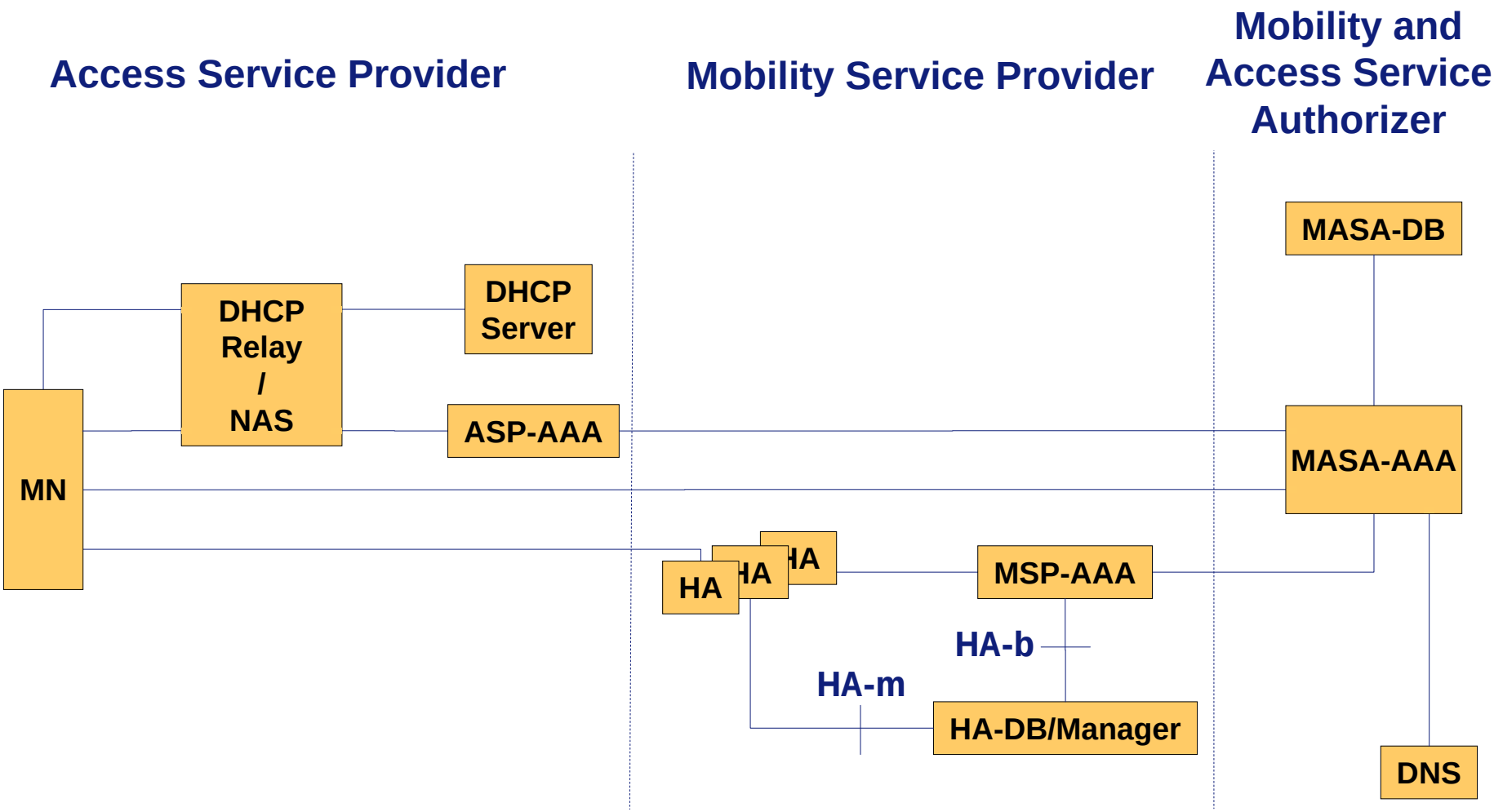
HA load sharing – Collection of selection parameters



HA load sharing – Functional overview

- HA-DB/Manager will
  - periodically collect selection parameters from each HA using e.g. SNMPv3 (HA-m interface)
- MSP-AAA will
  - access HA-DB/Manager for reading HAs selection parameters when needed using a data base protocol such as SQL or LDAPv3 (HA-b interface)
  - calculate load for each HA (weighted sum of selection parameters) and finally select and assign the best HA
    - m = a*x + b*y + c*z + …, with x, y, z, … being the normalized selection parameters, and a, b, c, … being the weighting factors of the respective selection parameters
    - the setting of the weighting factors a, b, c is done by the MSP according to its specific policy

HA load sharing – Integration with bootstrapping



Conclusion

- For operational MIPv6 service provision multiple HAs need to be deployed by a MSP
- A load sharing mechanism helps the MSP to select the most appropriate HA
  - During initial HA assignment
  - Later during HA relocation
- Various selection parameters are used for selecting the most appropriate HA

Further information

- Visit ENABLE project webite www.ist-enable.com
- Contact

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