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SLS Information Model for Ambient Networks

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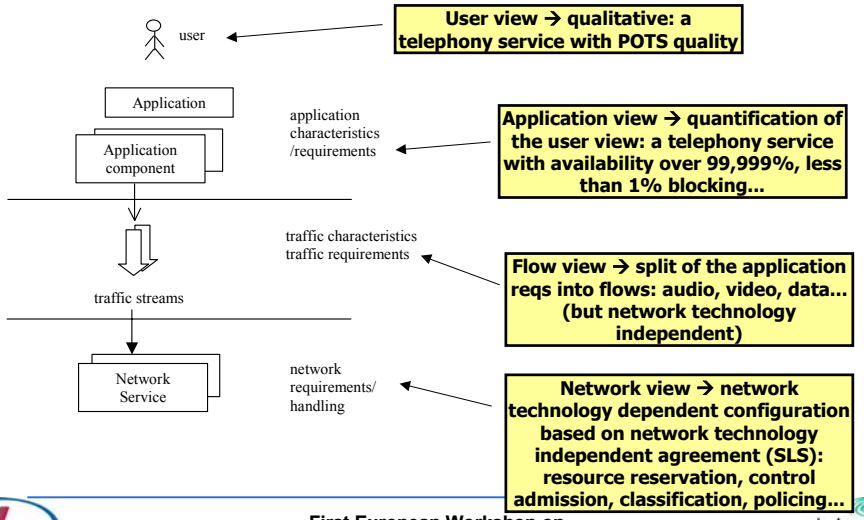
SLS Information Model

- Objective: To allow Ambient Networks to set up Service Level Specifications (SLS) among them in order to ensure a suitable QoS level for their communications.
- The Ambient Networking concept comprises:
  - Dynamically changing environments and heterogeneous technologies with different QoS guarantees
  - Internetworking not only at the level of basic addressing and routing
  - Seamless service continuity during vertical handover
  - Handover of media streams that lead to re-routing of media streams and content adaptation
  - Dynamic new business roles with varying levels of co-operation

SLS Information Model

- The SLS information model encompasses:
  - A generic SLS Template (SLS-T) for any QoS agreement.
  - The usage of the SLS-T to support different business relationships.
- The SLS-T includes network-level parameters (not application-level ones). A network service provided after a SLS negotiation can be used for very diverse purposes: real-time media, virtual private networks, QoS-aware peering agreements, ...

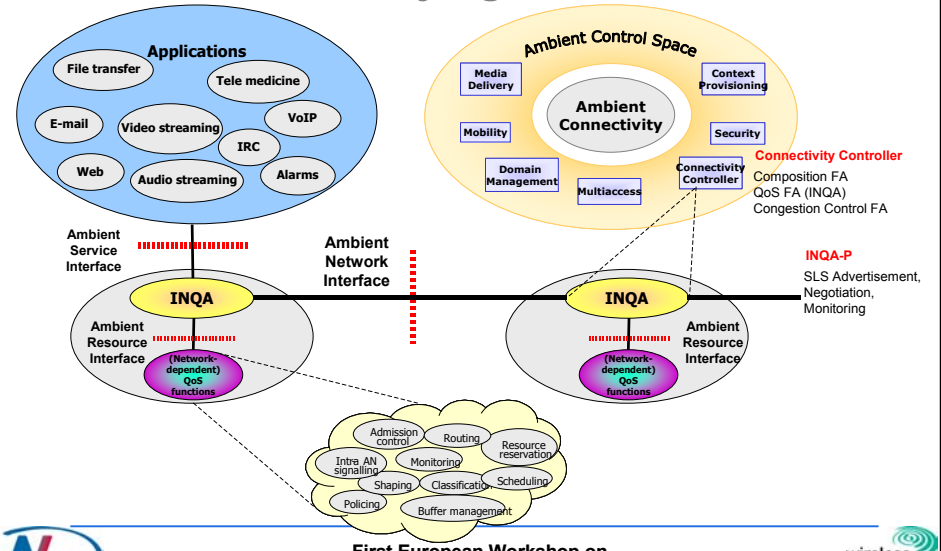
SLS-T includes network-level parameters



SLS Information Model uncoupled from underlying QoS model

- The SLS Information Model is decoupled from the underlying QoS network technologies to support the heterogeneity of the AN environments.
- However, agreed SLSs can be automatically translated into the technology-dependent QoS control planes of each AN.
- With this approach, the model allows the inter-working of many different networks, each following a distinct QoS model (DiffServ, IntServ or simply the best-effort service of the traditional Internet), in order to make feasible the end-to-end QoS process.

SLS Information Model uncoupled from underlying QoS model

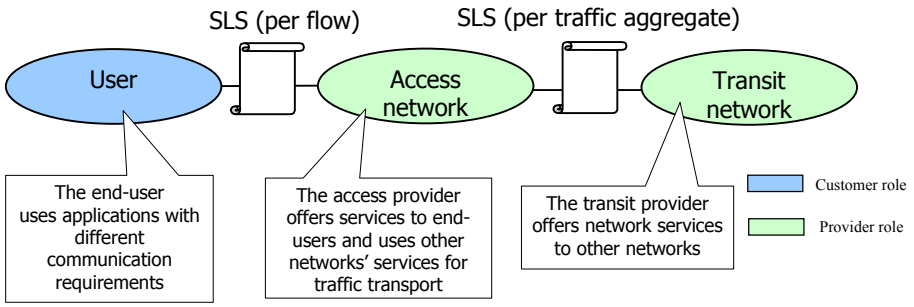


SLS instantiations for different types of network services

- Unlike the SLS negotiation protocol, which is independent of the network and QoS network technology, the QoS parameters included in a certain SLS instantiation may vary depending on the type of players negotiating the SLS in order to adapt it to the customer-provider relationship in each case and obtain better scalability while maintaining the required QoS assurance.
- Network administrators will configure which kind of services their networks can provide and the set of parameters and value ranges than must be included in the SLSs used to negotiate the provision of those services.

SLS instantiations for different types of network services

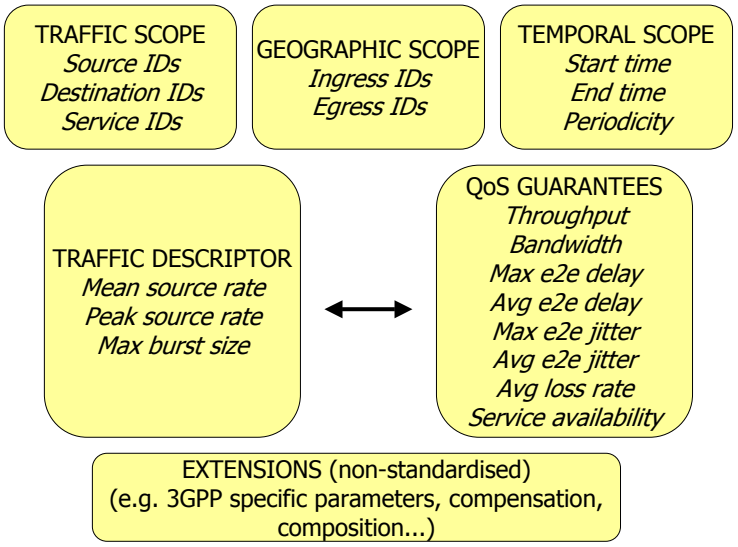
- With this approach, instantiated SLSs may describe services suitable for end-systems (per flow), or services suitable for traditional networks (per traffic aggregate)



Customer and provider roles in SLS negotiation

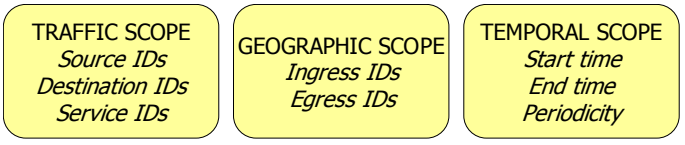
- An SLS is restricted to a unidirectional agreement between a provider AN and a customer AN for a specific QoS level.
- If an AN do not announce QoS services, it is not interested in providing connectivity with QoS guarantees
  - In a typical customer-provider relationship, it is the **provider** who first announces services and then **customers** look for services previously announced
- Therefore:
  1. The **provider** AN will instantiate SLSs from a well-known template (SLS-T) to offer their QoS services
  2. Potential **customer** ANs will receive the announced SLSs and will ask for them based on their own policies (e.g. "cheaper than X and quality bigger than Y, then negotiate")

SLS Template



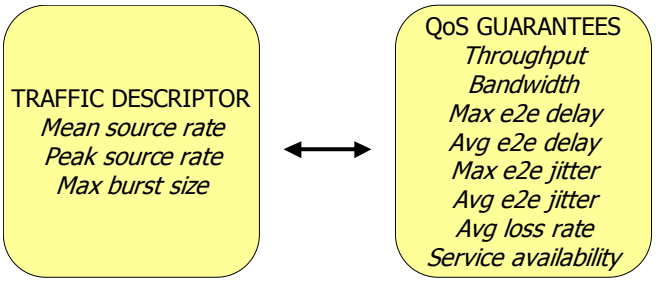
Scope

- **Traffic scope**: similar function that the flow identification in IP (source address and port, destination address and port and protocol number)
- **Geographic scope**: this provides information to perform a more accurate admission control
- **Temporal scope**: required for the usage of the resources in a well-known future time interval or when resources will not be used all the time (periodically active and non-active periods)



Traffic and QoS descriptions

- Each SLS specifies how a provider AN should treat traffic (**QoS guarantees**) sent by a customer AN, if that traffic meets certain conditions (**Traffic descriptor**).



Extensions

- The SLS template is open to be extended:
  - User communities can identify specific parameters as useful for their business models and/or underlying network technologies. E.g. specific parameters for 3GPP networks
  - Further Ambient-related categories:
    - Compensation and charging conditions and penalties to the provider AN when the SLS is not accomplished. Users normally take this into consideration when deciding between different services (with different QoS and prices).
    - Advertisement of composition intentions and the possible follow-up negotiations to enable Ambient Networks to merge or delegate their QoS functionality.

EXTENSIONS (non-standardised)
(e.g. 3GPP specific parameters, compensation, composition...)

SLS announcement message sent by a provider AN

<sls_description> includes a set of SLSs announced by the same provider AN

<common> includes parameters common to all the SLSs included in the message

Empty parameters can be fulfilled by the customer ANs

Fulfilled parameters can be modified by the customer ANs, but then the provider AN might reject them

```
<sls_description>
        <common >
                <source_id></source_id>
                <destination_id> </destination _id>
                <service_availability>10-5</service_availability>
        </common>
<sls>
<service_id></service_id>
<throughput></throughput>
<avg_e2e_delay>300ms</avg_e2e_delay>
<avg_loss_rate>0.01</avg_loss_rate>
</sls>
<sls>
<service_id> </service_id>
<peak_rate></peak_rate>
<mean_rate></mean_rate >
<max_e2e_delay>100ms</max_e2e_delay>
<max_loss_rate>0.01</max_loss_rate>
</sls>
</sls_description>
```


SLS negotiation message sent by a customer AN

An **<id>** is added to the SLS for further references in the negotiation

Although SLSs are agreed unidirectionally, a **bi-directional** attribute can be used for having shorter messages

Parameters that were empty in the announcement can be fulfilled for negotiation

Back-up values can be included as a way to bind two SLSs (e.g. two codecs with different rates)

```
<sls_description>
<sls id="caller_callee_RTP_audio" bi-directional="yes">
<source_id>caller_end-point_ID </source_id>
<destination_id>callee_end-point_ID </destination _id>
<service_id>RTP_audio_ID </service_id>
<peak_rate>
        <value01>16 kbps</value01>
        <value02>8 kbps</value02>
</peak_rate>
<mean_rate>
        <value01>12 kbps</value01>
        <value02>6 kbps</value02>
</mean_rate >
<max_e2e_delay>100ms</max_e2e_delay>
<max_loss_rate>0.01</max_loss_rate>
<service_availability>10-5</service_availability>
</sls>
</sls_description>
```

Although this example shows only one SLS, more can be included in the same negotiation message, which would mean that must be accepted or rejected together

Mapping into specific QoS models

- Some examples of mapping into QoS specific models have been made to show the feasibility of the e2e QoS process

SLS parameters	Values	DiffServ (EF class)	Values	3GPP (conversational class)	Values
Peak source rate	16 / 8 kbps	Peak Rate (EF)	16 kbps	Maximum bitrate	16 kbps
Mean source rate	12 / 6 kbps			Guaranteed bitrate	12 kbps
				Source statistics descriptor - additional	Speech (a)
Maximum end-to-end delay	100 ms	Delay	100 ms	Transfer delay	100 ms
Maximum Loss rate	0.01	Loss	0.01	SDU error ratio (fraction)	0.01
Availability	10^{-5}	Availability	10^{-5}		
				Residual bit error ratio	0.01 (a)
Classification (Ingress/ Egress ID, Traffic id)	CallerID, CalleeID	Classification (DSCP, Ingress/Egress)	DSCP (o)		
				Delivery order	NO (for IP) (a)
				Delivery of erroneous SDUs	Yes (a)
Start/ Finish time	Now/ -				
				Signalling Indication - additional	NO (a) (only for interactive classes)

Conclusions and further work

- The proposed SLS information model is decoupled from the underlying QoS network technologies.
- QoS negotiations are based on a generic template (SLS-T), which facilitates the automatic translation of QoS parameters into the technology-dependent control planes of each network.
- If an AN do not announce QoS services, it is not interested in providing connectivity with QoS guarantees
- The QoS parameters included in a certain SLS instantiation may vary depending on the type of players negotiating the SLS in order to adapt it to the customer-provider relationship

Conclusions and further work

- Instantiated SLSs may describe services suitable for end-systems (per flow), or services suitable for traditional networks (per traffic aggregate)
- The SLS-T is open to be extended to fulfill needs from specific user communities or extra AN functionality
- The SLS-T requires the standardisation in order to be universally well-known. In this context, the SLS-T can be used to enhance the QoS specification (QSpec) currently being defined in the NSIS charter of the IETF.

http://www.ambient-networks.org

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Any questions?