

Zeitschrift: Technische Mitteilungen / Schweizerische Post-, Telefon- und Telegrafienbetriebe = Bulletin technique / Entreprise des postes, téléphones et télégraphes suisses = Bollettino tecnico / Azienda delle poste, dei telefoni e dei telegrafi svizzeri

Herausgeber: Schweizerische Post-, Telefon- und Telegrafienbetriebe

Band: 73 (1995)

Heft: [1]: Spezial Edition ATM

Artikel: A connection acceptance control

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DOI: <https://doi.org/10.5169/seals-876034>

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A CONNECTION ACCEPTANCE CONTROL

eReS is a reservation system for ATM connections. Currently, Swiss Telecom PTT provides permanent and reserved connections. The reserved connections may be activated as specified by the user, for instance each Tuesday from 9 a.m. to 3 p.m. or every day between 8 a.m. and 10 a.m. Moreover, the user may ask for a new connection to start at any time, any day, for instance two weeks later, and to stop after an arbitrary duration. After presenting the eReS communication model, a sample session will demonstrate the tool features.

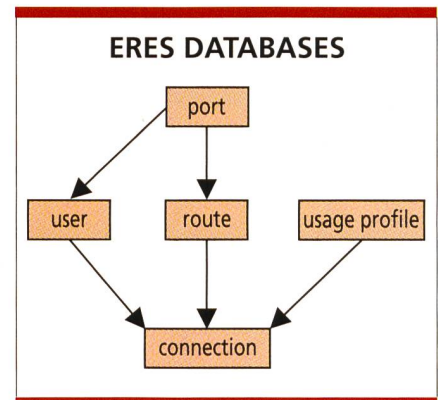


Fig. 1. The five main eReS data bases and its relationships.

A management tool is needed to check if a connection request can be accepted. This tool should check if enough bandwidth is available in all the ATM nodes along the connection

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route between the connection start date and end date. eReS is such a tool. It has been designed and implemented by the Research and Development Division of Swiss Telecom PTT and is currently used by its ATM Network Management Center. eReS is an Excel workbook running on a PC.

eReS communication network model

The five main eReS databases and its relationships are depicted in Figure 1. An arrow from data base A to data base B means that data base A is used in data base B.

Ports

eReS models a network with ports without referring to network nodes. A sample network is illustrated in Fig-

ure 2. Communication between national network nodes takes place through ports *port_N1* and *port_N2*. Users access the network at *port_U1*, *port_U2* and *port_U3*. *Port_I1* and *port_I2* are international ports. It has to be decided at the configuration phase which are the incoming and outgoing port directions. The incoming port direction in the sample network is indicated by the arrow. The port attributes are the port interface type and the port maximum load rate.

Routes

A route is modelled as a set of ports (Fig. 3). A route is unidirectional. When defining a route, the port directions taken by the route are to be specified.

A route, say *route_U1I1* from the user port *port_U1* to the international port *port_I1* in the sample network, is defined by the first three entries of the table below. The two last entries define a loopback route *route_U1U1* at the user port *port_U1*

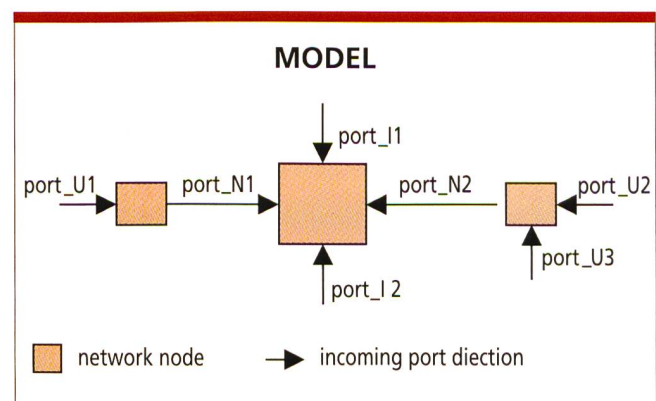


Fig. 2. A sample network.

route	port	direction
route_U1I1	port_U1	in
route_U1I1	port_N1	in
route_U1I1	port_I1	out
route_U1U1	port_U1	in
route_U1U1	port_U1	out

Fig. 3. Routes.

user	port
user_1	port_U1
user_1	port_U2
user_2	port_U2
user_3	port_I1
user_4	port_I1

Fig. 4. User data base.

Users

Users are associated to ports. A given user may be associated to several ports. A given port, for instance an international port, may be associated to several users.

The user data base may for instance contain the records as in *Figure 4*.

Bandwidth profiles

A bandwidth profile describes the use of bandwidth. Bandwidth use is specified for the forward and backward directions. Permanent, day and week periodic profiles can be defined.

A periodic profile is defined by a set of activations. Each activation has a start and an end time. A week periodic profile needs also a start and an end weekday.

Table 1 defines three profiles. A weekly activation profile, *profile_w*, with two activations: first activation on Monday between 9 a.m. and 12 a.m. and second activation between Thursday 8 a.m. and Friday 6 p.m.

The second profile, *profile_d*, is a day periodic profile with a single activation between 1 p.m. and 4 p.m. The third profile, *profile_p*, is a permanent profile.

Connections

A connection is defined by selecting user A and user B, a route between user-A and user-B port, a bandwidth profile, start and end connection dates, start and end connection times. The profile *forward* rates apply to the ports of the route which are taken in the *in* direction. The profile *backward* rates apply to the ports of the route which are taken in the *out* direction.

Table 2 defines two connections. The first connection, c1, is between *user_1* and *user_3* with route *route_U1I1* and profile *profile_w*. The *forward* rate 10 000 of the first *profile_w* activation is applied to *incoming* port_U1, *incoming* port_N1 and *outgoing* port_I1.

The second connection, c2, is test connection of *user_1* using the loop-back route *route_U1U1* and the permanent profile *profile_p*.

A sample session with eReS

The sample network

The sample network consists of two nodes, 'Bern' and 'Zurich'. An STM-1 link connects both nodes. The users Chocolate Ltd. and Meadows Ass. are connected to the black and green E3 ports of the Bern node. User Milk & Co. is connected to the white E3 port of the Zurich node.

We decide that the input direction of the port is as indicated in *Figure 5*, e.g. the brown port is considered from the Zurich node. The access ports black, white and green shall not be used over 80% of their capacity. The brown link can be used up to 85%.

Chocolate and Milk want a permanent 20000-cps (cells per second) connection from 3 April 1995, 8 a.m., to 28 April 1995, 6 p.m.

Milk & Co. needs a week periodic connection to Meadows Ass. from 24 April 1995, 8 a.m., to 26 May 1995, 6 p.m., 20 000 cps on Monday from 1 p.m. to 5 p.m., and 50 000 each Thursday from 9 a.m. to 11 a.m.

Configuring the network

After starting Excel and opening the eReS workbook, a reservation menu is added to the standard Excel menu bar. All eReS commands are accessed through the reservation menu.

Step 1: ports definition

We select *add port* from the reservation menu and enter *white* in the port ID text box, *E3 G.804* as interface, and

profile	activation number	forward PCR	backward PCR	start weekday	start time	end weekday	end time
profile_w	1	10 000	3000	Monday	9:00	Monday	12:00
profile_w	2	4 000	4000	Thursday	8:00	Friday	18:00
profile_d	1	8 000	8000	—	13:00	—	16:00
profile_p	—	1000	1000	—	—	—	—

Table 1. Three profiles of bandwidth.

con. ID	user A	user B	route	profile	start date	start time	end date	end time
c1	user_1	user_3	route_U1I1	profile_w	1 - Jan - 95	8:00	1 - Jul - 95	14:00
c2	user_1	user_1	route_U1U1	profile_p	1 - Jul - 94	8:00	1 - Mar - 95	18:00

Table 2. Two kinds of connections.

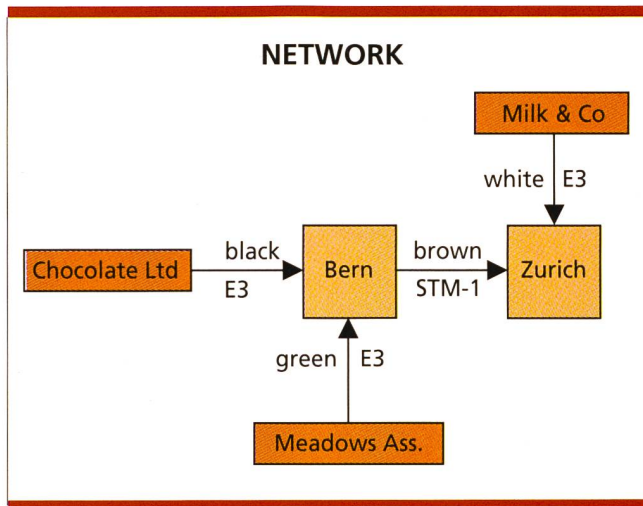


Fig. 5.
Sample network.

enter 80 as maximum usable capacity. The *black*, *green* and *brown* ports are defined similarly.

Step 2: users definition

We select the *add user access* command from the reservation menu. We want to associate the Chocolate Ltd. user to the black port. Chocolate Ltd. is entered in the user ID box, and *black* is selected in the access port list box. The Meadows Ass. and Milk & Co. users are defined similarly.

Step 3: routes definition

We will define first a route from the port *black* to the port *white* for the connection between Chocolate Ltd. and Milk & Co. This route consists of three route segments, which will be entered consecutively with the same route ID, *blackWhite*.

We select the *add route segment* command from the reservation menu, enter *blackWhite* as route ID and select the *black* port in the *in* direction. The second and third *blackWhite* route segments are defined similarly. The *whiteGreen* route is defined similarly.

Step 4: bandwidth profiles definition

The connection between Chocolate Ltd. and Milk & Co. uses a permanent profile of 20000 cps.

We select *add profile activation* command from the reservation menu,

enter *p20000* as profile ID and select the *permanent* mode. The start and end day and times lists become dim, because these parameters are not to be defined for permanent profiles. We enter 20000 in the forward and backward box.

Milk & Co. needs a week periodic profile: 20000 cps each Monday from 1 p.m. to 5 p.m. and 50000 each Thursday from 9 a.m. to 11 a.m. These two activations will be entered separately with the same profile ID, *w2050*.

We enter *w2050* as profile ID and select the *week periodic* mode. 20000 is entered in the forward and backward boxes, *Monday* is selected in the start and end day list boxes, 13:00 in the start date and 17:00 in the end date list boxes. The second activation of *w2050* is defined similarly.

Step 5: connections definition

Chocolate and Milk need a connection from 3 April 1995, 8 a.m., to 28 April 1995, 6 p.m.

We select the *add connection* command from the reservation menu. *ChocolateMilk* is entered as connection ID. *Chocolate Ltd.* is selected as User A, *Milk & Co.* as User B, *blackWhite* as route and *p20000* as profile. The start date is set to 3 April, 8:00 is the connection start time. We select 28 April 1995 as end date and 18:00 as connection end time. eReS will now check if the ports of the *blackWhite* route have specified the resource in the *p20000* profile.

We can now enter the second connection between Milk & Co. and Meadows Ass.

We select again the *add connection* command from the reservation menu, enter *MilkMeadow* as connection ID, select *Milk & Co.* as User A and *Meadows Ass.* as User B, select the *whiteGreen* route and the *w2050* profile, 24 April 1995 as start date, 8:00 as connection start time, 26 May 1995 as end date and 18:00 as connection end time.

eReS will now check if the ports of the *whiteGreen* route have specified the resource in the *w2050* profile.

eReS detects an overbooking event on 27 April 1995 at 9.00 on port *white* due to the second activation of connection *whiteGreen*. At this date and time, 6000 cps are not available on both directions of port *white*.

The overbooking event is based on the maximum usable capacity parameter of the network ports. In the case of *white*, this parameter has been set to 80 %, so that only $80000 \times 0.80 = 64000$ cells are left for the *white* input and output ports. On 24 April 1995, 20 000 cps are reserved for the *ChocolateMilk* permanent connection, and 50 000 cps are needed for the Thursday activation of the *MilkMeadow* connection, i.e. 6000 cps more than available.

Displaying port resources

As overbooking occurred at port *white*, we want to see all the resource allocation occurring at this port.

We select the *port statistics* command from the reservation menu. We choose the *white* port, 1 April 1995 as start date and 1 June 1995 as end date. We select the activation box to see *all* the activations occurring at port *white*. eReS displays the 22 activations taking place at port *white* in the selected period in a dialog box.

Copying eReS data bases

The eReS data bases can be copied with the *copy data base* command from the reservation menu. Selecting the port data base copies *Table 3*. Selecting the *activation* data base copies *Table 4*.

The *in* and *ResourceIn* fields refer to the incoming port. The *out* and *ResourceOut* field refer to the outgoing port. *In* and *out* represent the resource change at the corresponding date and time. *ResourceIn* and *ResourceOut* represent the total availa-

date	time	port	connection	act	in	out	ResourceIn	ResourceOut
3 - Apr - 95	8:00	white	ChocolateMilk	1	20000	20000	44000	44000
24 - Apr - 95	13:00	white	MilkMeadow	1	20000	20000	24000	24000
24 - Apr - 95	17:00	white	MilkMeadow	1	-20000	-20000	44000	44000
27 - Apr - 95	9:00	white	MilkMeadow	2	50000	50000	-6000	-6000
27 - Apr - 95	11:00	white	MilkMeadow	2	-50000	-50000	44000	44000
28 - Apr - 95	18:00	white	ChocolateMilk	1	-20000	-20000	64000	64000
1 - May - 95	13:00	white	MilkMeadow	1	20000	20000	44000	44000
1 - May - 95	17:00	white	MilkMeadow	1	-20000	-20000	64000	64000
4 - May - 95	9:00	white	MilkMeadow	2	50000	50000	14000	14000
4 - May - 95	11:00	white	MilkMeadow	2	-50000	-50000	64000	64000
8 - May - 95	13:00	white	MilkMeadow	1	20000	20000	44000	44000
8 - May - 95	17:00	white	MilkMeadow	1	-20000	-20000	64000	64000
11 - May - 95	9:00	white	MilkMeadow	2	50000	50000	14000	14000
11 - May - 95	11:00	white	MilkMeadow	2	-50000	-50000	64000	64000
15 - May - 95	13:00	white	MilkMeadow	1	20000	20000	44000	44000
15 - May - 95	17:00	white	MilkMeadow	1	-20000	-20000	64000	64000
18 - May - 95	9:00	white	MilkMeadow	2	50000	50000	14000	14000
18 - May - 95	11:00	white	MilkMeadow	2	-50000	-50000	64000	64000
22 - May - 95	13:00	white	MilkMeadow	1	20000	20000	44000	44000
22 - May - 95	17:00	white	MilkMeadow	1	-20000	-20000	64000	64000
25 - May - 95	9:00	white	MilkMeadow	2	50000	50000	14000	14000
25 - May - 95	11:00	white	MilkMeadow	2	-50000	-50000	64000	64000

Table 4. Activation data base.

ble resource at the port. A positive in or out value represents a bandwidth allocation at an activation start. A negative in or out value represents a bandwidth restoration at an activation end. A negative value of ResourceIn or ResourceOut indicates an overbooking situation.

Through Table 4 one can then proceed with the usual Excel tools. Selecting for instance the date, ResourceIn and ResourceOut columns of the previous table and clicking the Excel chart wizard button produces a graphical representation of the white port available resources.

port	interface	usable capacity
black	E3 G.804	80
brown	STM-1 electrical	85
green	E3 G.804	80
white	E3 G.804	80

Table 3.
Port data
base.

Ramzi Sawwaf, born in Buenos Aires, Argentina. He received degrees in Economics and Mathematics at the University of Fribourg and the «Ingenieur» degree in Computer Science at the Swiss Institute of Technology (EPFL) in Lausanne. Since 1987 he has worked in the telecommunication area. In 1991 he joined the Research and Development department of Swiss Telecom PTT where he currently leads the Broadband Networks group. He has been involved in the specification, evaluation and testing of the Swiss ATM Pilot. He is the Swiss Telecom PTT representative in the Technical Working Group of the European ATM Pilot.