Abbreviations \sim M 1 = nonce 6 \sim M 2 = rpid 7 \sim M 3 = senc(Auth1(username 4,rpid 7,skA 2),wk 2) \sim M 4 = dhexp(g,dh spairRP 2) \sim M_5 = sign(RP1(nonce_6,rpid_7,senc(Auth1(username_4, rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)),sskey_RP_3) \sim M_6 = dhexp(g,dh_spairRP_2) \sim M 7 = sign(RP1(nonce 6,rpid 7,senc(Auth1(username 4, rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)),sskey_RP_3) \sim X 1 = (hash(Client1(rpid 7,nonce 6)),HMAC(pinAuth 3, hash(Client1(rpid 7,nonce 6))),RP1(nonce 6,rpid 7, senc(Auth1(username_4,rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)),sign(RP1(nonce_6,rpid_7,senc(Auth1(username_4,rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)), sskey RP 3)) $\sim X_2 = (Auth4(Auth2(h(rpid_7),aaguid_4,senc(Auth1(username_4,$ rpid 7,skA 2),wk 2),spk(skA 2)),sign(Auth3(Auth2(h(rpid 7), aaguid 4, senc(Auth1(username 4, rpid 7, skA 2),wk 2),spk(skA 2)),hash(Client1(rpid 7,nonce 6))), skA 2),senc(Auth1(username 4,rpid 7,skA 2),wk 2), RP1(nonce 6,rpid 7,senc(Auth1(username 4,rpid 7, skA_2),wk_2),dhexp(g,dh_spairRP_2)),dhexp(g,dh_spairA_2)), sign(Auth4(Auth2(h(rpid 7),aaguid 4,senc(Auth1(username 4,rpid_7,skA_2),wk_2),spk(skA_2)),sign(Auth3(Auth2(h(rpid 7),aaguid 4,senc(Auth1(username 4, rpid_7,skA_2),wk_2),spk(skA_2)),hash(Client1(rpid_7, nonce 6))),skA 2),senc(Auth1(username 4,rpid 7, skA_2),wk_2),RP1(nonce_6,rpid_7,senc(Auth1(username 4, rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)),dhexp(g,dh spairA 2)),sskey RP 3)) \sim M_8 = h(rpid_7) \sim M 9 = aaguid_4 \sim M_10 = senc(Auth1(username_4,rpid_7,skA_2),wk_2) \sim M 11 = spk(skA 2) \sim M 12 = sign(Auth3(Auth2(h(rpid 7),aaguid 4,senc(Auth1(username_4,rpid_7,skA_2),wk_2),spk(skA 2)), hash(Client1(rpid 7,nonce 6))),skA 2) \sim M 13 = senc(Auth1(username 4,rpid 7,skA 2),wk 2) \sim M 14 = nonce 6 \sim M 15 = rpid 7 \sim M 16 = senc(Auth1(username_4,rpid_7,skA_2),wk_2) \sim M 17 = dhexp(g,dh spairRP 2) \sim M 18 = dhexp(g,dh_spairA_2) \sim M 19 = sign(Auth4(Auth2(h(rpid 7),aaguid 4,senc(Auth1(username 4,rpid 7,skA 2),wk 2),spk(skA 2)), sign(Auth3(Auth2(h(rpid 7),aaguid 4,senc(Auth1(username 4,rpid 7,skA 2),wk 2),spk(skA 2)),hash(Client1(rpid 7,nonce 6))),skA 2),senc(Auth1(username 4, rpid 7,skA 2),wk 2),RP1(nonce_6,rpid_7,senc(Auth1(username_4,rpid_7,skA_2),wk_2),dhexp(g,dh_spairRP_2)), dhexp(g,dh spairA 2)),sskey RP 3) \sim M 20 = rpid 7 \sim M 21 = nonce 6 $\sim X \ 3 = (Auth4(Auth2(h(\sim M \ 2), \sim M \ 9, \sim M \ 3, \sim M \ 11), \sim M \ 12, \sim M \ 3,)$ $RP1(\sim M \ 1,\sim M \ 2,\sim M \ 3,\sim M \ 6),\sim M \ 18),\sim M \ 19,Client1($ \sim M 2, \sim M 1)) = (Auth4(Auth2(h(rpid 7), aaguid 4,senc(Auth1(username 4,rpid 7,skA 2),wk 2),spk(skA 2)),sign(Auth3(Auth2(h(rpid_7),aaguid_4,senc(Auth1(username 4,rpid 7,skA 2),wk 2),spk(skA 2)), hash(Client1(rpid 7,nonce 6))),skA 2),senc(Auth1(username 4,rpid 7,skA 2),wk 2),RP1(nonce 6,rpid 7, senc(Auth1(username 4,rpid 7,skA 2),wk 2),dhexp(g,dh spairRP 2)),dhexp(g,dh spairA 2)),sign(Auth4(

Auth2(h(rpid 7), aaguid 4, senc(Auth1(username 4,

rpid 7,skA 2),wk 2),spk(skA 2)),sign(Auth3(Auth2(

h(rpid 7), aaguid 4, senc(Auth1(username 4, rpid 7,

skA 2),wk 2),spk(skA 2)),hash(Client1(rpid 7,nonce 6))),

skA 2), senc(Auth1(username 4, rpid 7, skA 2), wk 2),

RP1(nonce 6,rpid 7,senc(Auth1(username 4,rpid 7,

A trace has been found, assuming the following hypothesis: The attacker has $\sim M_6 = \mathrm{dhexp}(g,\mathrm{dh_spairRP_2[]})$ The attacker has $\sim M_7 = \mathrm{sign}(\mathrm{RP1}(\mathrm{nonce_6[],rpid_7[]},\mathrm{senc}(\mathrm{Auth1}(\mathrm{username_4[],rpid_7[],skA_2[]}),\mathrm{wk_2[]}),\mathrm{dhexp}(g,\mathrm{dh_spairRP_2[]}),\mathrm{sskey_RP_3[]})$

