

1 SchemePBAC

This scheme is only applicable to symmetric groups of prime orders.

1.1 Setup() \rightarrow (mpk, msk)

$q \leftarrow \|\mathbb{G}\|$
 $g \leftarrow 1_{\mathbb{G}_1}$
 generate $s, \alpha \in \mathbb{Z}_r$ randomly
 $H_1 : \{0, 1\}^* \rightarrow \mathbb{G}_1$
 $H_2 : \{0, 1\}^* \rightarrow \mathbb{G}_1$
 $H_3 : \mathbb{G}_T^2 \times \{0, 1\}^\lambda \rightarrow \mathbb{Z}_r$
 $H_4 : \{0, 1\}^* \rightarrow \{0, 1\}^\lambda$
 $H_5 : \{0, 1\}^* \rightarrow \mathbb{G}_1$
 $H_6 : \{0, 1\}^* \rightarrow \mathbb{G}_1$
 $\hat{g} \leftarrow g^s$
 $mpk \leftarrow (g, \hat{g}, H_1, H_2, H_3, H_4, H_5, H_6)$
 $msk \leftarrow (s, \alpha)$
return (mpk, msk)

1.2 SKGen(id_S) $\rightarrow ek_{id_S}$

$ek_{id_S} \leftarrow H_1(id_S)^\alpha$
return ek_{id_S}

1.3 RKGen(id_R) $\rightarrow dk_{id_R}$

$dk_{id_R,1} \leftarrow H_2(id_R)^\alpha$
 $dk_{id_R,2} \leftarrow H_2(id_R)^s$
 $dk_{id_R} \leftarrow (dk_{id_R,1}, dk_{id_R,2})$
return dk_{id_R}

1.4 Enc(ek_{id_1}, id_2, m) $\rightarrow C$

generate $\eta_1, \eta_2 \in \mathbb{G}_T$ randomly
 $r \leftarrow H_3(\eta_1, \eta_2, m)$
 $C_1 \leftarrow g^r$
 $C_2 \leftarrow \eta_1 \cdot e(\hat{g}, H_2(id_2)^r)$
 $C_3 \leftarrow \eta_2 \cdot e(ek_{id_1}, H_2(id_2))$
 $C_4 \leftarrow m \oplus H_4(\eta_1) \oplus H_4(\eta_2)$
 $S \leftarrow H_5(id_2 || C_1 || C_2 || C_3 || C_4)^r$
 $C \leftarrow (C_1, C_2, C_3, C_4, S)$
return C

1.5 PKGen($ek_{id_2}, dk_{id_2}, id_1, id_2, id_3$) $\rightarrow rk$

generate $N_1 \in \{0, 1\}^\lambda$ randomly
 generate $N_2 \in \{0, 1\}^\lambda$ randomly
 $K_1 \leftarrow e(dk_{id_2,2}, H_2(id_3))$
 $K_2 \leftarrow e(ek_{id_2}, H_2(id_3))$

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 $rk_1 \leftarrow (N_1, H_6(K_1 || id_2 || id_3 || N_1) \cdot dk_{id_2,2})$ 
 $rk_2 \leftarrow (N_2, H_6(K_2 || id_2 || id_3 || N_2) \cdot dk_{id_2,1})$ 
 $rk \leftarrow (id_1, id_2, rk_1, rk_2)$ 
return  $rk$ 

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1.6 ProxyEnc(ct, rk) $\rightarrow CT$

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 $h \leftarrow H_5(id_2 || C_1 || C_2 || C_3 || C_4)$ 
if  $e(h, C_1) = e(g, S)$  then
  generate  $t \in \mathbb{Z}_r$  randomly
   $C'_2 \leftarrow C_2 / \frac{e(C_1, rk_{1,2} \cdot h^t)}{e(g^t, S)}$ 
   $C'_3 \leftarrow C_3 / e(H_1(id_1), rk_{2,2})$ 
   $CT \leftarrow (id_1, C_1, C'_2, C'_3, C_4, rk_{1,1}, rk_{2,1})$ 
else
   $CT \leftarrow \perp$ 
end if
return  $CT$ 

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1.7 Dec₁($dk_{id_2}, id_2, id_1, ct$) $\rightarrow m$

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 $h \leftarrow H_5(id_2 || C_1 || C_2 || C_3 || C_4)$ 
generate  $t \in \mathbb{Z}_r$  randomly
 $\eta_1 \leftarrow C_2 / \frac{e(C_1, dk_{id_2,2} \cdot h^t)}{e(g^t, S)}$ 
 $\eta_2 \leftarrow C_3 / e(dk_{id_2,1}, H_1(id_1))$ 
 $m \leftarrow C_4 \oplus H_4(\eta_1) \oplus H_4(\eta_2)$ 
 $r \leftarrow H_3(\eta_1, \eta_2, m)$ 
if  $S \neq h^r \vee C_1 \neq g^r$  then
   $m \leftarrow \perp$ 
end if
return  $m$ 

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1.8 Dec₂($dk_{id_3}, id_3, id_2, CT$) $\rightarrow m'$

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 $K'_1 \leftarrow e(dk_{id_3,2}, H_2(id_2))$ 
 $K'_2 \leftarrow e(dk_{id_3,1}, H_1(id_2))$ 
 $\eta'_1 \leftarrow C'_2 \cdot e(C_1, H_6(K'_1 || id_2 || id_3 || N_1))$ 
 $\eta'_2 \leftarrow C'_3 \cdot e(H_6(K'_2 || id_2 || id_3 || N_2), H_1(id_1))$ 
 $m' \leftarrow C_4 \oplus H_4(\eta'_1) \oplus H_4(\eta'_2)$ 
 $r' \leftarrow H_3(\eta'_1, \eta'_2, m')$ 
if  $C_1 \neq g^{r'}$  then
   $m' \leftarrow \perp$ 
end if
return  $m'$ 

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