Assuming that $a = (A\setminus B)\setminus C$, $b = (B\setminus A)\setminus C$, $c = (C\setminus A)\setminus B$, $d = (A\cap B)\setminus C$, $e = (B\cap C)\setminus A$, $f = (A\cap C)\setminus B$, $g = A\cap B\cap C$

So, $A = a\cup d\cup g\cup f$, $B = b\cup d\cup g\cup e$, $C = c\cup e\cup g\cup f$

According to the definition of symmetric difference, $A\Delta B = a\cup f\cup b\cup e$, $B\Delta C = b\cup d\cup c\cup f$, $A\Delta C = a\cup d\cup c\cup e$.

1. $A\Delta(B\Delta C) = A\Delta(b\cup d\cup c\cup f) = (a\cup d\cup f\cup g)\Delta(b\cup d\cup c\cup f) = a\cup b\cup c\cup g$

   $(A\Delta B)\Delta C = (a\cup f\cup b\cup e)\Delta C = (a\cup f\cup b\cup e)\Delta(c\cup e\cup g\cup f) = a\cup b\cup c\cup g$

   Thus, $A\Delta(B\Delta C) = (A\Delta B)\Delta C$, the operation Δ is associative

2. $\overline{A} = b\cup e\cup c$, $\overline{B} = a\cup f\cup c$, $\overline{C} = a\cup d\cup b$

   $A\cap B\cap C = g$, $A\cap\overline{B}\cap\overline{C} = a$, $B\cap\overline{C}\cap\overline{A} = b$, $C\cap\overline{B}\cap\overline{A} = c$, $A\cap B\cap\overline{C} = d$, $B\cap C\cap\overline{A} = e$, $C\cap A\cap\overline{B} = f$

   $(A\cap B\cap C)\cup(A\cap\overline{B}\cap\overline{C})\cup(B\cap\overline{C}\cap\overline{A})\cup(C\cap\overline{B}\cap\overline{A})\cup(A\cap B\cap\overline{C})\cup(B\cap C\cap\overline{A})\cup(C\cap A\cap\overline{B})=g+a+b+c+d+e+f$

   $A\cup B\cup C = a+b+c+d+e+f+g$

   Thus, $A\cup B\cup C=(A\cap B\cap C)\cup(A\cap\overline{B}\cap\overline{C})\cup(B\cap\overline{C}\cap\overline{A})\cup(C\cap\overline{B}\cap\overline{A})\cup(A\cap B\cap\overline{C})\cup(B\cap C\cap\overline{A})\cup(C\cap A\cap\overline{B})$

3. Convert the logic into English: If $A\ \Delta\ (B\ \Delta\ C)=\emptyset$, then $A\cup B\cup C=((A\cap B)\setminus C)\cup((A\cap C)\setminus B)\cup((B\cap C)\setminus A)$

   Given that $A\Delta(B\Delta C)=\emptyset$, it can be inferred that $a\cup b\cup c\cup g =\emptyset$, $a=b=c=g=\emptyset$

   $A\cup B\cup C = a\cup b\cup c\cup d\cup e\cup f\cup g = d\cup f\cup e$

   $$((A\cap B)\setminus C)\cup((A\cap C)\setminus B)\cup((B\cap C)\setminus A) = ((d\cup g)\setminus(c\cup f\cup g\cup e))\cup((g\cup f)\setminus(b\cup d\cup g\cup e))\cup((g\cup e)\setminus(a\cup d\cup g\cup f))$$
   $$= d\cup f\cup e$$

   Thus, $A\cup B\cup C=((A\cap B)\setminus C)\cup((A\cap C)\setminus B)\cup((B\cap C)\setminus A)$ when $A\ \Delta\ (B\ \Delta\ C)=\emptyset$