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which are discrete unions of compact sets.

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Obviously, if X is σ - \mathcal{DC} , then X is \mathcal{DC} -like.

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Telgarsky proved \mathcal{DC} -likeness also from the weaker assumption that X has a σ -closure-preserving cover by compact closed subsets. In a metrizable space, every locally compact subset is an F_{σ} -set. Hence a metrizable space X is σ -locally compact iff X is σ - \mathcal{DC} . K. Alster conjectured that the converse of Telgarsky's theorem holds,

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Such an X is said to be *paracompact at infinity*.

A neighbornet of X is a binary relation U on X such that, for every $x \in X$, the set $U\{x\}$ is a neighborhood of x in X. A neighbornet of X is a binary relation U on X such that, for every $x \in X$, the set $U\{x\}$ is a neighborhood of x in X. A neighbornet U of X is co-compact provided that, for every $x \in X$, the set $U^{-1}\{x\}$ is compact. A neighbornet of X is a binary relation U on X such that, for every $x \in X$, the set $U\{x\}$ is a neighborhood of x in X. A neighbornet U of X is co-compact provided that, for every $x \in X$, the set $U^{-1}\{x\}$ is compact.

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The following is a slight extension of Alster's result.

Lemma Let X be a paracompact space,

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Lemma Let X be a paracompact space, and let $G = \{z \in X : z \text{ has a compact neighborhood in } X\}$. Assume that X has a neighbornet U such that, for every $x \in X$, **Lemma** Let X be a paracompact space, and let $G = \{z \in X : z \text{ has a compact neighborhood in } X\}.$

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for every $x \in X$, the set $\overline{U^{-1}\{x\} \setminus G}$ is compact.

Lemma Let X be a paracompact space, and let $G = \{z \in X : z \text{ has a compact neighborhood in } X\}$. Assume that X has a neighbornet U such that, for every $x \in X$, the set $\overline{U^{-1}\{x\} \setminus G}$ is compact. Then X is \mathcal{DC} -like. **Theorem** Let X be paracompact and paracompact at infinity.

A. X is productively paracompact.

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- B. $X \times Y$ is strongly collectionwise T_2

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D. X is \mathcal{DC} -like.

Proof. $A \Rightarrow B$:

- A. X is productively paracompact.
- B. $X \times Y$ is strongly collectionwise T_2 for every paracompact Y.
- C. X has a neighbornet U such that,
- for every $x \in X$, the set $\overline{U^{-1}\{x\} \setminus G}$ is compact,
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Proof. A \Rightarrow B: Every paracompact space is strongly collectionwise T_2 .

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Proof. $A \Rightarrow B$: Every paracompact space is strongly collectionwise T_2 . $C \Rightarrow D$:

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Proof. $A \Rightarrow B$: Every paracompact space is strongly collectionwise T_2 . $C \Rightarrow D$: By the above lemma.

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Proof. $A \Rightarrow B$: Every paracompact space is strongly collectionwise T_2 . $C \Rightarrow D$: By the above lemma.

 $D \Rightarrow A$: By Telgarsky's Theorem.

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 $D \Rightarrow A$: By Telgarsky's Theorem.

The implication $B \Rightarrow C$

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D. X is \mathcal{DC} -like.

Proof. $A \Rightarrow B$: Every paracompact space is strongly collectionwise T_2 . $C \Rightarrow D$: By the above lemma.

 $D \Rightarrow A$: By Telgarsky's Theorem.

The implication $B \Rightarrow C$ is a consequence of the following result.

Lemma

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Proof. Denote by τ the topology of βX . Define a new topology π for βX by requiring that every point of X is π -isolated and every point $z \in X^*$ has a π -neighborhood base by sets $O \setminus G$, where O is a τ -neighborhood of z. Denote by Z the set βX equipped with the topology π .
Lemma Let X be paracompact at infinity. Assume that $X \times Y$ is strongly collectionwise T_2 for every paracompact Y. Then X has a neighbornet U such that, for every compact $K \subset X$, the set $\overline{U^{-1}K \setminus G}$ is compact.

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Proof. Denote by τ the topology of βX . Define a new topology π for βX by requiring that every point of X is π -isolated and every point $z \in X^*$ has a π -neighborhood base by sets $O \setminus G$, where O is a τ -neighborhood of z. Denote by Z the set βX equipped with the topology π .

We have $\tau \subset \pi$, and hence Z is Hausdorff.

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Let $K \subset X$ be compact. To show that $\operatorname{Cl}_X(U^{-1}K \setminus G)$ is compact, it suffices to show that $\operatorname{Cl}_{\beta X}(U^{-1}K \setminus G) \subset X$. Let $p \in X^*$.

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Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX such that $(W \setminus G) \times K$ does not meet any $\{x\} \times U\{x\}$. Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX such that $(W \setminus G) \times K$ does not meet any $\{x\} \times U\{x\}$. Now if $x \in (W \setminus G) \cap X$, then $U\{x\} \cap K = \emptyset$. Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX such that $(W \setminus G) \times K$ does not meet any $\{x\} \times U\{x\}$. Now if $x \in (W \setminus G) \cap X$, then $U\{x\} \cap K = \emptyset$. Hence $(U^{-1}K) \cap (W \setminus G) = \emptyset$, Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX such that $(W \setminus G) \times K$ does not meet any $\{x\} \times U\{x\}$. Now if $x \in (W \setminus G) \cap X$, then $U\{x\} \cap K = \emptyset$. Hence $(U^{-1}K) \cap (W \setminus G) = \emptyset$, i.e., $(U^{-1}K \setminus G) \cap W = \emptyset$. Let $p \in X^*$. By discreteness of \mathcal{U} , each point $(p,k) \in \{p\} \times K$ has a neighborhood in $Z \times X$ which does not meet $\{x\} \times U\{x\}$ for any $x \in X$. It follows from compactness of $\{p\} \times K$ that there exists a neighborhood W of p in βX such that $(W \setminus G) \times K$ does not meet any $\{x\} \times U\{x\}$. Now if $x \in (W \setminus G) \cap X$, then $U\{x\} \cap K = \emptyset$. Hence $(U^{-1}K) \cap (W \setminus G) = \emptyset$, i.e., $(U^{-1}K \setminus G) \cap W = \emptyset$. This shows that $p \notin \operatorname{Cl}_{\beta X} (U^{-1}K \setminus G)$.

 \Box

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has a (transitive) co-finite neighbornet

but it does not have a strongly co-compact neighbornet.

The previous lemma establishes the following result.

Proposition Assume that X is productively paracompact and paracompact at infinity. Then the subspace $X \setminus LC(X)$ has a strongly co-compact neighbornet.

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Corollary Assume that X is nowhere locally compact, productively paracompact and paracompact at infinity. Then X has a strongly co-compact neighbornet. **Problem** Let X be productively paracompact and paracompact at infinity. **Problem** Let X be productively paracompact and paracompact at infinity.

Does X have a (strongly) co-compact neighbornet?

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Proof. Consider the nowhere locally compact space $X \times \mathbb{Q}$.
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Nyikos and I have shown that suborderable spaces of point-countable type are paracompact at infinity. Hence the previous results can be applied to such spaces.

Proposition Let X be productively paracompact, suborderable and of point-countable type. Then X has a co-compact neighbornet.

Proposition A nowhere locally compact productively paracompact suborderable space X of point-countable type

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Lemma X has a transitive strongly co-compact neighbornet iff X has a closure-preserving cover \mathcal{F} by compact sets such that every compact subset of X is contained in some member of \mathcal{F} .

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Theorem The following are equivalent for a metrizable space X:A. X is productively paracompact.

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- **A.** X is productively paracompact.
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- **D.** X has a σ -discrete cover by compact sets.
- **E.** X is σ -locally compact.